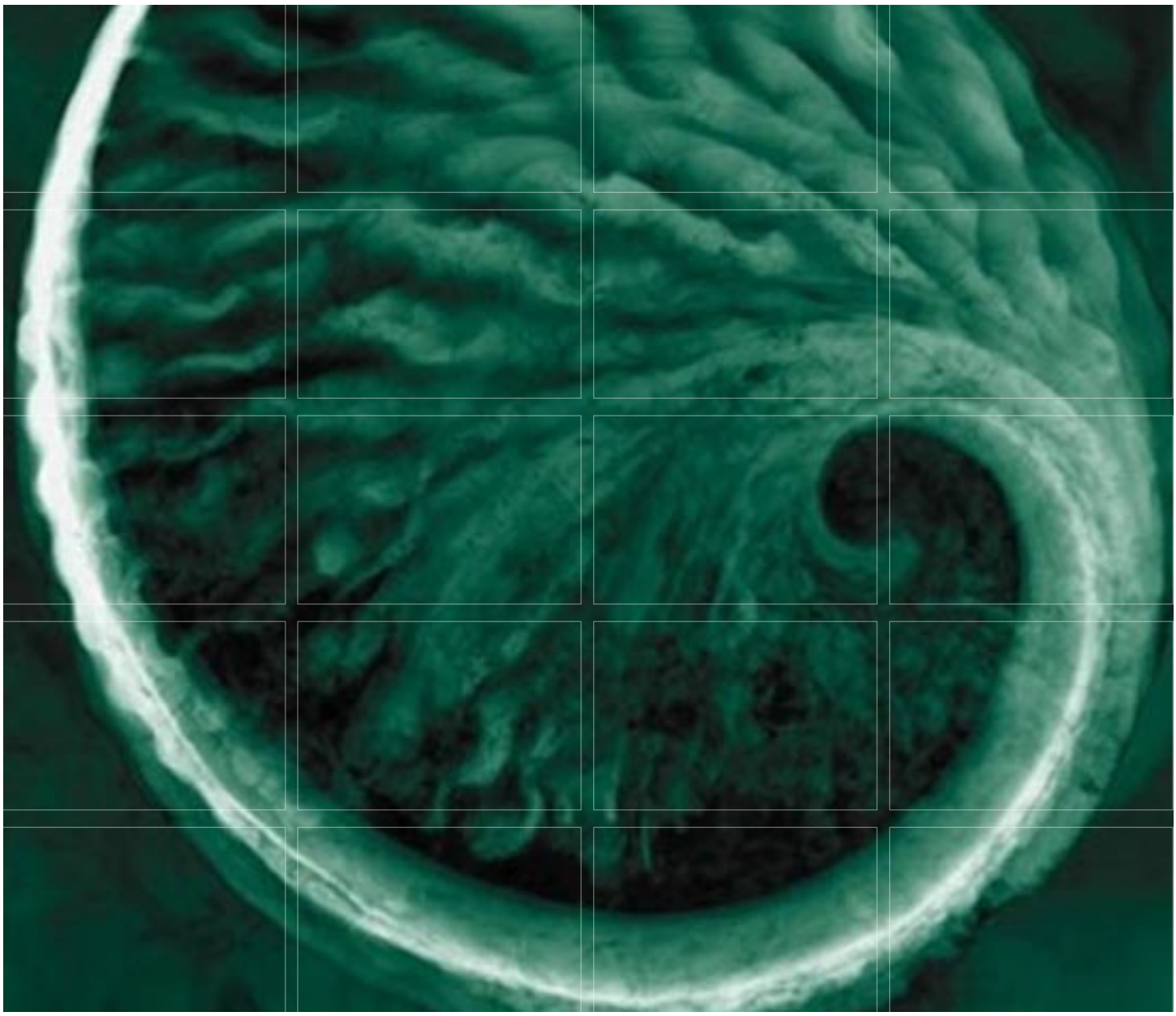


*Prepared for:*

newgold

BLACKWATER GOLD PROJECT

# Evaluation of Alternative Tailings Technologies for the Blackwater Project

December 2015

*The world's leading sustainability consultancy*

ERM

**New Gold Inc.**

# BLACKWATER GOLD PROJECT

# Evaluation of Alternative Tailings Technologies for the Blackwater Project

**December 2015**

Project #0289076-0009

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# EXECUTIVE SUMMARY

New Gold completed this Tailings Alternatives Assessment (TAA) for the Blackwater Gold Project (Project) in response to a request from the British Columbia (BC) Environmental Assessment Office (EAO; March 19, 2015) that all mining proponents consider the implementation of Best Available Technology (BAT) and Best Available Practices (BAP) identified by the Mount Polley Independent Investigation Review Panel (the Panel).

In a letter dated June 3, 2015, the Canadian Environmental Assessment Agency requested that environmental effects, as defined in section 5 of the *Canadian Environmental Assessment Act, 2012*, be included as factors to be considered in the assessment of the preferred option.

To identify BAT and BAP for the Project, New Gold conducted a comprehensive assessment of tailings and potentially acid generating/metal leaching (PAG/ML, hereafter referred to as Non-acid generating 3 [NAG3]) waste rock management alternatives. Tailings and PAG/NAG3 waste rock management must be considered in an integrated manner for the Project due to the geochemical reactivity of the majority of the waste rock (445 million tonnes [Mt] of PAG/NAG3 waste rock out of 685 Mt total).

New Gold developed and followed a six step process to complete the TAA:

- Step 1 – Identified initial candidate alternatives utilizing three tailings management technologies (thickened slurry, paste, and filtered 'dry stack' over a wide area of potential sites (23 candidates identified).
- Step 2 – Conducted a pre-screening assessment (fatal-flaw analysis) to eliminate any candidate that did not meet certain minimum criteria for the Project (10 candidates eliminated; 13 remained).
- Step 3 – Conducted a high level risk assessment (HLRA) to identify the lowest risk candidates for each of the tailings technologies, and eliminate the higher risk candidates from further consideration.
- Step 4 – Conducted a multiple accounts analysis (MAA) to identify BAT for the Blackwater Project (3 candidates eliminated; 1 selected candidate).
- Step 5 – Assessed the selected BAT candidate using a Failure Modes Effects Assessment (FMEA) to determine BAP including additional practices beyond those described in the Application/EIS that could further improve the physical safety of the impoundment.
- Step 6 – assessment of the impacts to Aboriginal rights and interests.

Step 1 involved the identification of 23 candidates (including alternative sites and technologies) across an area of approximately 35 km by 30 km from the Blackwater River to Nechako Reservoir and from Tatelkuz Lake to Entiako Provincial Park. The sites for tailings and waste rock storage were developed based on topographical maps of the local area with the aim to identify suitable

terrain for the tailings technology, minimize the size of the upstream catchment and provide sufficient storage capacity for the duration of the Project.

Step 2 involved conducting a pre-screening assessment to eliminate candidates that were non-compliant with certain minimum criteria developed for the Project. Those criteria were:

1. Will the candidate result in deposition of tailings into a fish-bearing lake?
2. Will the candidate be located within the Blackwater River watershed?
3. Will the candidate be located in Ungulate Winter Range?
4. Will the candidate encroach on provincially or federally designated lands and/or private lands?
5. Will the candidate have insufficient capacity to store waste produced during the mine life?
6. Will the candidate render collection and treatment of surface discharges impractical or improbable?

The pre-screening "fatal-flaw" analysis excluded 10 candidates from further assessment with 13 advancing to Step 3.

Step 3 involved conducting a high-level risk assessment of the remaining 13 candidates to determine the lowest risk candidate for each tailings technology: thickened slurry, paste, and filtered 'dry stack' tailings, as well as for the candidate with the lowest physical stability risk. The goal of step 3 was to select the lowest risk options for the three technologies. The risks of high-level safety, environmental, and technical execution hazards were determined for the candidates. The safety hazard evaluated was a loss of containment of a dam leading to the release of mine tailings, waste rock and/or water. Environmental hazards included the loss of effluent, either from failure to collect the effluent or from failure of a treatment system, or tailings pipeline rupture leading to loss of tailings. Technical hazards included the use of complex technology resulting in an inability to meet design criteria.

Four candidates, all located primarily within the Davidson Creek catchment were selected from the HLRA for further assessment:

- Candidate 1 – thickened slurry tailings with submerged PAG/NAG3 waste rock;
- Candidate 7 – filtered 'dry stack' tailings with submerged PAG/NAG3 waste rock;
- Candidate 10 – paste tailings with submerged PAG/NAG3 waste rock; and
- Candidate 22 – and filtered 'dry stack' tailings with PAG/NAG3 waste rock on land.

Step 5 involved conducting a multiple accounts analysis of the four candidates in order to determine BAT for the Blackwater Project. That is, the candidate with the overall best score with respect to effects on the physical and human environment and technical, physical stability, and economics (lifecycle cost) considerations. The MAA was conducted as per Environment Canada's (2011) *Guidelines for the Assessment of Mine Waste Disposal Alternatives* except Physical Stability was

established as a separate account to reflect the importance of physical stability in mine waste and water management.

The MAA determined that thickened slurry tailings with submerged PAG/NAG3 waste rock (Candidate 1), was the best overall candidate and therefore is BAT for the Project. Candidate 1 scored the highest in the technical, environmental, human environment, and Project economics accounts, and scored second overall for physical stability. Candidate 22 scored the highest in the physical stability account, because this candidate did not involve storing submerged mine waste behind a dam. However, Candidate 22 scored much lower than Candidate 1 for all other accounts primarily because it exhibited much lower geochemical stability for the reactive wastes. Candidate 1 was second best in the physical stability account. Additionally, Candidate 1 scored better than any other candidates when the Project economics account was not considered, which demonstrates that cost is not a determining factor in the evaluation.

Candidate 1 scored highest for technical criteria because it involves efficient seepage control; favourable overall foundation conditions for long term waste containment and geotechnical stability; no operational discharge of surface water; a manageable water balance and submergence of all PAG/NAG3 material to minimize metal leaching and prevent acid rock drainage (ML/ARD) with minimal long-term monitoring and maintenance. Candidate 1 scored the highest in the environmental account because wetted mine waste minimizes dust emissions; produces the least volume of seepage because the pond is not adjacent to the dam; and has the best water quality because all reactive waste is submerged. Candidate 1 was the best alternative for the human environment account because of reduced dust emissions and better water quality minimizes potential health effects from consumption of harvested resources.

Step 5 involved applying a FMEA to Candidate 1 (i.e., Project BAT) to identify measures already incorporated into the Application/EIS and additional opportunities to further reduce Project risk, especially regarding physical stability, and further reduce project risk and enhance safety through improvement in water management processes The FMEA identified and characterized risks and associated management plans and contingencies for 39 hazards involving potential accidents, failures of an engineered system or malfunctions. Taken together the management practices and contingencies constitute Best Available Practices for the Project.

The FMEA demonstrated that the majority of risks to the TSF are mitigated through measures in place in the current design and measures to be applied during permitting. The FMEA process identified several measures that reduce risk with four additional measures providing the most benefit in risk reduction by managing likelihood and consequence of potential hazards:

- Installation of diversions upstream of tailings storage facility (TSF) Site D (northern diversion) and upstream of the mine facilities south of the TSF (southern diversion) to conduct any excess water around rather than into the tailings facility;
- Transfer and storage of the majority of tailings pond supernatant in TSF Site C to minimize water in TSF Site D and maximize the beach width;
- Establishment of interim emergency overflow channels around the Site D Main Dam during operations to ensure that the incremental increase in runoff from the Probable Maximum

Flood (PMF) during operations is safely transmitted around the dam in a controlled manner; and

- Emergency water storage in the open pit in the event that excessive water is encountered in the TSF that causes a violation of freeboard requirements that require water levels to be lowered. Use of the pit for emergency water storage would lead to a suspension of operations until conditions could be returned to normal.

These additional practices combined with the design measures and practices already in place in the Project design comprise the best available practices for the project TSF. The FMEA created a catalogue of potential hazards to the proposed TSF and documents the best available practices to mitigate the risk of each hazard.

The Physical Stability account of the MAA was reevaluated given these four additional BAP measures and showed that the physical stability was significantly enhanced.

Step 6 involved evaluating potential impacts to Aboriginal rights and interests for the Project's BAT/BAP candidate. The traditional territories of four First Nations overlap with the candidate tailings and waste rock storage sites: Lhoosk'uz Dene Nation, Ulkatcho First Nation, Skin Tyee Nation, and Tsilhqot'in National Government. Métis' Aboriginal rights are not tied to traditional sites and territories, given their traditionally extensive mobility. Métis Nation British Columbia (MNBC) has asserted harvesting rights around the proposed Project.

Candidate 1 has the potential to infringe Aboriginal rights and interests to the extent that it interferes with Aboriginal groups' distinctive practices, customs, and traditions relating to lands and resources in the area. Interference could result from impeded access, reduced resource availability, reduced resource quality, and other factors that could interfere with the exercise of Aboriginal rights. Candidate 1 will be located in a restricted area, and therefore may limit Aboriginal groups from exercising Aboriginal rights in the vicinity of the facility through the life of the mine.

Candidate 1 is anticipated to infringe Lhoosk'uz Dene Nation's and Ulkatcho First Nation's – and potentially Skin Tyee Nation's and Métis Nation British Columbia's - Aboriginal rights to hunt caribou and moose on the lower north slope of Mount Davidson, to fish in the upper reaches of Davidson Creek and Creek 661, and to gather plants in the facility footprint due to access constraints to some traditional use sites throughout the life of the mine. The exercise of these Aboriginal rights will resume following reclamation. Effects on Aboriginal rights due to changes in the abundance or quality of resources are anticipated to be negligible to low, and will be reversible following reclamation. No effects on Aboriginal title (proven or asserted) are anticipated.

In summary, New Gold conducted a comprehensive assessment of tailings and PAG/NAG3 waste rock storage alternatives for the Project. This assessment considered and compared BAT/BAP for tailings management for the Project, considering the safety, technical, water balance, and lifecycle costs aspects for all Project phases, as well as the implications for environmental, health, social and economic values. This assessment has also considered how the candidates interact and affect values under Section 5 of CEAA 2012. The assessment showed that thickened slurry tailings with PAG/NAG3 underwater (Candidate 1) in the Davidson Creek valley is BAT for the Blackwater

Project. A list of BAP for the project was developed and included additional measures to actively manage the water balance during operations that significantly enhance physical stability while maintaining best practices for geochemical stability. New Gold maintains that both physical and geochemical stability of the mine waste can be achieved for the Blackwater Project by implementing thickened slurry tailing with PAG/NAG3 underwater in the Davidson Creek valley and with the management practices and contingencies described in this report.

# ACKNOWLEDGEMENTS

This report is the result of a joint effort between ERM and Knight Piésold Ltd. In particular, ERM and Knight Piésold would like to acknowledge Ferguson Sustainability Engineering for technical oversight and support throughout the preparation of this report.

BLACKWATER GOLD PROJECT

# Evaluation of Alternative Tailings Technologies for the Blackwater Project

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# GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

| | |
|---|---|
| **AA** | Alternatives assessment |
| **AIA** | Archaeological impact assessment |
| **ALSA** | Aquatics Local Study Area |
| **ARSA** | Aquatics Regional Study Area |
| **Application** | Application for an Environmental Assessment Certificate |
| **ARD** | Acid rock drainage |
| **BAP** | Best available practices |
| **BAT** | Best available technology |
| **BC** | British Columbia |
| **BC JTST** | British Columbia Ministry of Jobs, Tourism, Skills and Training |
| **BCFWG** | British Columbia Guidelines for the Protection of Fresh Water Aquatic Life |
| **BC FLNRO** | British Columbia Ministry of Forests, Lands and Natural Resource Operations |
| **BC MEM** | British Columbia Ministry of Energy and Mines |
| **BC MOE** | British Columbia Ministry of Environment |
| **bgs** | Below ground surface |
| **Bt** | Metric billion tonnes |
| **CCTC** | Carrier-Chilcotin Tribal Council |
| **CEA Agency** | Canadian Environmental Assessment Agency |
| **CEAA 2012** | *Canadian Environmental Assessment Act, 2012* |
| **COSEWIC** | Committee on the Status of Endangered Wildlife in Canada |
| **CMT** | Culturally modified tree |
| **COPC** | Chemical of potential concern |
| **CSTC** | Carrier Sekani Tribal Council |
| **EA** | Environmental Assessment |
| **EAO** | Environmental Assessment Office |

| | |
|---|---|
| **EC** | Environment Canada |
| **EDGM** | Earthquake Design Ground Motion |
| ***Guidelines*** | *Guidelines for the Assessment of Alternatives for Mine Waste Disposal*, published by Environment Canada (2011) |
| **FSR** | Forest Service Road |
| **ha** | Hectare or 10,000 $m^2$ |
| **IDF** | Inflow Design Flood |
| **IR** | Indian Reserve |
| **km** | Kilometre(s) |
| **LDN** | Lhoosk'uz Dene Nation |
| **LPS** | Low-permeability subgrade |
| **LRUS** | Land and Resource Use Study |
| **MAA** | Multiple Accounts Analysis |
| **m** | Metre(s) |
| **masl** | Metres above sea level |
| **MAL** | Multiple Accounts Ledger |
| **MARR** | Ministry of Aboriginal Relations & Reconciliation |
| **MCE** | Maximum Credible Earthquake |
| **MDC** | Mine Development Concept |
| **ML** | Metals leaching |
| **$Mm^3$** | Million cubic metres |
| **MNBC** | Métis Nation British Columbia |
| **NAG** | Non-acid-generating |
| **New Gold** | New Gold Inc. |
| **NFN** | Nazko First Nation |
| **NP** | Neutralization potential |
| **NPR** | Neutralization potential ratio |
| **NPV** | Net present value |
| **NRCan** | Natural Resources Canada |
| **NWFN** | Nadleh Whut'en First Nation |

| | |
|---|---|
| **PAD** | Permanent alteration to, or destruction of fish habitat, Section 35.2 of the *Fisheries Act* (1985) |
| **PAG** | Potentially acid-generating |
| ***Panel Report*** | The report on the Mount Polley Tailings Storage Facility Breach issued on January 30, 2015 by the Independent Expert Engineering Investigation and Review Panel (IEEIRP) |
| **PGA** | Peak ground acceleration |
| **The Project** | The Blackwater Gold Project |
| **PMF** | Probable maximum flood |
| **ppm** | Parts per million |
| **SARA** | *Species At Risk Act* (2002c) |
| **SFN** | Saik'uz First Nation |
| **STN** | Skin Tyee Nation |
| **SMU** | Soil mapping unit |
| **StFN** | Stellat'en First Nation |
| **TDS** | Total dissolved solids |
| **TELSA** | Terrestrial Ecology Local Study Area |
| **TERSA** | Terrestrial Ecology Regional Study Area |
| **TEM** | Terrestrial Ecosystem Mapping |
| **TLUS** | Traditional Land Use Study |
| **TSF** | Tailing Storage Facility |
| **Tpd** | Tonnes per day |
| **TK/TLU** | Traditional Knowledge and Traditional Land Use |
| **TNG** | Tsilqho'tin National Government |
| **UFN** | Ulkatcho First Nation |
| **UWR** | Ungulate Winter Range |
| **VC** | Valued Component |
| **VLSA** | Vegetation Local Study Area |
| **VRSA** | Vegetation Regional Study Area |
| **WLSA** | Wetland Local Study Area |
| **WRSA** | Wetland Regional Study Area |

# TABLE OF CONCORDANCE

## Table of Concordance: Letter dated March 19, 2015 from the British Columbia Environmental Assessment Office

| Required Information | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
|---|---|
| 1. Provide a description and an assessment of alternative means of undertaking the proposed project with respect to options for tailings management that considers: | New Gold developed and followed the following process for assessing alternative means assessment for tailings and Potential Acid Generating/Metal Leaching (PAG/ML; hereafter referred to as Non-acid generating 3 [NAG3]) waste rock management:<br>**Step 1 – Initial candidate identification**: Concepts (candidates) for management of mine waste were developed based on topographical maps of the project area. The candidates are interspersed within an area of approximately 35 km by 30 km. Candidate sites were roughly bounded by the Blackwater River to the south, the Nechako Reservoir to the north, Tatelkuz Lake to the east, and Entiako Provincial Park to the west. The tailings technology applied at each candidate site was chosen based on site specific constraints and professional judgement. (Section 4 of this TAA Report; Appendix D);<br>**Step 2 – Pre-screening assessment**: Criteria were developed based on technical, environmental, and social site constraints to pre-screen the candidates to remove those with obvious deficiency and create a set of appropriate and manageable, sufficiently detailed alternatives. The objective of this step is to optimize the decision making process by not evaluating alternatives that have obvious deficiencies or employ the same technologies that have similar risk profiles (Section 5 of the main TAA Report text; Appendix D);<br>**Step 3 – High-level risk assessment**: Candidates were compared to determine the relative risks for similar candidates, and to identify the best candidate (i.e., lowest risk) for the different tailings technologies evaluated (Section the main TAA Report text; Appendix D);<br>**Step 4 – Multiple accounts analysis**: thorough and rigorous evaluation of the short-listed candidates to determine which candidate is preferred with respect to physical stability, technology, environmental, human environment and Project economic considerations (Section 7 of the main TAA Report text, Appendix E)<br>**Step 5 – Failure modes effects assessment**: identification and characterization of risks from accidents, failures of an engineered system or malfunctions. This FMEA evaluated risks specific to the TSF concept identified to be the BAT for the Project (from Steps 1 through 4, above). The FMEA identified areas where additional mitigations and contingencies, based on BAP for tailings management, could be implemented to minimize identified risks (Section 8 of the main TAA Report text; Appendix F).<br>**Step 6 – Determination of Best Available Practices:** BAP were identified to reduce residual Project risks during the FMEA. These measures included additional design elements, operational practices, |

| Required Information | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
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| | and contingencies that reduce risk (Section 9 of the main TAA Report text; Appendix F) |
| a. technology, | Technologies considered for tailings management include thickened slurry, paste, and filtered tailings "dry stack" with and without co-disposal of ML waste rock (NAG3) in the tailings storage facility. (Section 4 of the main TAA Report text; Appendix D). |
| b. siting and | Candidates for management of mine waste were developed based on topographical maps of the project area. The candidates are interspersed within an area of approximately 35 km by 30 km. Candidate sites were roughly bounded by the Blackwater River to the south, the Nechako Reservoir to the north, Tatelkuz Lake to the east, and Entiako Provincial Park to the west. The tailings technology applied at each candidate site was chosen based on site specific constraints and professional judgement. (Section 4 of the main TAA Report text; Appendix D). |
| c. water balance | Water balance and water management are key considerations in all steps of the assessment:<br>**Pre-screening assessment**: prevention of surface water discharge without treatment was used as a 'fatal flaw' criterion to eliminate candidates from further consideration (Section 5 of the main TAA Report text; Appendix D).<br>**HLRA**: the environmental hazard considered for each candidate was based on the potential for unplanned loss or discharge of effluent. This hazard applies to all candidates and includes unplanned spilling from an environmental control dam spillway, unplanned discharge from a water treatment facility and/or tailings pipeline rupture leading to loss of tailings to the environment. In particular, the risk of ML/ARD was evaluated (Section 6 of the main TAA Report text; Appendix D).<br>**MAA**: the physical stability account included the following relevant sub-accounts: location of water storage, tailings and waste rock interstitial water, normal pond operating volume, emergency water management (passive and active), and tailings density. The technical account included water management as a sub-account. The environmental account included the following relevant sub-accounts: surface water quantity, surface water quality, and groundwater (Section 7 of the main TAA Report text; Appendix E).<br>The **FMEA** identifies several design measures intended to reduce the risk of environmental effects of the selected candidate alternative through improved water management (Sections 8 and 9 of the main TAA Report text; Appendix F). These design measures were: additional diversion structures, relocation of water storage to TSF Site C; interim overflow channel during operations; and open pit emergency water storage. |

| Required Information | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
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| 2. The assessment must present and compare best practices and best available technologies for tailings management for the project, | This assessment presents and compares best practices and best available technologies for tailings management for the Project. As described above, Steps 1 through 4 determine Project BAT (Sections 4 through 7 of the main TAA Report text; Appendices B and C) and Steps 5 and 6 determine Project BAP (Sections 8 and 9 of the main TAA Report text; Appendix F). |
| a. along with options for managing water balance to enhance safety and reduce the risk (likelihood and consequence) of a tailings dam failure during all phases of mine life | |
| i. construction, | Options for managing water balance to enhance safety and reduce the risk of a tailings dam failure during construction are identified in the FMEA, together with key defensive measures to be applied to reduce risk (e.g., swales in cofferdams to safely pass extreme flood events) (Sections 8 and 9 of the main TAA Report text; Appendix F). |
| ii. operations, | Options for managing water balance to enhance safety and reduce the risk of a tailings dam failure during operations are identified in the FMEA, together with key defensive measures to be applied to reduce risk (Sections 8 and 9 of the main TAA Report text; Appendix F). These measures include additional diversion structures, relocation of water storage to TSF Site C; interim overflow channel during operations; and open pit emergency water storage. These measures enhance safety and reduce the risk of a tailings dam failure by moving water in extreme conditions out of the TSF, and moving water in normal operating conditions away from the main dam. |
| iii. closure, | Options for managing water balance to enhance safety and reduce the risk of a tailings dam failure during closure are identified in the FMEA, together with key defensive measures to be applied to reduce risk as described above (Sections 8 and 9 of the main TAA Report text; Appendix F). These measures include additional diversion structures and final closure spillways. These measures enhance safety and reduce the risk of a tailings dam failure by reducing freshwater inputs to the TSF when necessary and providing for safe passage of extreme flood events around the TSF dams. |
| iv. post-closure | Options for managing water balance to enhance safety and reduce the risk of a tailings dam failure during post-closure are identified in the FMEA, together with key defensive measures to be applied to reduce risk (Sections 8 and 9 of the main TAA Report text; Appendix F). These measures enhance safety and reduce the risk of a tailings dam failure by providing for safe passage of extreme flood events around the TSF dams. |
| b. the assessment must present and compare technically and economically viable engineering | The assessment presents and compares technically and economically viable engineering solutions that are available to address site conditions through the FMEA and subsequent determination of Best |

| Required Information | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
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| solutions that are available to address site conditions | Available Practices:<br>• Failure modes effects assessment: identification and characterization of risks from accidents, failures of an engineered system or malfunctions. This FMEA evaluated risks specific to the TSF concept identified to be the BAT for the Project (from Steps 1 through 4, above). The FMEA identified areas where additional mitigations and contingencies, based on BAP for tailings management, could be implemented to minimize identified risks (Section 8 of the main TAA Report text; Appendix F).<br>• Determination of Best Available Practices: BAP (i.e., technically and economically viable engineering solutions available to address site conditions) identified to reduce residual Project risks identified during the FMEA. These measures included additional design elements, operational practices, and contingencies that reduce risk (Section 9 of the main TAA Report text; Appendix F) |
| 3. The assessment must provide a clear and transparent evaluation of the factors that supported the selection of the most suitable option | The assessment provides a clear and transparent evaluation of the factors that supported the selection of the preferred candidate, outlined in the following 6 steps:<br>**Step 1 – Initial candidate identification**: Concepts (candidates) for management of mine waste were developed based on topographical maps of the project area. The candidates are interspersed within an area of approximately 35 km by 30 km. Candidate sites were roughly bounded by the Blackwater River to the south, the Nechako Reservoir to the north, Tatelkuz Lake to the east, and Entiako Provincial Park to the west. The tailings technology applied at each candidate site was chosen based on site specific constraints and professional judgement. (Section 4 of this TAA Report; Appendix D);<br>**Step 2 – Pre-screening assessment**: Criteria were developed based on technical, environmental, and social site constraints to pre-screen the candidates to remove those with obvious deficiency and create a set of appropriate and manageable, sufficiently detailed alternatives. The objective of this step is to optimize the decision making process by not evaluating alternatives that have obvious deficiencies or employ the same technologies that have similar risk profiles (Section 5 of the main TAA Report text; Appendix D);<br>**Step 3 – High-level risk assessment**: Candidates were compared to determine the relative risks for similar candidates, and to identify the best candidate (i.e., lowest risk) for the different tailings technologies evaluated (Section the main TAA Report text; Appendix D);<br>**Step 4 – Multiple accounts analysis**: thorough and rigorous evaluation of the short-listed candidates to determine which candidate is preferred with respect to physical stability, technology, environmental, human environment and Project economic considerations (Section 7 of the main TAA Report text, Appendix E)<br>**Step 5 – Failure modes effects assessment**: identification and characterization of risks from accidents, failures of an engineered system or malfunctions. This FMEA evaluated risks specific to the TSF concept identified to be the BAT for the Project (from Steps 1 |

| Required Information | | | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
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| | | | through 4, above). The FMEA identified areas where additional mitigations and contingencies, based on BAP for tailings management, could be implemented to minimize identified risks (Section 8 of the main TAA Report text; Appendix F).<br>**Step 6 – Determination of Best Available Practices:** BAP identified to reduce residual Project risks identified during the FMEA. These measures included additional design elements, operational practices, and contingencies that reduce risk (Section 9 of the main TAA Report text; Appendix F) |
| a. | factors that will be taken into consideration in the evaluation include | | |
| | i. | safety | Safety is considered throughout the assessment. Within the HLRA (Section 6 of the main TAA Report text; Appendix D), the safety hazards (i.e., potential for loss of containment of mine waste and/or mine water for all options for tailings and waste rock management) for the candidates were evaluated and ranked. The MAA incorporates a physical stability (i.e., safety) account which includes the following considerations: location of water storage, tailings and waste rock interstitial water, normal operating pond volume, emergency water pond management – active/passive, design basis/regulatory requirement, tailings density, maximum dam height, and operational monitoring requirements – safety.<br>Residual safety risk to the selected BAT candidate were further evaluated during the FMEA (Section 7 of the main TAA Report text; Appendix F), and the following key additional defensive measures were determined to further reduce those residual risks: additional diversion structures, relocation of water storage to TSF Site C; interim overflow channel during operations; and open pit emergency water storage. |
| | ii. | technical and financial aspects | Technical aspects of the candidate alternatives (adequate storage capacity and collection and treatment of surface discharge), were considered in pre-screening assessment (Section 5 of the main TAA Report text; Appendix D), in the HLRA under "technical execution" (Section 6 of the main TAA Report text; Appendix D) and under the technical account of the MAA. The sub-accounts considered within the technical account were containment design, construction requirements, water management, execution, and closure in the MAA (Section 7 of the main TAA Report text; Appendix E).<br>Financial aspects of the candidate alternatives were considered indirectly in the HLRA as a consequence of operational delays as a result of technical failure Section 6 of the main TAA Report text and in the cost of clean-up and remediation of major failure; Appendix D). Financial aspects were specifically considered in the MAA Project economics account for the mine life cycle: initial capital costs, sustaining capital and operating costs, closure costs, and post-closure costs (Section 7 in the main TAA Report text; Appendix E). |
| | iii. | and implications for | Factors considered in this assessment that have environmental |

| Required Information | | | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
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| | | environmental | implications include:<br><br>**Pre-screening assessment**: the following environmental criteria were used as 'fatal flaw' criteria to eliminate candidates: deposition in a fish-bearing lake; location within ungulate winter range, and ability to collect and treat surface discharges (Section 5 of the main TAA Report text; Appendix D).<br>**HLRA**: the environmental hazard considered for each candidate was based on the potential for unplanned loss or discharge of effluent. This hazard applies to all candidates and includes unplanned spilling from an environmental control dam spillway, unplanned discharge from a water treatment facility and/or tailings pipeline rupture leading to loss of tailings to the environment. In particular, the risk of ML/ARD was evaluated (Section 6 of the main TAA Report text; Appendix D).<br>**MAA**: the environmental account included the following sub-accounts: climate and atmosphere; surface water quantity; surface water quality; groundwater; terrestrial ecosystems; fish, fish habitat and aquatic resources; wildlife and wildlife habitat; and terrain and soil (Section 7 of the main TAA Report text; Appendix E).<br>The **FMEA** identified several key additional design measures intended to reduce the risk of environmental effects of the selected candidate alternative (Sections 8 and 9 of the main TAA Report text; Appendix F). These key design measures were: additional diversion structures, relocation of water storage to TSF Site C; interim overflow channel during operations; and open pit emergency water storage.<br>Section 9 of the main TAA Report text assesses the proposed design measures impacts to the conclusions of the Project's Application/EIS. No incremental changes to any VCs were required to be assessed as a result of these changes. |
| | iv. | health | Risks to human health resulting from the candidate alternatives are considered within the human environment account of the MAA; the assessment is based on the four short-listed candidates' potential to affect air quality, country foods and drinking water (Section 7 in the main TAA Report text; Appendix E). |
| | v. | social | Factors considered in this assessment that have social (human environment) implications include:<br>**Pre-screening assessment**: the following social criteria were used as 'fatal flaw' criteria to eliminate candidates: location within the Blackwater River watershed, and encroachment on provincially or federally designated lands and/or private lands (Section 5 of the main TAA Report text; Appendix D).<br>**MAA**: the human environment account included the following sub-accounts: effects of changes to the environment on Aboriginal peoples, non-traditional land use, and public recreation (Section 7 of the main TAA Report text; Appendix E). |
| | vi. | heritage | Factors considered in this assessment that have heritage implications |

| Required Information | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
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| | include:<br>**Pre-screening assessment**: the following heritage criterion was used as 'fatal flaw' criteria to eliminate candidates: location within the Blackwater River watershed (Section 5 of the main TAA Report text; Appendix D).<br>**MAA**: the human environment account included the following sub-account: heritage (Section 7 of the main TAA Report text; Appendix E). |
| vii. and economic values | Factors considered in this assessment that have economic implications include:<br>• **MAA**: the human environment account included the following sub-account: employment (Section 7 of the main TAA Report text; Appendix E). |
| b. the assessment must consider these factors in relation to tailings management options in both the short and long-term context | The assessment considers these factors during construction and operations (short-term context), as well as during closure and post-closure (long-term context). For example, the potential for short and long-term water treatment and associated potential effects for each alternative are considered in the High Level Risk Assessment and in the MAA's Technical, Environmental and Economic Accounts. The MAA evaluated long-term considerations for each candidate with respect to physical and geochemical stability and long-term maintenance and monitoring requirements within the relevant Accounts (Section 7 of the main TAA Report text; Appendix E). |
| c. life cycle cost assumptions (construction, operations, closure, post-closure) must be included in the analysis of options | Within the HLRA, the potential cost of failure is considered in the rating of consequence (Section 6 of the main TAA Report text; Appendix D). Within the MAA, mine lifecycle costs are considered within the Project Economics account as initial capital costs, sustaining capital and operating costs, closure costs, and post-closure costs (Section 7 of the main TAA Report text; Appendix E). |
| i. construction | Initial capital cost estimates have been assessed in the MAA based on the technology applied, design and configuration (Section 7 of the main TAA Report text; Appendix E). |
| ii. operations | Sustaining capital and operating cost estimates have been assessed in the MAA for the candidates based on operational costs for the technology applied (Section 7 of the main TAA Report text; Appendix E). |
| iii. closure | Closure cost estimates have been assessed in the MAA for the candidates based on the anticipated level of remediation and reclamation work required (Section 7 of the main TAA Report text; Appendix E). |
| iv. post-closure | Post-closure costs have been assessed in the MAA for the candidates based primarily on the anticipated level of active management after the closure phase (e.g. long-term water treatment requirements; Section 7 of the main TAA Report text; Appendix E) |
| 4. The requirements outlined in this letter are to ensure that proponents | |

| Required Information | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
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| have: | |
| a. considered other options that can address the potential for adverse effects on the factors noted above | The main TAA Report text assessed 23 tailings / NAG3 waste rock storage candidate alternatives to determine the BAT and BAP for the Project. The assessment contained within this report entails a comprehensive consideration of the safety, technical and financial aspects, and implications to environment, health, social, heritage, and economics values from these alternatives. BAP for the selected candidate was identified through the FMEA and includes four specific key additional measures that will significantly reduce safety and environmental risk through improved water management. |
| b. for the project design option selected | |
| i. considered the potential risks and implications of that option | The potential risks and implications for the selected option are considered in the HLRA through consideration of safety, technical execution, and environmental hazards (Section 6 of the main TAA Report text; Appendix D); in the MAA (Section 7 of the main TAA Report text; Appendix E) and in the FMEA (Sections 8 and 9 of the main TAA Report text; Appendix F). |
| ii. and have a technically and economically feasible plan to address the potential risks and implications; and | The FMEA identified no high risks with the selected BAT option; the highest assessed risk was medium. These risks were assessed as: failure to follow staged construction plan to meet filling requirements or storage of excess water leading to design freeboard violation, and inadequate tailings pond capacity or excessive water resulting in need to discharge tailings pond supernatant to receiving streams (Sections 8 and 9 of the main TAA Report text; Appendix F). The design measures that will be incorporated into the Project to improve water management going forward are: additional diversion structures, relocation of water storage to TSF Site C; interim overflow channel during operations; and open pit emergency water storage. After implementation of these design measures, the residual Project risk was assessed as Very Low. |
| c. provided a clear and transparent rationale for the selected option(s) | New Gold developed and followed the following process for assessing alternative means assessment for tailings and PAG/NAG3 waste rock management:<br>**Step 1 – Initial candidate identification**: Concepts (candidates) for management of mine waste were developed based on topographical maps of the project area. The candidates are interspersed within an area of approximately 35 km by 30 km. Candidate sites were roughly bounded by the Blackwater River to the south, the Nechako Reservoir to the north, Tatelkuz Lake to the east, and Entiako Provincial Park to the west. The tailings technology applied at each candidate site was chosen based on site specific constraints and professional judgement. (Section 4 of this Tailings Assessment Report (Report); Appendix D);<br>**Step 2 – Pre-screening assessment**: Criteria were developed based on technical, environmental, and social site constraints to pre-screen the candidates to remove those with obvious deficiency and create a set of appropriate and manageable, sufficiently detailed alternatives. The objective of this step is to optimize the decision making process |

| Required Information | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
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| | by not evaluating alternatives that have obvious deficiencies or employ the same technologies that have similar risk profiles (Section 5 of the main TAA Report text; Appendix D);<br>**Step 3 – High-level risk assessment**: Candidates were compared to determine the relative risks for similar candidates, and to identify the best candidate (i.e., lowest risk) for the different tailings technologies evaluated (Section the main TAA Report text; Appendix D);<br>**Step 4 – Multiple accounts analysis**: thorough and rigorous evaluation of the short-listed candidates to determine which candidate is preferred with respect to physical stability, technology, environmental, human environment and Project economic considerations (Section 7 of the main TAA Report text, Appendix E);<br>**Step 5 – Failure modes effects assessment**: identification and characterization of risks from accidents, failures of an engineered system or malfunctions. The FMEA evaluated risks specific to the TSF concept identified to be the BAT for the Project (from Steps 1 through 4, above). The FMEA identified areas where design elements and practices already present in the Application/EIS and additional mitigations and contingencies, based on BAP for tailings management, could be implemented to minimize identified risks (Section 8 of the main TAA Report text; Appendix F).<br>**Step 6 – Determination of Best Available Practices:** BAP identified to reduce residual Project risks identified during the FMEA. These measures included additional key design elements, operational practices, and contingencies that reduce risk (Section 9 of the main TAA Report text; Appendix F).<br>Within each of these steps, assumptions and decisions are justified and supported within the section text.<br>New Gold developed this approach through consultation with the Working Group (WG). Consultation meetings specifically on this assessment have been held with various members of the WG on June 11 and 12, July 20, August 13, and October 8 and 13, 2015. New Gold incorporated feedback throughout the assessment including: expanding the spatial and temporal scope of potential candidates and inclusion of paste tailings mine development concepts (Section 2 of the main TAA Report text; Appendix A). |
| 5. Include any information in their assessments regarding potential implication of the options for Aboriginal Interests (asserted or established Aboriginal rights, including title and treaty rights) | Potential consequences on Aboriginal rights and titles were considered in the High Level Risk Assessment. The MAA considers candidate's potential interaction with Current Use of Lands and Resources for Traditional Purposes for the following First Nations or governmental organizations: Lhoosk'uz Dene Nation, Nadleh Whut'en First Nation, Nazko First Nation, Metis, Saik'uz First Nation, Skin Tyee Nation, Stellat'en First Nation, Ulkatcho First Nation, and Tsilqot'in National Government (Section 6 of the main TAA Report text; Appendix E). An assessment of potential implications to Aboriginal rights and interests is included in Section 10 of the main TAA Report text. |

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| 6. proactive and timely discussions with Aboriginal Groups | New Gold has proactively engaged with Aboriginal Groups as part of the development of this Tailings Alternatives Assessment, described in Sections 1.4.3 and 2 of the main TAA Report text, and Appendix A. |

## Table of Concordance: Letter dated June 03, 2015 from the Canadian Environmental Assessment Agency

| Required Information | Explanation of How the Information Requirements Have Been Met in the Main TAA Report Text |
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| The Agency requests that the environmental effects, as defined in section 5 of CEAA 2012, be considered in the assessment of the preferred option.<br>Section 5 of CEAA 2012 includes<br>5. (1) For the purposes of this Act, the environmental effects that are to be taken into account in relation to an act or thing, a physical activity, a designated project or a project are: | |
| (*a*) a change that may be caused to the following components of the environment that are within the legislative authority of Parliament:<br>(i) fish and fish habitat as defined in subsection 2(1) of the *Fisheries Act*,<br>(ii) aquatic species as defined in subsection 2(1) of the *Species at Risk Act*,<br>(iii) migratory birds as defined in subsection 2(1) of the *Migratory Birds Convention Act, 1994*, and<br>(iv) any other component of the environment that is set out in Schedule 2; | (i): potential effects to fish and fish habitat are evaluated within the MAA through investigation of risks to commercial, recreational and aboriginal (CRA) fisheries, fish species, and fish habitat (Section 6 of the main TAA Report text; Appendix E). Potential effects to ecosystems from a loss of effluent are a consequence criterion in the High Level Risk Assessment (Section 5 of the main TAA Report text; Appendix D).<br>(ii) impacts to aquatic species at risk were evaluated within the MAA through investigation of risks to non-CRA fisheries and aquatic resources, and presence of rare and endangered aquatic species (Section 6 of the main TAA Report text; Appendix E).<br>(iii) potential effects to migratory birds were evaluated within the MAA through investigation of loss of high-quality habitat for species of conservation concern; toxicological risk to migratory birds, amphibians and bats; toxicological risks to terrestrial wildlife species (Section 6 of the main TAA Report text; Appendix E).<br>(iv): N/A |

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| (*b*) a change that may be caused to the environment that would occur<br>(i) on federal lands,<br>(ii) in a province other than the one in which the act or thing is done or where the physical activity, the designated project or the project is being carried out, or<br>(iii) outside Canada; and | (i) the Project will not affect federal lands<br>(ii) the Project will not affect any province, other than BC<br>(iii) the Project will not have any effects outside Canada |
| (*c*) with respect to aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on<br>(i) health and socio-economic conditions,<br>(ii) physical and cultural heritage,<br>(iii) the current use of lands and resources for traditional purposes, or<br>(iv) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. | (i) potential effects to health and socio-economic conditions of Aboriginal people are evaluated within the MAA through investigation of human health, non-traditional land use, and current use of lands and resources for traditional purposes for the following First Nations or governmental organizations: Lhoosk'uz Dene Nation, Nadleh Whut'en First Nation, Nazko First Nation, Metis, Saik'uz First Nation, Skin Tyee Nation, Stellat'en First Nation, Ulkatcho First Nation, and Tsilhqot'in National Government (Section 6 of the main TAA Report text; Appendix E). An assessment of impacts to Aboriginal rights and interests is included in Section 9 of this report. Aboriginal interests were also a consequence criterion for rating the alternatives in the High Level Risk Assessment.<br>(ii) potential effects to physical and cultural heritage conditions of Aboriginal people are evaluated within the MAA through investigation of impacts to heritage (Section 6 of the TAA Report text; Appendix E).<br>(iii) potential effects to current us of lands and resources for traditional purposes of Aboriginal people are evaluated within the MAA through investigation of current use of lands and resources for traditional purposes for following First Nations or governmental organizations: Lhoosk'uz Dene Nation, Nadleh Whut'en First Nation, Nazko First Nation, Metis, Saik'uz First Nation, Skin Tyee Nation, Stellat'en First Nation, Ulkatcho First Nation, and Tsilhqot'in National Government (Section 6 of the TAA Report text; Appendix E). Aboriginal interests were also a consequence criterion for rating the alternatives in the High Level Risk Assessment.<br>(iv) potential effects to any structure, site or thing that is of historical, archaeological, paleontological or architectural significance are evaluated within the MAA through investigation of impacts to heritage (Section 6 of the TAA Report text; Appendix E) |

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| Exercise of power or performance of duty or function by federal authority<br>(2) However, if the carrying out of the physical activity, the designated project or the project requires a federal authority to exercise a power or perform a duty or function conferred on it under any Act of Parliament other than this Act, the following environmental effects are also to be taken into account: | n/a* |
| (*a*) a change, other than those referred to in paragraphs (1)(*a*) and (*b*), that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated project or the project; and | n/a |
| (*b*) an effect, other than those referred to in paragraph (1)(*c*), of any change referred to in paragraph (*a*) on<br>(i) health and socio-economic conditions,<br>(ii) physical and cultural heritage, or<br>(iii) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. | n/a |
| Schedule 2<br>(3) The Governor in Council may, by order, amend Schedule 2 to add or remove a component of the environment. | n/a |

**n/a = not applicable*

# 1. INTRODUCTION

This report provides an assessment of alternative means (technology, location, and practices) for storing tailings and potentially acid generating/non-acid generating metal leaching (PAG/ML; hereafter referred to as non-acid generating 3 [NAG3]) waste rock generated during the Blackwater Project (the Project).

This assessment has been undertaken in response to correspondence from the British Colombia (BC) Environmental Assessment Office (EAO) dated March 19, 2015. The EAO requires that environmental assessments (EAs) on mining projects appropriately consider the recommendations of the "Report on Mount Polley Tailings Storage Facility Breach" by the Independent Expert Engineering Investigation and Review Panel (the *Panel Report*; IEEIRP 2015). For proposed mining projects with new proposed tailings dams, Proponents must provide the following information:

- A description and assessment of alternative means of undertaking the proposed project with respect to options for tailings management that considers technology, siting and water balance.
- A presentation and comparison of best practices and best available technologies for tailing management for the project, along with options for managing water balance to enhance safety and reduce the risk (likelihood and consequence) of tailings dam failure during all phases of mine life (construction, operations, closure and post closure). The assessment must present and compare technically and economically viable engineering solutions that are available to adequately address site conditions.
- Provision of a clear and transparent evaluation of the factors that supported the selection of the most suitable option. Factors that will be taken into consideration in the evaluation include safety, technical and financial aspects, and implications for environmental, health, social, heritage and economic values. The assessment must consider these factors in relation to tailings management options in both the short and long-term context. Life cycle cost assumptions (construction, operations, closure, and post closure) must be included in the analysis of options.

In a letter dated June 03, 2015, the Canadian Environmental Assessment Agency (CEA Agency) requested that environmental effects, as defined in section 5 of the *Canadian Environmental Assessment, 2012* (CEAA 2012), be included as factors to be considered in the assessment of the preferred option.

In response, New Gold has conducted an assessment of alternative sites and management options for tailings and ML/PAG waste rock storage to determine Best Available Technology (BAT) specific to the Project and to identify Best Available Practices (BAP) to reduce residual risk. The Project will produce about 345 million tonnes (Mt) of tailings (the majority are PAG) and 446 Mt of ML/PAG waste rock. Tailings and ML/PAG waste rock management alternatives must be developed and assessed in an integrated manner because the technology applied to tailings disposal affects options available for ML/PAG waste rock management. Both conventional and customized risk assessment

methods as well as Environment Canada's (EC; 2011) *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* (*Guidelines*) have been modified to emphasize the importance of physical stability in the assessment and used to screen and assess the candidate alternatives.

## 1.1 PROPONENT DESCRIPTION

New Gold Inc. (New Gold) is an international gold producer with operations in Canada, the United States (US), Mexico, and Australia, and development projects in Canada. It is publicly traded, with common shares trading on the Toronto (TSX:NGD) and New York (NYSE MKT:NGD) stock exchanges with offices in Toronto and Vancouver. The Project is managed from the company's Vancouver office. New Gold Inc. (Incorporation Number BC1014904) was amalgamated under the Business Corporations Act (British Columbia) effective October 1, 2014.

## 1.2 PROJECT LOCATION AND PROJECT DESCRIPTION

The Project is a proposed open pit gold and silver mine, located approximately 110 km southwest of Vanderhoof, and approximately 160 km west-southwest of Prince George, BC (Figure 1.2-1). The mine site is centred at latitude 53°11'22.872" N, and longitude 124°52' 0.437" W (375400 E, 5893000 N) on National Topographic System sheet 93F/02.

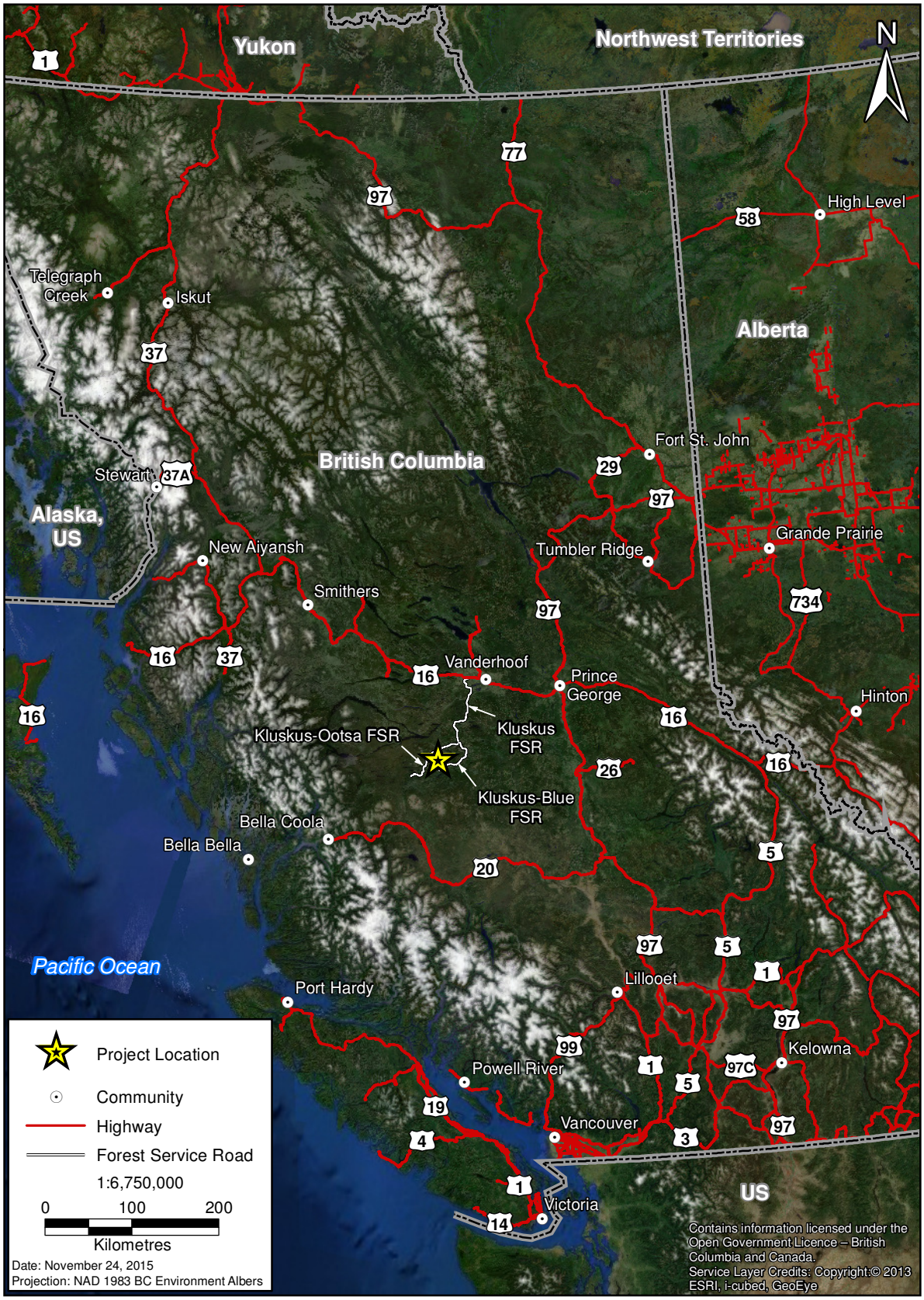
The proposed mine site is located within the established territory of the Tsilqot'in National Government (TNG; within Engagement Zone A under the Tsilhqot'in Framework Agreement 2009) and the asserted traditional territories of the Ulkatcho First Nation (UFN), Lhoosk'uz Dene Nation (LDN), and Skin Tyee Nation (STN). The asserted traditional territory of the Saiku'z First Nation (SFN) is downstream of the proposed mine site. The asserted territories of the Nadleh Whut'en First Nation (NWFN) and Stellat'en First Nation are further downstream of the Project. Lhoosk'uz Tatelkuz Lake IR #28 is located approximately 17 km northeast of the proposed mine site and is the closest Indian Reserve to the Project footprint. The Métis, as represented by Métis Nation BC, have indicated they have uses in the Project area.

The proposed mine site is accessed by vehicle from the Kluskus Forest Service Road (FSR) that originates approximately 100 km west of Prince George, and 10 km west of Vanderhoof, off Highway 16 (Yellowhead Highway). A new 16 km mine access road will replace the existing exploration access road to the mine site. The mine access road will originate at KM 124.5 on the Kluskus-Ootsa FSR and extend south to the mine site. The current driving time from Vanderhoof to the site is about two and a half hours. An airstrip will be constructed about 15 km north of the process plant site.

The mine site will cover an area of 3,300 hectares. The mine will be developed as a conventional diesel-powered truck-shovel open pit mine, which will feed a plant where the ore will be crushed and processed by whole ore cyanide leaching to extract gold and silver. The mine is designed to process 60,000 tonnes per day of ore with a life of mine of 17 years. Mine site components will include an open pit, process plant site and facilities (mill, conveyors and crushers), a TSF and associated structures, waste rock dumps, site water management structures (including freshwater reservoir, site runoff, ditches, diversion, and sediment and erosion control), low grade ore stockpiles,

overburden and topsoil stockpiles, borrow areas, a construction camp, an operation camp, and a truck shop and warehousing facilities. Offsite infrastructure will include a 140 km transmission line, a mine access road, a freshwater supply system, an airstrip, and fish habitat compensation sites. The Project has a projected 3 year construction phase followed by a 17 year operation phase.

**Figure 1.2-1**
**General Location of the Blackwater Gold Project**



## 1.3 REGULATORY CONTEXT

The proposed Project is subject to review under the BC *Environmental Assessment Act* (2002a) administered by the BC EAO, and CEAA 2012 administered by CEA Agency. Pursuant to section 19(1)(g) of CEAA 2012, the alternative means of carrying out the designated project that are technically and economically feasible and the environmental effects of any such alternative means must be considered in the EA. Additionally, the approved Application Information Requirements (May 2014) for the Project included a commitment to identify and assess the alternative means of undertaking the proposed Project, including mine waste management alternatives. While this information was provided in the Application/EIS (New Gold 2015), this report provides additional context and a more detailed assessment of the BAT/BAP for the Project pursuant to the EAO's March 19, 2015 and CEA Agency's June 03, 2015 letters to New Gold. These letters are in support of the *Panel Report*'s objectives and recommendations for new mines in BC:

1. Use of the best available technologies (BAT);
2. Corporations operating a TSF should be required to become a member of the Mining Association of Canada (MAC) or commit to an equivalent tailings management program (including auditing);
3. Expansion of corporate design commitments including a detail evaluation so potential failure modes, cost/benefit analysis of BAT tailing and closure options and detail Quantitative Performance Objectives; and
4. Utilization of an Independent Tailings Review Board.

Other recommendations in the *Panel Report* were directed at a regulatory or another governing body for implementation including:

1. Strengthening of regulatory operations;
2. Professional practice guideline improvements; and
3. Improvements to dam safety guidelines.

New Gold is committed to staying up to date on any changes in regulation, guidelines, policies, and best practices to ensure that the design, mitigation, inspection, and monitoring of the Project TSF meets or exceeds all requirements for dam safety and operation.

## 1.4 PROJECT SETTING

### 1.4.1 Environmental Setting

#### *1.4.1.1 General Setting*

The mine site is located on the Nechako Plateau along the northern flanks of Mount Davidson. The Nechako Plateau topographic landscape consists of moderate relief mountains with wide, gently sloping glacial valleys. Topographic features are largely associated with glacial deposition and erosion and include flutings, parallel ridges, eskers, melt water channels, and localized moraines.

The elevation of the Blackwater property ranges from just over 1,000 m in low-lying areas northeast of the mine site to 1,800 m at the summit of Mt. Davidson, the highest peak in the Fawnie Range. The Project area spans two ecoregions, the Fraser Plateau and Fraser Basin; and three ecosections, the Nazko Upland, Bulkley Basin and Nechako Lowland (AMEC 2012a).

The climate in the Project area is sub-continental, characterized by brief warm summers and long cold winters resulting from the influence of cold arctic air. The climate is also influenced by moisture-laden weather systems moving east by way of the low Kitimat Ranges. Temperatures range from a minimum of -40°C in winter to a maximum of 32°C in summer. Average annual precipitation is 636 mm/a, with 310 mm falling as rain and the rest as snow. The rainy season is from May to September. Snow typically starts to accumulate in October, and snowmelt is generally between April and May. The prevailing wind direction is from the southwest (AMEC 2012a). Long-term climate and streamflow records indicate no notable climate change effects on climatic or hydrologic conditions near the Project, with the exception of possibly decreasing annual peak flows (Knight Pièsold 2013a).

#### *1.4.1.2 Geology and Topography*

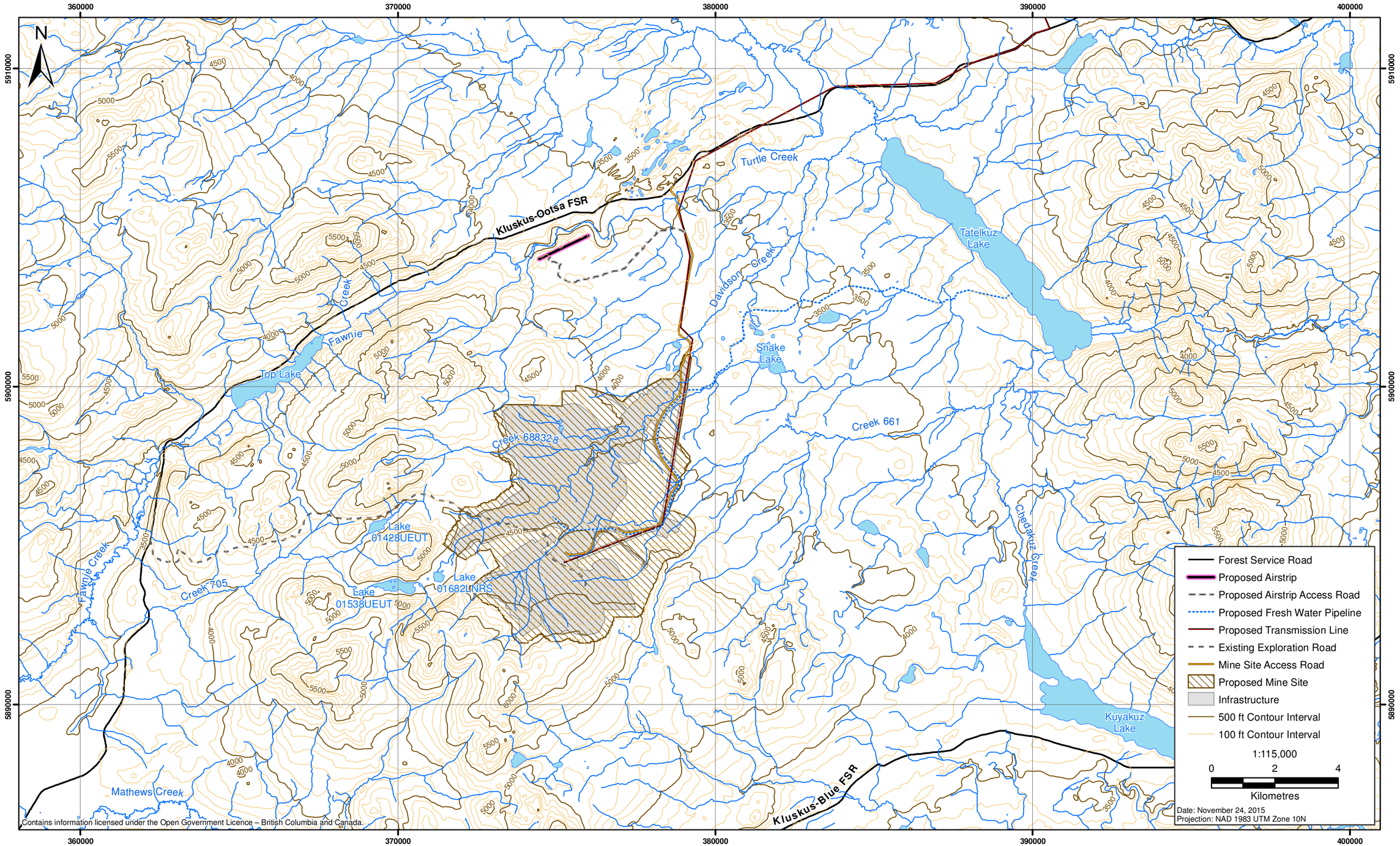
Local topographic and geological factors considered for conventional TSF and waste rock facility siting and technology are bedrock type and condition, overburden type and depth, slope characteristics, and valley geometry. Bedrock and overburden affect dam foundation conditions, associated earthquake risks, and potential seepage. Steepness of slopes and valley geometry affect containment dam construction, and magnify the risks of local geohazards such as debris chutes, rock falls, avalanches, and landslides.

The Project is located on the northern flanks of Mount Davidson within the Nechako Plateau of the Interior Plateau physiographic region. The topographic form of the region is controlled by volcanic uplift of bedrock and subsequent erosion by glacial ice during the last glaciations (Diakow and Levson 1997). The Nechako Plateau topographic landscape is generally described as moderate relief mountains intersected by wide, gently sloping glacial valleys. Topographic features are largely associated with glacial deposition and erosion and include flutings, parallel ridges, eskers, meltwater channels, and localized moraines.

The local topography is moderately steep to steep and has been shaped by glacial erosion. Average elevations vary from approximately 1,200 masl to approximately 1,900 masl, with the Project area located on one of the higher points in the region, reaching approximately 1,860 masl (Figure 1.4-1).

The Project area's regional geology is defined by the uplifted Nechako block. The Nechako Uplift juxtaposes older Jurassic arc-related rocks of the Hazelton and Bowser Lake groups with younger Eocene extensional-related rocks of the Ootsa Lake and Endako groups. The Nechako uplift is a structurally raised block bounded to the north and south by two faults, which provides a window through younger cover rocks into older rocks. Quaternary glacial overburden, colluvial, and fluvial deposits mask the majority of bedrock within the Project mine site.

**Figure 1.4-1**
**Topographic Relief**




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The Project area is underlain by the "Blackwater wedge," a laterally discontinuous wedge of intercalated volcanic and volcaniclastic felsic to intermediate lapilli and ash tuff, volcanic breccias, and andesitic flows. The Blackwater deposit has characteristics of a low sulphidation epithermal gold-silver deposit. Mineralization occurs in volcanic rocks of Late Cretaceous age emplaced through and on Hazelton Group strata. Gold grains are between 5 and 50 microns in size and are mainly associated with sulphide minerals (AMEC 2011).

The surficial sediments in the Project area consist of Quaternary and Holocene deposits, with localized areas of bedrock outcroppings near the flanks and peak of Mount Davidson. Morainal, glaciofluvial, and glaciolacustrine deposits are Quaternary in age, with deposition associated with the last glacial period. Holocene sediments include materials that were deposited since the end of glaciation to the present, and include fluvial, colluvial, eolian, and organic (peat) deposits (AMEC 2013h). The thickness of the till in the Project area is described as till blankets (bedrock controlled but masking bedrock outcrops) along the lower mountain slope positions, and till veneers, of variable thickness and generally less than 1 m, over higher elevations. On steeper slopes, colluvial deposits are identified. These deposits are generally derived from local till or bedrock outcrop sources (Plouffe, Levson, and Mate 2004). The sediments tend to occur in the valley bottom locations where glacial meltwater flowed throughout deglaciation. Localized occurrences of modern sediments, including fluvial and organic deposits, also occur in the Project area.

The Project is located in an area of low seismic activity (the southern Cordillera seismic region), with the closest major fault line (the Queen Charlotte fault system) approximately 500 km to the west along the west coast of Haida Gwaii (Knight Pièsold 2014a). The results of a site-specific seismic hazard assessment indicate a range of Peak Ground Acceleration (PGA) for various return periods at the Project area. The assessment shows that the 10,000-year return period mean PGA of 0.11g could be associated either with a randomly located earthquake of magnitude 8.5 along the Queen Charlotte fault system or a magnitude 7.5 earthquake along the BC coast (approximately 300 km west of the Project area). The largest earthquake recorded in the southern Cordillera region was an event of about magnitude 6.0 in 1918, located in the Valemount area of the Rocky Mountain trench. More recently, a magnitude 5.4 earthquake occurred near Prince George in 1986 (New Gold 2014b).

#### *1.4.1.3 Surface Water*

Activities associated with the construction, operation, and closure of tailngs and waste rock storage facilities can alter surface water hydrology and quality with consequent effects on hydrological features (e.g., streams, lakes and wetlands) as well as terrestrial and aquatic species and habitat. The natural hydrological regime of a TSF's catchment affects the safe construction, operation and closure of the facility. Surface water factors such as catchment size, precipitation, and runoff affect the water flows in and out of a TSF site, influencing water quality, surplus water, and flood risks. These effects are key parameters for consideration in the tailings and waste rock management alternatives assessment.

The Project area is located entirely within the Nechako sub-basin north of the Euchiniko Lake watershed of the Blackwater sub-basin. Both the Nechako and the Blackwater sub-basins are part of the greater Fraser River Basin, with relevant regional catchment areas provided in Figure 1.4-2 (New Gold 2012).

The surface hydrology of the Blackwater deposit area includes the Turtle Creek, Davidson Creek, Creek 661, Creek 705, and Chedakuz watersheds (Figure 1.4-2). The Chedakuz Creek basin, in turn, drains toward the northwest via the Nechako River system into the Nechako Reservoir, which was created by the construction of the Kenney Dam in 1952. The Davidson Creek valley is incised locally and flows northeast from the site toward Chedakuz Creek downstream of Tatelkuz Lake. The Blackwater deposit lies within the upper reaches of the Davidson Creek catchment area. The terrain within this footprint is predominantly gently inclined, except along the incised portions of Davidson Creek. Creek 661 flows northeast from the project site into Chedakuz Creek upstream of Tatelkuz Lake (Knight Pièsold 2015).

An unnamed catchment drains Snake Lake, which is located between the Davidson Creek and Creek 661 catchments. This area drains directly to Tatelkuz Lake. Chedakuz Creek drains Tatelkuz Lake before its confluence with Davidson Creek approximately 800 m downstream of the lake. Chedakuz Creek flows northwest passing under a bridge at the Kluskus Forest Service Road (FSR) approximately 2 km downstream from the Lake. Turtle Creek, located to the north of Davidson Creek, drains another undisturbed catchment running parallel to Davidson Creek towards Chedakuz Creek. Turtle Creek flows closely to Davidson Creek near the base, before flowing north under the Kluskus FSR to its confluence with Chedakuz Creek downstream of the Kluskus FSR. Chedakuz Creek flows northwest from this point for approximately 25 km to the Nechako Reservoir.

Matthews Creek and Creek 705 both flow west of the deposit area and combine with Fawnie Creek to form a second predominant surface water flow pattern in the region. Fawnie Creek flows towards Laidman Lake and Johnny Lake, into Entiako Provincial Park, and ultimately forming a portion of the flow of the Entiako River into the Nechako Reservoir.

South of the deposit area lies the catchment divide for the Blackwater River, which constitutes the third major surface water flow pattern in the region. The Blackwater River is a tributary of the Fraser River and flows generally north-eastward across the Fraser Plateau in the Chilcotin region of central British Columbia. Its confluence with the Fraser River is approximately 40 km northwest of Quesnel and it forms the division between the Chilcotin Plateau and the Nechako Plateau, which are subdivisions of the Fraser Plateau. The river is of significant historical importance to First Nations and Canadian history. The Blackwater River has been designated as a heritage river by the government of British Columbia (MOE 2010).

Hydrological data were collected within the Project area from the spring of 2011 through the winter of 2013. Baseline data collection is ongoing; sampling is consistent with hydrology regulatory requirements. These data were used in conjunction with regional data to develop baseline hydrological estimates of monthly, annual, peak, and low flows for the Project (Knight Pièsold 2013a). Project hydrometric monitoring stations are shown in Figure 1.4-3.

Streams in the area were generally characterized by high flows in late spring and early summer due to rain and snowmelt, and low flows in the winter. The long-term mean annual unit runoff for the Project area was estimated to be 6.1 litres per second per square kilometre (L/s/km$^2$), which equates to a watershed average runoff of 198 mm. The effective annual runoff coefficient for the natural drainage areas in the Project was estimated to be 0.31 (Knight Pièsold 2013a).

**Figure 1.4-2**
**Watershed Boundaries and Major Waterbodies**

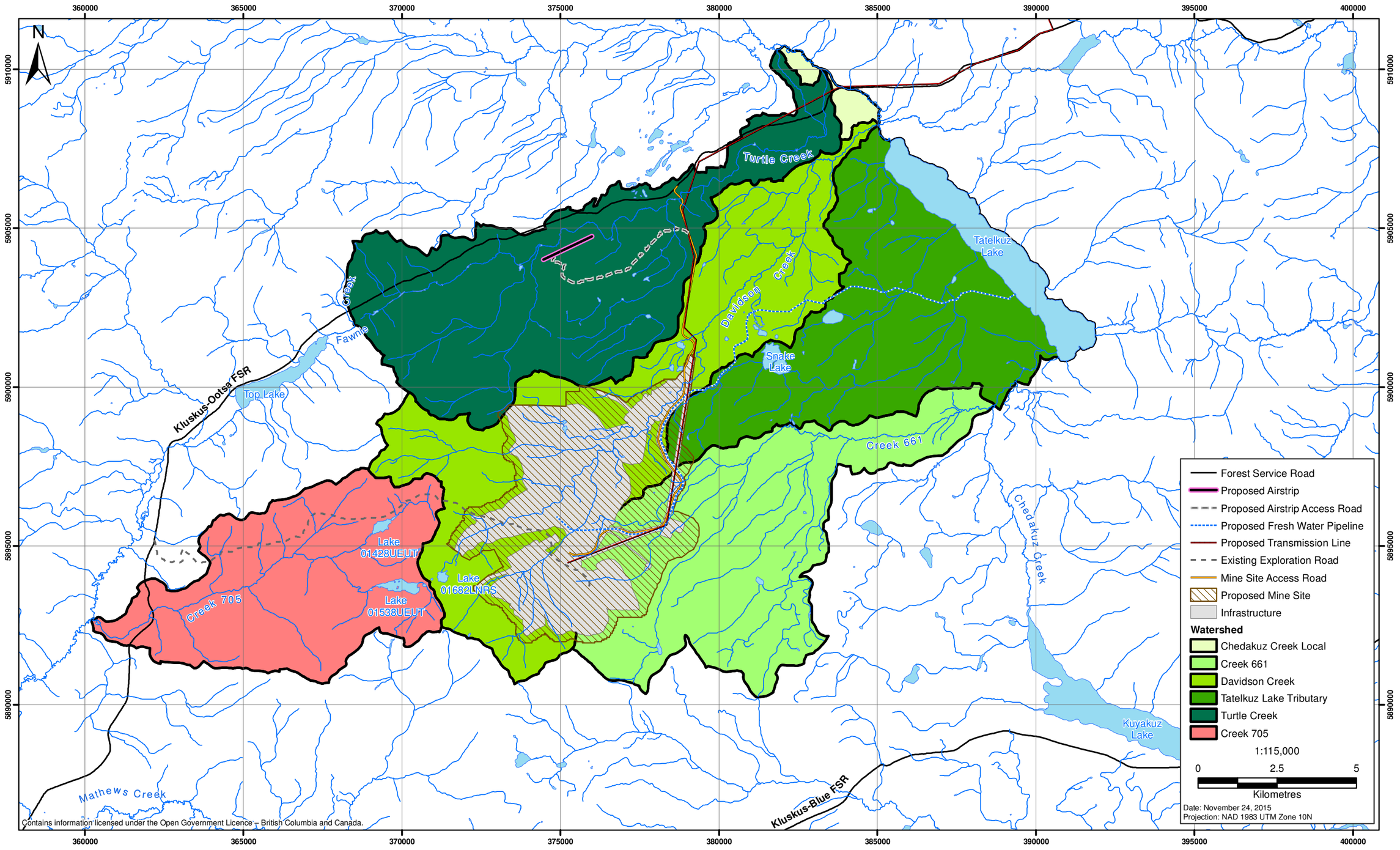
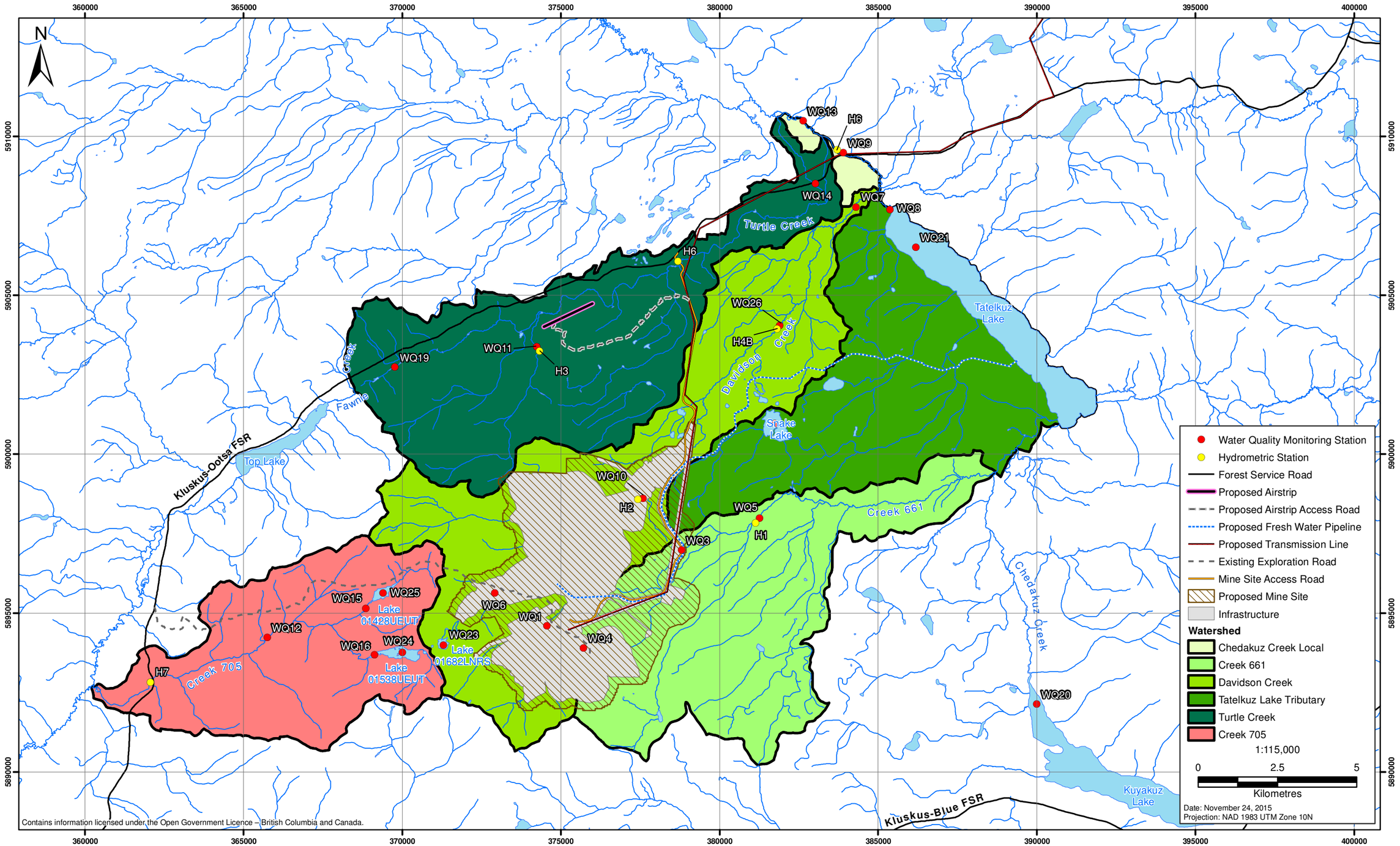


**Figure 1.4-3**
**Location of Hydrometric and Surface Water Quality Monitoring Stations**



Surface water quality within the Project area was monitored in 2011 and 2012, and continue to be monitored, to provide baseline water quality prior to Project development (AMEC 2013d). Water and sediment quality samples were collected at a number of sites within the Project area that could potentially be affected by mine development. Results were compared against the BC Ministry of Environment (MOE) water quality guidelines (British Columbia Ministry of Environment 2006a) and working or approved water quality guidelines (BCFWG; British Columbia Ministry of Environment 2006b).

Based on the mean water quality monitoring result, streams of the Project area water has circum-neutral pH and low hardness; alkalinities are also low, consistent with low hardness and conductivity. Metals concentrations are low, typically one to several orders of magnitude below their available BCFWG. The exceptions are listed below (AMEC 2013d).

- **Total cadmium:** Cadmium naturally occurs in the earth's crust and can enter surface water through weathering and erosion of rocks and soils. Monitoring sites draining the Blackwater mineral depostit (WQ 1, WQ4,), on Davidson Creek (WQ 7) and Creek 705 (WQ16) on average exceeded the 30-day guidelines (mean of all availble data). The results for cadmium indicate that some cadmium is being leached from country rock at the site; therefore, a site-specific objective may be required by the BC MOE.
- **Total zinc:** Monitoring sites near the deposit (WQ4, above 30-day and maximum BC FWG), and on Davidson Creek (WQ 7, above 30-day BCFWG ) was anomalous for zinc (above the 30-day guidelines), which indicates that a site-specific objective for zinc may be required.
- **Dissolved aluminum:** Monitoring sites in the Project Area consistently exceed the available the 30-day BCFWG (sites: WQ1, WQ3, WQ4, WQ5, WQ6, WQ7, WQ10, WQ11, WQ12, WQ26), while six exceeded the maximum BCFWG (WQ1, WQ4, WQ5, WQ10, WQ11, and WQ16). The results for aluminum are not unusual and reflect the country rock and a generally high background in Project area relative to guidelines.

In general the 95$^{th}$ percentile exceedance pattern for Project-area streams followed that of the means, although some additional exceedances are noted. That is some sites exceeded 30-day BCFWG for turbidity (sites WQ4, WQ7, and WQ8), total chromium (sites WQ3), total iron (WQ 18), and total copper (site WQ11, WQ18), with these exceedances linked mainly to erosion and weathering of soils and rocks (Figure 1.4-3). Further, changes from 30-day to maximum exceedances are, for the most part, coincident with 95$^{th}$ percentile values driven by freshet concentrations.

Water quality monitoring results for lakes in the Project area were generated by combining epilimnion, metalimnion, and hypolimnion profile samples. Results indicate that there were few observed exceedances of BC FWG; these include: mean total cadmium in Tatelkuz Lake (WQ21), Snake Lake (WQ22), Lake 1538 (WQ24), and Lake 1428 (WQ25), and mean dissolved iron at Lake 1682 (WQ23) and WQ24. .

Baseline sediment quality studies were completed along with surface water quality studies for the Project area. Stream sediment quality was monitored in the Project area from 2011 through 2013 Exceedances of CCME Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) guidelines, and BC MOE Lowest Effects Level (LEL) and Severe Effects Level (SEL) guidelines occurred,,

these include: arsenic, iron, and manganese. Results are not atypical for streams, particularly in mineralized areas where sediment guidelines are often naturally exceeded. Healthy aquatic populations exist in all area streams and thus exceedances of guidelines do not indicate naturally occurring impairment of aquatic ecosystems. Sediment guidelines are often not a useful indicator of bioavailability and metals exposure for aquatic organisms.

#### *1.4.1.4 Groundwater*

Activities associated with construction, operation, and closure of tailings and waste rock facilities can alter groundwater flows and water quality with consequent effects on hydrological features (e.g., streams, lakes and wetlands) as well as terrestrial and aquatic species and habitat. These effects are key parameters for consideration in the tailings and waste rock management alternatives assessment.

The groundwater baseline program is based on 130 boreholes as part of geotechnical, geomechanical and hydrogeological site investigations. The groundwater program includes measurements of hydraulic head from a minimum of 18 monitoring wells (at 11 locations), 22 vibrating wire piezometers (at six locations), and baseflows at 11 locations.

Understanding of the groundwater site conditions is based on investigations that began in mid-2012 (Knight Pièsold 2013a) . Typically, the groundwater table in the Project area exhibits a muted form of topography (Section 1.8.2) and is recharged from surface infiltration (New Gold 2012). Groundwater levels vary greatly across the Project area and range from surface level to 36 m below ground surface (m bgs). The majority (20 of 26) of initial groundwater levels measured were shallower than 18 m bgs (Knight Pièsold 2013a). Groundwater flows from higher elevations to lower-lying areas where it discharges to streams and small wetland areas (New Gold 2012).

The Project's deposit area is situated on a groundwater subcatchment divide and near the upper reaches of Davidson Creek and Creek 661 catchments. In the western portion of the deposit area, groundwater flows downslope towards the Davidson Creek catchment. Groundwater from the eastern portion of the deposit area flows downslope towards the northeast in the Creek 661 subcatchment. Seasonal variation in groundwater levels is expected given the climate conditions in the area with groundwater levels highest during periods of snowmelt (New Gold 2012).

Groundwater quality samples were collected from 13 sets of wells. The wells were strategically placed to provide baseline results up-gradient of the proposed mine site as well as from downstream for capturing potential future mine activity–impacted groundwater. The sampling started in May 2012 and is on-going as of the writing of this report (AMEC 2013e).. With the exception of aluminum, lead, arsenic, iron, and manganese, the baseline analytcial results for groundwater samples meet the applicable BC MOE water quality guidelines (AMEC 2013c; AMEC 2013d).

Analyzed groundwater pH values range between pH 6.4 and pH 8.9 with an average pH 7.8. Groundwater from the Project area ranges from soft to hard (hardness ranges between 13 and 167 mg/L; average 77 mg/L as calcium carbonate) and has a wide ranging total alkalinity (20 to 206 mg/L; average 87 mg/L as calcium carbonate; AMEC 2013d).

### *1.4.1.5 Geochemistry*

Activities associated with construction, operation, and closure of tailings and waste rock storage facilities can alter geochemistry and water quality with consequent effects on terrestrial and aquatic species and habitat. TSF construction materials as well as the tailings and waste rock stored in the impoundment may be potential sources of ML/ARD to the receiving environment. These effects are key parameters for consideration in the tailings and waste rock management alternatives assessment.

#### Geology

The Blackwater Project site is located on the northern flank of Mt. Davidson within the uplifted Nechako block. In the region the Hazelton Group is overlain by the Bowser Lake Group and both groups are intruded by late Cretaceous felsic plutons. The two groups and felsic pluton are overlain by Eocene Ootsa Lake and Endako groups and the entire package is capped by Chilcotin Group basalts. There is very low potential for carbonate units in the region and the majority of the host rock is a laterally discontinuous wedge of intercalated volcanic and volcaniclastic felsic to intermediate lapilli and ash tuffs with volcanic breccias and andesitic flows.

#### Characterization Program

Geochemical sampling was conducted from 2011 to 2013 with some kinetic tests continuing to present. The program design incorporated existing assay rejects, drill core from 2009 through 2013 drilling, surface grab samples, and from metallurgical testing programs (AMEC 2014; Table 1.4-1).

**Table 1.4-1. Summary of Characterization Program**

| Test | Waste Rock [1] | Ore [1] | Tailings [2] | Overburden [3] |
|---|---|---|---|---|
| **Static Tests** | | | | |
| Acid Base Accounting | 890 | 72 | 18 | 95 |
| Exploration ICP Database | ≈285,000 | ≈70,000 | - | - |
| Multi-element Chemistry | 617 | 87 | 18 | 95 |
| Mineralogy / Petrography | 25 | 48 | - | 2 |
| Shake Flask Extraction | 58 | 8 | 5 | 14 |
| Net Acid Generation (NAG) Test | 587 | 36 | 8 | 29 |
| NAG Leachate | 78 | 7 | 5 | 5 |
| **Kinetic Tests** | | | | |
| Humidity Cells | 19 | 2 | 5 | - |
| Modified Humidity Cells | 3 | 1 | - | - |
| Saturated Columns | 2 | - | - | - |
| Kinetic Field Bins | 6 | 2 | - | - |
| **Project Specific Tests** | | | | |
| Oxygen Consumption | 1 | - | - | - |
| Acid Buffering Characteristic Curve | 12 | - | - | - |

| Test | Waste Rock [1] | Ore [1] | Tailings [2] | Overburden [3] |
|---|---|---|---|---|
| Sequential NAG | 4 | - | - | - |
| Kinetic NAG | 6 | - | - | - |
| Humidity Cell pH Neutralization | 5 | 1 | - | - |
| Sequential Extraction | 10 | - | - | - |
| Adsorption Experiments | 6 | - | - | - |
| Scanning Electron and Optical Microscopy | 5 | - | 2 | - |
| $SO_2$ Air/Cyanide Destruction | - | - | 23 | - |

*Note: Sample numbers from AMEC (2014).*
*[1] Samples of waste rock and ore include 10 m composites.*
*[2] Tailings samples were obtained from metallurgical testing.*
*[3] Overburden samples were selected from core and test pits.*

Acid potential (AP) was calculated from the measured total sulphur value, neutralization potential (NP) was measured using the modified Sobek method, and the net potential ratio (NPR) was calculated as the ratio of NP to AP (AMEC 2014).

Waste Rock

AMEC (2014) identified five classes of waste rock based on NPR and zinc content (Table 1.4-2).

Sulphide mineral phases identified in waste rock samples included pyrite or pyrrhotite (0.3 to 4.0%) and sphalerite (0.1 to 0.8%). Carbonate mineral phases were reported, with calcite and siderite reported as the most frequently occurring mineral phases; calcite abundances ranged from 0.7 to 3.3%. AMEC (2014) reported that siderite was found only in the PAG1, PAG2, and NAG3 samples, while calcite was more commmonly found in the NAG4 and NAG5 samples. The median NPR values of the five waste rock classifications according to the ARD block model were: PAG1 NPR=0.22, PAG2 NPR=1.4, NAG3 NPR=3.9, NAG4 NPR=5.5, and NAG5 NPR=7.4.

**Table 1.4-2. Acid Rock Classification of Project Samples**

| Classification | NPR | Metal Content |
|---|---|---|
| PAG 1 | NPR <1 | - |
| PAG 2 | NPR 1-2 | - |
| NAG 3 | NPR >2 | zinc > 1,000 mg/kg |
| NAG 4 | NPR >2 | zinc 600 to 1,000 mg/kg |
| NAG 5 | NPR >2 | zinc < 600 mg/kg |

*Notes:*
*mg/kg = milligram per kilogram*
*PAG = potentially acid generating; NAG = non-acid generating*
*NPR = neutralization potential ratio*

The ML potential of the waste rock samples was assessed through elemental content, NAG test leachate analyses, and shake flask extractions (SFE). The elemental content indicated that Ag, As, Bi, Cd, Zn and P were elevated and had a positive correlation with sulphide sulphur. The 77 NAG test

leachate analyses indicated that the majority of samples had elevated parameters including Ag, Al, Cd, Co, Cu, Pb, and Zn. SFE leachate concentrations indicate the potential for elevated Al, Cd, and Zn.

Ore and Tailings

Ore material contained pyrite (1.2 to 15.0%), sphalerite (0.5 to 1.6%) and detectable carbonate abundances (less than 1.0%). AP values ranged from 0.3 to 278.0 kg $CaCO_3$/t and NP values ranged from 0 to 22 kg $CaCO_3$/t. Ore material was classified as PAG as 92% of ore samples had a NPR value less than 2.0 (AMEC 2014).

Elemental abundance of the ore material demonstrated elevated Ag, As, Bi, Cd, P, Pb, S, Sb, and Zn (AMEC 2014) with elevated values of Ag, Al, Cd, Cu, Fe, Mn, Pb, and Zn in the majority of NAG leachate or SFE tests.

A variety of tailings samples were selected from the metallurgical test program representing:

- Flotation rougher tails;
- Flotation cleaner tails;
- Cyanide leach tails; and
- Head ore.

The whole ore leach was selected as the processing methodology of the Project and characterization focused on that method. In the whole ore leach process the tailings would have similar ABA characteristics as the ore since sulphide mineral separation is not included in the processing. Ore at Blackwater is divided into oxide, transition and sulphide facies. Pyrite (3.0%), pyrrhotite (1%) and sphalerite (0.5%) comprised the major sulphide phases in the sulphide facies. Carbonate phases were detected in trace amounts (AMEC 2014). According to the ARD block model, median total sulphur in the oxide ore was very low at 0.08% (majority expected to be sulphate sulphur) compared to 0.55% and 1.11% for transition and sulphide ore respectively. The median NPR of the oxide, transition, and sulphide ore facies was 0.3, 0.1, and 0.1 respectively.

The ML potential of the tailings material was assessed through solid phase elemental content and SFE. Elemental content suggested elevated concentrations of: Ag, As, Bi, Cd, P, Pb, S, Sb, and Zn in the transition and sulphide tailings samples. The whole ore leach transition and sulphide tailings had elevated As, Cd, and Zn in the solid phase. The results of the SFE analyses on the whole ore leach transition and sulphide tailings indicate elevated potential for ML of Cd, Co, Mn, and Zn, although the detection limits of some parameters were above screening criteria. The leachate from the NAG leach tests typically had elevated As, Cr, and Tl. Humidity cell results suggest that the lag time to the onset of ARD for some transition and sulphide tailings could be less than one year (based on lab conditions) with a longer period expected in the field if the tailings were left exposed (New Gold 2014a, Section 5).

Overburden

The AP and NP values for overburden samples was low (0.31 to 20.2 and 1 to 127 kg $CaCO_3$/t respectively). Calculated NPR values were greater then 2.0 for 95% of overburden samples indicating that overburden was non-PAG (AMEC 2014).

The metal content of overburden samples indicated elevated Bi, Cd, Pb, Sb, Se, and Zn, while the SFE results indicated elevated Al, Cd, and Fe.

Summary

Some of the waste rock and most of the ore samples within the proposed Open Pit had high ARD potential and elevated concentrations of several elements, which suggests that oxidation of some waste rock and tailings could cause these elements to be released if left exposed in an unsaturated condition. Waste rock from the Open Pit will be segregated and managed according to its ML/ARD potential. Tailings also will be managed.

Overburden samples are NAG with low concentrations of most trace metals. Overburden at the Project is not expected to be a source of acidic drainage or metal leaching.

#### *1.4.1.6 Climate*

Climate consists of the long-term statistical trends of temperature, precipitation, humidity, atmospheric pressure, wind, atmospheric particle count, and other meteorological elements in a given region. Climate conditions, particularly precipitation events (e.g., 1:200 year recurrence), contribute strongly to TSF design for safe construction, operation, and closure. The siting of a TSF with respect to the prevailing wind direction can also influence air quality through fugitive dust emissions.

The climate in the Project area is sub-continental, characterized by brief warm summers and long cold winters resulting from the influence of cold Arctic air. The climate is also influenced by moisture-laden weather systems moving east by way of the low Kitimat Ranges (AMEC 2012b).

Climate data have been collected from two meteological stations at the Project site since early 2011. Data collected on site were combined with historical data from the Meteorological Services of Canada (MSC) branch of Environment Canada and the BC Forestry Service to develop long-term meteorological estimates for the Blackwater Gold Project (Knight Pièsold 2013a). The results of the climate analyses for elevation 1,470 masl are as follows (Knight Pièsold 2013a):

- The mean annual temperature at the site is estimated to be 2°C, with minimum and maximum mean monthly temperatures of -7.7°C and 12.5°C occurring in January and July, respectively.
- The mean annual precipitation for the site is estimated to be 636 mm, with about 49% falling as rain and 51% falling as snow. Precipitation is fairly evenly distributed throughout the year, with mean monthly values ranging from a low of 20 mm in April to a high of 74 mm in November.
- The mean annual lake evaporation (potential evapotranspiration) at the site is estimated to be 445 mm.

- The mean annual wind speed on site is approximately 2.4 m/s (8.6 km/h), with the wind direction being predominantly from the southwest.

A review of long-term climate[1] and streamflow records[2] indicates no notable climate change effects on climatic or hydrologic conditions near the project, with the exception of possibly decreasing annual peak flows (Knight Pièsold 2013b).

#### *1.4.1.7 Air Quality*

Activities associated with construction, operation, and closure of tailings and waste rock storage facilities can alter air quality with consequent effects on wildlife and surrounding ecosystems. These effects are important parameters for consideration in the alternatives assessment.

Availability of reliable, public domain air quality data covering remote areas of central and northern BC allows the determination of the most likely baseline concentrations of relevant air contaminants near the Project.

Several databases were identified and analyzed using such references as the number of monitored criteria air contaminants (CACs), instrumentation, location, the monitoring period, and the relevance to the Project with respect to level of development (AMEC 2013b). The final selection was narrowed to the following four data sources (AMEC 2013b):

- Canadian Air and Precipitation Monitoring Network (CAPMoN);
- National Air Pollution Surveillance Program (NAPS);
- BC MOE Monitoring Network; and
- On-site Blackwater particulate monitoring.

Based on relevant data available at the above sources, values of the background concentrations for the Project site for relevant contaminants are presented in Table 1.4-3 (AMEC 2013b).

**Table 1.4-3. Background Concentrations for Criteria Air Contaminants**

| Source | Concentration |
|---|---|
| Particulate matter 2.5 µm diameter ($PM_{2.5}$) | 4 µg/m$^3$ |
| Particulate matter 10 µm diameter ($PM_{10}$) | 9 µg/m$^3$ |
| Nitrogen dioxide ($NO_2$) | 8 µg/m$^3$ |
| Sulphur dioxide ($SO_2$) | 1 µg/m$^3$ |
| Ozone ($O_3$) | 48 µg/m$^3$ |
| Carbon monoxide (CO) | 120 µg/m$^3$ |

[1] Ootsa climate station operated by Environment Canada has the longest climate record available in the region (46 years of complete data). This dataset was used to analyze long-term regional climate trends applicable to the Project area.

[2] Data reviewed from flow records for the Dean River (1973 to 2010) and Van Tine Creek (1975 to 2005).

As the Project is located in a remote area with no existing anthropogenic emission sources, the background concentrations are low compared to ambient air quality objectives.

### *1.4.1.8 Vegetation*

The construction and operation of tailings and waste rock storage facilities may affect ecosystems through direct loss or degradation. In particular, the loss of rare and endangered ecosystems and the presence of rare and endangered plants are significant factors that are considered in the candidate alternative selection process.

Vegetation baseline surveying was conducted over a period of three years, from July 2011 to July 2013. These surveys included three terrestrial ecosystem mapping studies and four species at risk surveys (AMEC 2013a).

The Project area spans two ecoregions, the Fraser Plateau and Fraser Basin; and three ecosections, the Nazko Upland, Bulkley Basin and Nechako Lowland. There are four biogeoclimatic variants within the Project vegetation mine site local study area (VLSA; Figure 1.4-4), presented in Table 1.4-4 (AMEC 2013h).

**Table 1.4-4. Biogeoclimatic Variants Identified within the Project Vegetation Local Study Area**

| Biogeoclimactic Code | Biogeoclimactic Unit | General Description | Elevation (masl) |
|---|---|---|---|
| SBSmc2 | Sub-Boreal Spruce Moist Cold Babine variant | Low elevation interior forests and wetlands | 900 to 1,250 m |
| SBSmc3 | Sub-Boreal Spruce Moist Cold Kluskus variant | Low elevation interior forests and wetlands | 975 to 1,300 m |
| ESSFmv1 | Engelmann Spruce – Subalpine Fir Moist Very Cold Nechako variant | High elevation interior forest and wetlands | 1,300 to 1,620 m |
| ESSFmvp | Engelmann Spruce – Subalpine Fir Moist Very Cold Nechako Parkland variant | High elevation subalpine parkland; rolling landscape tree islands interspersed with herbaceous meadows | 1,620 to 1,660 m (cool aspect); 1,660 to 1,800 m (warm aspect) |

Sensitive ecosystems in the Project mine site VLSA include riparian and mature forest (AMEC 2013h).

Four plant species of conservation concern were documented within the mine site VLSA: whitebark pine (*Pinus albicaulis*), meesia moss (*Meesia longiseta*), sickleleaf tomentypnum moss (*Tomentypnum falcifolium*), small-flowered lousewort (*Pedicularis parviflora subsp. Parviflora*; Figure 1.4-4). All species are Blue-listed in BC (BC CDC 2015), with the whitebark pine also listed as Status 1 endangered under the *Species at Risk Act* (2002c) and endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2010). All of the confirmed plant species at risk are found in wetlands with the exception of whitebark pine (AMEC 2013h; Figure 1.4-4). Whitebark pine was identified as an at-risk species under the Project's Section 79(1) notice under the *Species at Risk Act* (SARA; 2002c).

#### *1.4.1.9 Terrestrial Wildlife and Habitat*

Terrestrial wildlife are characterized and considered in the tailings and waste management alternatives assessment process. In particular, the loss of rare and endangered ecosystems and the presence of rare and endangered wildlife are significant factors that are considered in the candidate alternative selection process.

Wildlife field surveys were conducted within the terrestrial ecology local study area (TELSA) and terrestrial ecology regional study area (TERSA; Figure 1.4-5) according to modified Resources Information Standards Committee (RISC) protocols). Targeted studies for songbirds, diurnal and nocturnal raptors, waterbirds, common nighthawks (*Chordeiles minor*), sharp-tailed grouse (*Tympanuchus phasianellus columbianus*), pond-breeding amphibians, ungulates, furbearers, bats, butterflies, and dragonflies were undertaken in 2011 and 2012 (AMEC 2013j).

Thiry-five species of conservation concern[3] were identified as having the potential to be affected by the Project under the Project's Section 79(1) notice under the *Species at Risk Act* (2002c; Table 1.4-5).

Note that while Northern Goshawk laingi (*Accipter gentilis langii*) subspecies is red-listed in BC, and a species at risk under SARA and COSEWIC, this subspecies does not occur in the Project area. The Northern Goshawk laingi subspecies is found west of the Coast Mountains and would not occur further east of Terrace, BC. The wildlife baseline report provided in Appendix 5.1.3.4A of the Application/EIS states in Section 3.4.2.5 *Raptors* that with respect to the mine site LSA "The most frequently detected raptor was the red-tailed hawk *(Buteo jamaicensis),* followed by the northern goshawk". This statement refers to the *atricapillus* subspecies, which is yellow-listed in BC and not considered a species of concern under SARA or COSEWIC.

Two species, moose (Alces alces) and caribou (*Rangifer tarandus*), have been assessed individually due to the high importance of these species to First Nations (see section 1.4.3).

Moose

Moose are a year-round native resident of BC. Moose have a widespread distribution throughout the provincial mainland but is absent from most coastal areas and from the arid southern interior of the province (Stevens and Lofts 1988). Moose are most abundant in central and northern British Columbia.

Important moose habitat types include mature / old-growth climax coniferous forests complexed with wetlands, ponds, and lakes and semi-open successional stages of forested habitats with abundant browse. Moose will occasionally forage in clear-cuts depending on the size of the opening cover characteristics surrounding the cutblock (Hamilton, Drysdale, and Euler 1980; Baker 1990). Moose prefer semi-open successional stages of forested habitats with abundant browse. They will feed in many forest types including coniferous, deciduous, and mixed forests. Foraging needs vary with the seasons. Browse is eaten at all seasons but is dominant in the winter diet.

[3] COSEWIC; Federal *Species at Risk Act* (2002c); and BC provincially listed species.

Shrub communities of willow (*Salix* spp.), birch, highbush-cranberry (*Viburnum edule*), red osier dogwood (*Cornus stolonifera*), and aspen provide essential winter forage. In spring and summer, moose seek out succulent horsetails, grasses, sedges, forbs, and aquatic vegetation. Habitats that provide the forage needs of moose include riparian forests, structural stages 3a and 3b of moist forests, shrub-carrs, avalanche shrubland, subalpine parkland, wetlands, lakes, and ponds. Depending on the age of the area, moose will also feed in clearcuts and recent burns but usually will stay within 200 metres of cover.

Moose tend to rut in semi-open areas often adjacent to forest openings. Calving is usually in dense shrubby areas in forested or wetland and riparian habitats (Stevens and Lofts 1988). Calving and rutting sites for moose were not rated separately because of their site-specific nature.

Six aerial reconnaissance transects were flown along the 2011 mine site LSA and RSA near the proposed mine site along the slopes of Mount Davidson on 16 March 2011 (Ecofor 2011). Transects were oriented from northwest to southeast with an average length of approximately 16 km each. The northwest limit of the survey was the Top Lake/Fawnie Creek drainage and the southeast limit of survey was the northwest tip of Kuyakuz Lake. Detections of tracks and wildlife were identified where possible and recorded.

The winter tracking surveys completed at Mount Davidson in 2011 concluded that wildlife and winter wildlife habitat values were considered moderate and the area did not appear to provide any high-value or high-use wintering habitat for ungulates, including moose. However, use may be determined by annual snow levels and availability of food each year. The moderate rating was based on the density of tree density, shrubs, forbs, and lichens as well as on depth of snow pack, canopy closure, and availability of wintering habitats. Highest use of ungulates observed was by moose in the lower elevation pine habitat types and cutblocks and along riparian corridors within the TERSA.

Moose sign in the form of scat, beds, rub, and browse were recorded during other wildlife surveys throughout the Mine Site and TELSA. Moose use was recorded in a number of locations along the Davidson Creek corridor. Both winter and summer browse sign of this ungulate was recorded in 25% of the TEM plots that occurred within the Mine site TELSA and TERSA. A moose lick recorded within the Mine Site was filled in and no longer exists (AMEC 2013j).

Caribou

Woodland caribou (*R. tarandus caribou*) of the Tweedsmuir-Entiako population are part of the Southern Mountain Population and are designated as red-listed in BC (BC CDC 2015), as Endangered by COSEWIC and as Threatened under Schedule 1 of SARA (COSEWIC 2014). The Tweedsmuir-Entiako herd consists of approximately 500 animals, which typically spends the summer in high elevation areas and migrates into forested lower elevations for the winter (Cichowski and Banner 1993).

Caribou eat a wide variety of plant species including graminoids, forbs, mosses, fungi, shrubs, and lichens. Consumption of conifers is believed to be incidental (Rominger and Oldemeyer 1990). Bergerud (1972) reported caribou food preferences were for greens in the growing season, fungi in

summer and fall, and lichens in fall. Lichens become increasingly important in winter due to their abundance, accessibility, and high digestibility provided sufficient nitrogen is available in the rumen (D. C. Thomas and Kroeger 1981; D. C. Thomas, Kroeger, and Hervieux 1984).

To reduce predation levels on calves during parturition, northern caribou disperse widely throughout rugged, exposed terrain above the treeline. Many caribou calve at higher elevations in alpine or subalpine habitat (Yaremko and Sulyma 2005); however, in the northern portion of Tweedsmuir Provincial Park only 30% of the breeding caribou were found above the treeline and 50% were found at low elevations (Cichowski 1985). They also use this dispersal strategy in forested habitats (Bergerud, Butler, and Miller 1984; Hatler 1986; Cichowski 1993). However, calf survival rates have been found to be higher in rugged, mountainous terrain where the cows and calves can distance themselves from other prey species and predators (Seip and Cichowski 1996).

The Tweedsmuir-Entiako herd consists of approximately 500 animals, although recent estimates are as low as 200 animals which typically spend the summer in high elevation areas and migrate into forested lower elevations for the winter (Cichowski and Banner 1993). Caribou are sensitive to human disturbance and development and have been shown to avoid areas up to 4 km and suffer from disruptions in behaviour and habitat use up to 6 km from a mine site (Weir et al. 2007).

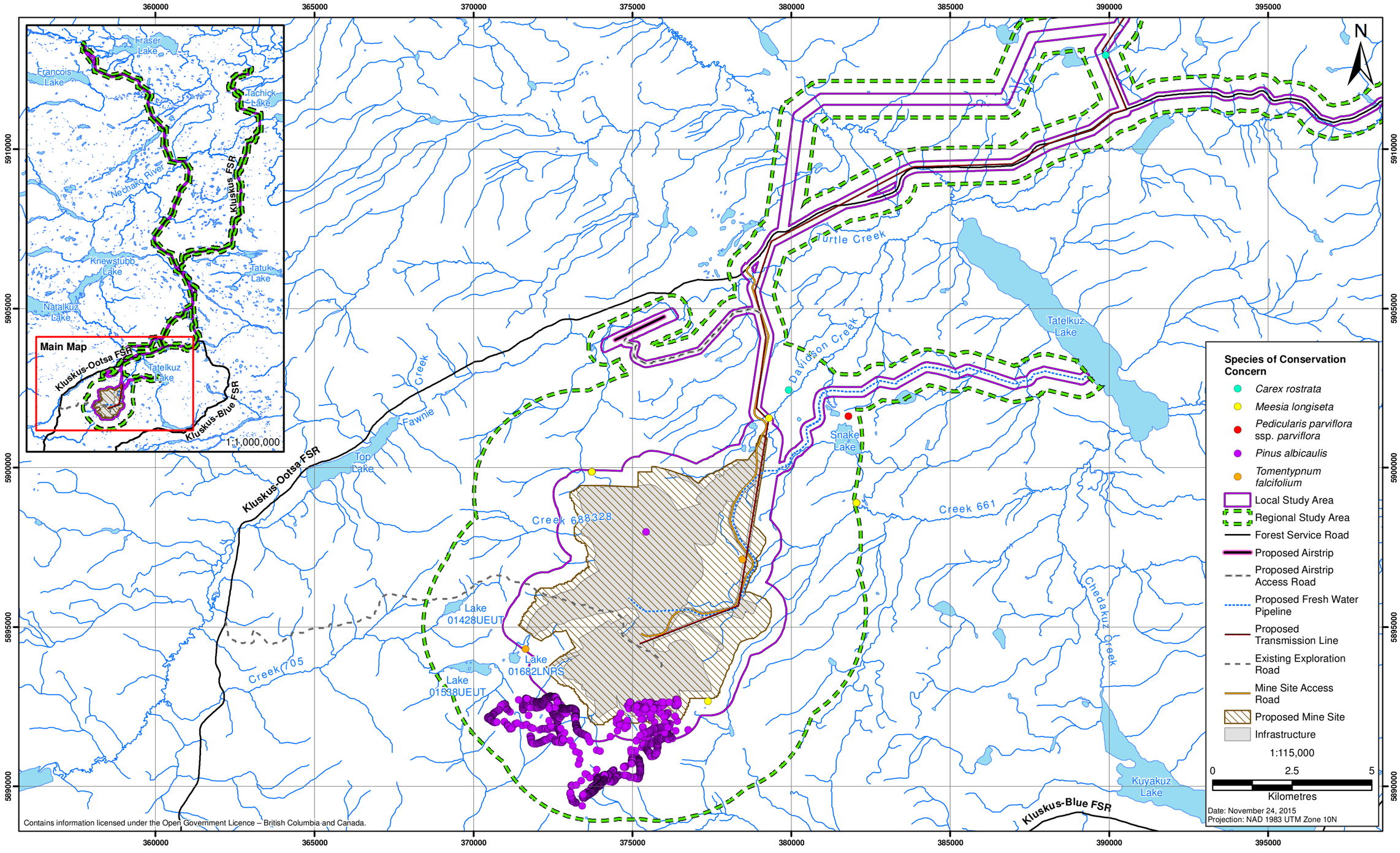
A baseline dataset on the Tweedsmuir-Entiako caribou subpopulation was initiated in the mid-1980s. Habitats and movements of the caribou herd by Marshall (1984) and Simpson et al. (1987) were monitored from 1982 to 1984. Cichowski (1985) followed the herd from 1985 to 1988. Recent historical field work on the Tweedsmuir-Entiako herd occurred from 2006 to 2009, and studies have looked at the effects of the mountain pine beetle on the distribution of the caribou (Cichowski 2010). It was determined that seasonal range movements, range use, and habitat of the caribou herd were similar to that recorded prior to the epidemic. The herd uses the Entiako Provincial Park during winter and moves to Tweedsmuir Provincial Park for the summer.

Caribou scat has been identified within or near the Mine Site. Caribou may use the area as part of their wintering habitat during high snowpack years. No caribou were observed in the during baseline surveys; however, scat was found at eight locations within or near the Mine Site TELSA, twice along the Davidson Creek corridor, and once in the subalpine of Mount Davidson. Caribou use of the Mine Site is likely confined to incidental late spring, summer, and fall use for foraging and travel to and from wintering grounds (AMEC 2013j).

#### *1.4.1.10 Aquatic Life and Habitat*

Activities associated with construction, operation, and closure of the tailings and waste rock facilities can cause alterations in the water chemistry, water quality, and hydrology of streams and lakes. In turn, these changes can impact fish and other aquatic organisms, including the aquatic food web resources upon which fish depend for growth and reproduction (Vander Zanden and Vadeboncoeur 2002).

**Figure 1.4-4**
**Vegetation Local and Regional Study Areas and Locations of Identified Species of Conservation Concern**




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**Figure 1.4-5**
**Terrestrial Ecology Local and Regional Study Areas**

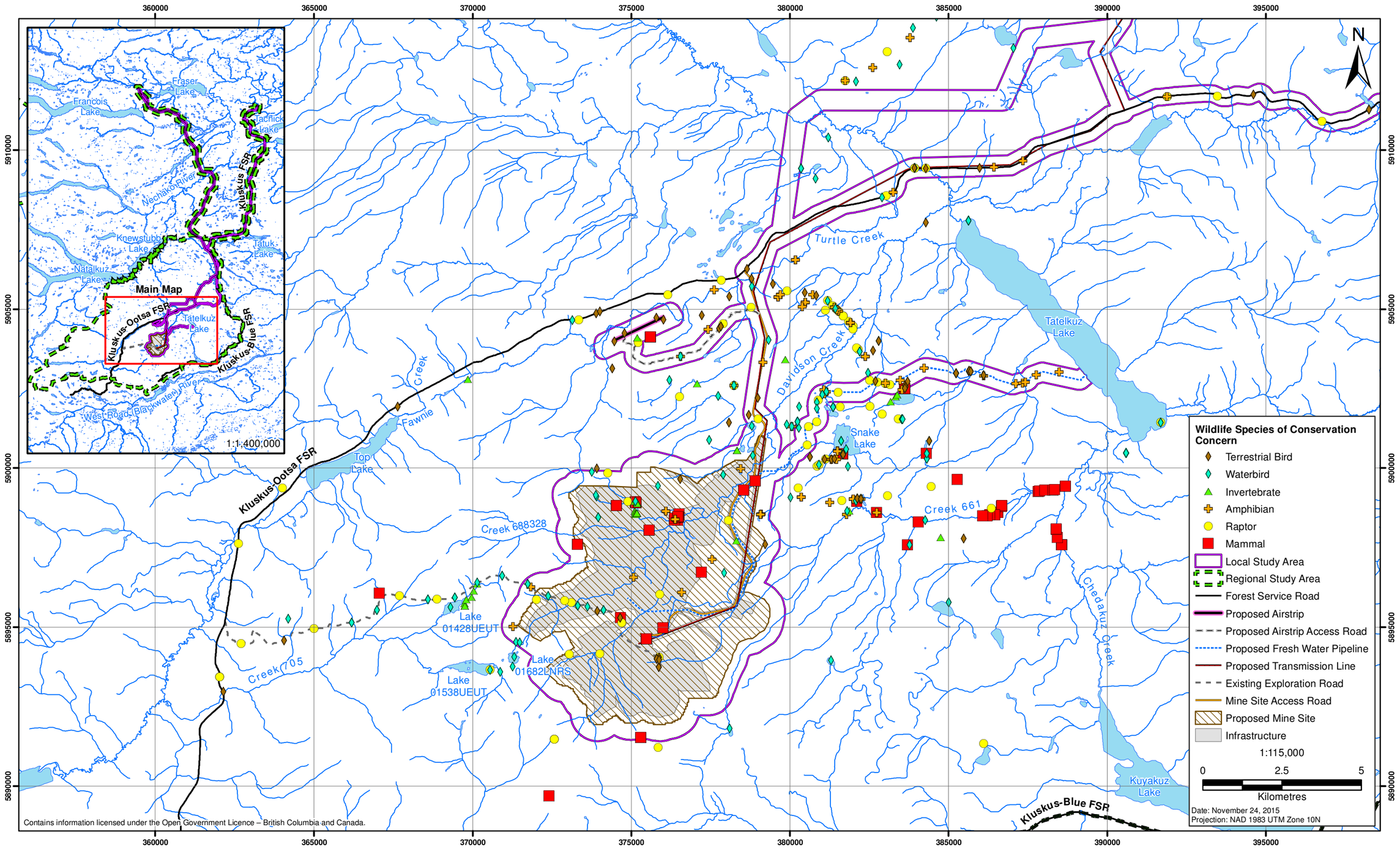


**Table 1.4-5. Wildlife Species of Conservation Concern Recorded within the Project Mine Site Terrestrial Ecology Local and Regional Study Areas**

| Species | Status | | |
|---|---|---|---|
| | COSEWIC | SARA | Provincial |
| Western toad (*Anaxyrus boreas*) | Special Concern | Special Concern, Schedule 1 | Blue |
| Olive-sided flycatcher (*Contopus cooperi*) | Threatened | Threatened, Schedule 1 | Blue |
| Common nighthawk (*Chordeiles minor*) | Threatened | Threatened, Schedule 1 | Yellow |
| Short-eared owl (*Asio flammeus*) | Special Concern | Special Concern, Schedule 1 | Blue |
| Rusty blackbird (*Euphagus carolinus*) | Special Concern | Special Concern, Schedule 1 | Blue |
| Long-billed curlew (*Numenium americanus*) | Special Concern | Special Concern, Schedule 1 | Blue |
| Yellow Rail (*Coturnicops noveboracensis*) | Special Concern | Special Concern, Schedule 1 | Red |
| Barn swallow (*Hirundo rustica*) | Threatened | Not listed | Blue |
| Horned grebe (*Podiceps auritus*) | Special Concern | Not listed | Yellow |
| Sharp-tailed grouse columbianus subspecies (*Tympanuchus phasianellus columbianus*) | Not listed | Not listed | Blue |
| Peregrine falcon (*Falco peregrinus*) | Special Concern | Not listed | No status |
| Western screech owl (*Megascops kennicottii kennicottii*) | Threatened | Special Concern, Schedule 1 | Blue |
| Lewis's woodpecker (*Melanerpes lewis*) | Threatened | Threatened, Schedule 1 | Red |
| American bittern (*Botaurus lentiginosus*) | Not listed | Not listed | Blue |
| American golden-plover (*Pluvailis dominica*) | Not listed | Not listed | Blue |
| California gull (*Larus californicus*) | Not listed | Not listed | Blue |
| Caspian tern (*Hydroprogne caspia*) | Not listed | Not listed | Blue |
| Wolverine (*Gulo gulo luscus*) | Special Concern | Not listed | Blue |
| Grizzly bear western population (*Ursus arctos*) | Special Concern | Not listed | Blue |
| Fisher (*Pekania pennanti*) | Not listed | Not listed | Blue |
| Woodland caribou (Northern Mountain population) (*Rangifer tarandus caribou*) | Threatened | Special Concern, Schedule 1 | Blue |
| Woodland caribou (Southern Mountain population) (*Rangifer tarandus caribou*) | Threatened | Threatened, Schedule 1 | Red |
| Little brown myotis (*Myotis lucifugus*) | Endangered | Not listed | Yellow |
| Northern myotis *(Mytois septentrionalis*) | Endangered | Not listed | Blue |
| Hagen's bluet (*Enallagma hageni*) | Not listed | Not listed | Blue |
| Beaverpond baskettail (*Epitheca canis*) | Not listed | Not listed | Blue |
| Quebec emerald (*Somatochlora brevicincta*) | Not listed | Not listed | Blue |
| Forcipate emerald (*Somatochlora forcipata*) | Not listed | Not listed | Blue |
| Kennedy's emerald (*Somatochlora kennedyi*) | Not listed | Not listed | Blue |
| Assiniboine skipper (*Hesperia assiniboia*) | Not listed | Not listed | Red |
| Checkered skipper (*Pyrgus communis*) | Not listed | Not listed | Blue |
| Jutta arctic (*chermocki* subspecies) (*Oeneis jutta chermocki*) | Not listed | Not listed | Blue |
| Northern tightcoil (*Pristiloma arcticum*) | Not listed | Not listed | Blue |
| Black-footed tightcoil (*Pristiloma chersinella*) | Not listed | Not listed | Blue |

*Notes: COSEWIC = Committee on the Status of Endangered Wildlife in Canada; SARA = Species at Risk Act (2002c); Provincial = BC provincially listed species.*

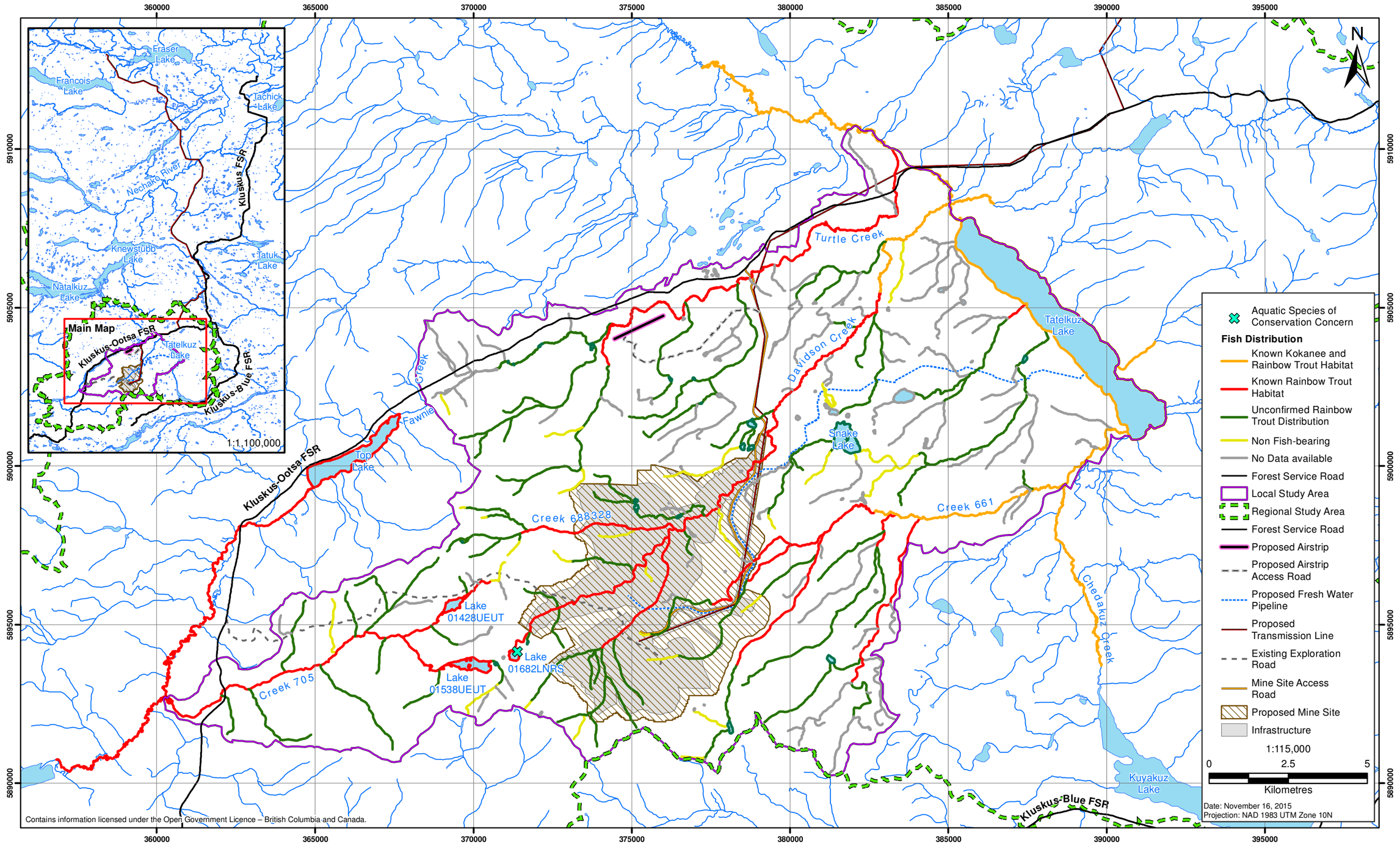
Fresh water systems in the Project area contain habitat such as riparian zones, wetlands, and stream channels that support aquatic life, including several species of fish. The key streams and lakes that have the potential to be affected by the Project include (Figure 1.4-6):

- Tatelkuz Lake;
- Lake 01682LNRS in the Davidson Creek watershed;
- Lakes 01538UEUT and 01428UEUT in the Creek 705 watershed;
- Davidson Creek, which flows into Chedakuz Creek downstream of Tatelkuz Lake;
- Chedakuz Creek immediately downstream of Tatelkuz Lake;
- Turtle Creek, an ungazetted stream that flows into Chedakuz Creek downstream of Tatelkuz Lake;
- Creek 661, an ungazetted stream that flows into Chedakuz Creek upstream of Tatelkuz Lake;
- Creek 705, an ungazetted stream that flows down the west side of Mt. Davidson into Fawnie Creek; and
- Ungazetted tributaries to the streams listed above.

Fish and aquatic life baseline studies were conducted within the Aquatics Local Study Area (ALSA) and Aquatics Regional Study Area (ARSA) specifically for the project from 2011 to 2013. One set of baseline studies focussed on fish communities and the aquatic resources that are important to fish habitat in the lakes and streams of the Project area (AMEC 2013f, 2013e). The investigated biological resources included primary and secondary producers (periphyton and macroinvertebrates in streams; phytoplankton primarily, zooplankton, and macroinvertebrates in lakes), many of which serve as important food items for fish or key trophic links sustaining the growth, reproduction, and other life processes of fish (Vander Zanden and Vadeboncoeur 2002).

A second set of baseline studies focussed on physical and chemical characteristics, water quality, and sediment quality of selected streams and three headwater lakes in the ALSA and ARSA (AMEC 2013d).

**Figure 1.4-6**
**Aquatics Local and Regional Study Areas, Fish Species Distribution, and Identified Aquatic Species of Conservation Concern**



Results of the two sets of 2011-2012 baseline studies are summarized as follows:

- **Stream temperatures:** Measured stream temperatures within the ARSA and ALSA fall below the BC MOE optimal temperature ranges (BC MOE 2001) for the full life history (i.e., spawning, rearing, over-wintering, and migration) of Rainbow Trout (*Oncorhynchus mykiss*) and Kokanee (*Oncorhynchus nerka*), the two most common fish species in the region. Hence, low temperatures rather than high temperatures limit aquatic biological processes in the ARSA and ALSA.
- **Periphyton density and biomass:** Mean periphyton density and biomass (as indexed by chlorophyll a concentration) within the ALSA both showed substantial variation among sites, but different spatial distributions. This variation was associated with differences in taxonomic composition among sites. Overall, periphyton communities tended to be dominated by diatoms and cyanobacteria. Diatoms were predominant at 10 of the 14 sites and cyanobacteria at the other four sites. The presence of motile diatoms, between 35 and 86 % of total diatoms, indicates some degree of siltation in creeks in the ALSA and ARSA. Samples collected from lower chedakuz creek (BI-06) suggest some degress of nutrient enhancement.
- **Phytoplankton:** Mean phytoplankton cell density and biomass were highest in Lake 01682LNRS (the headwater lake of Davidson Creek) and lowest in Lake 01538UEUT (one of two headwater lakes in the Creek 705 Watershed). Mean densities and biomasses were similar among depths in each of the three lakes within the ALSA and ARSA. Different taxa of Chrysophyta (i.e., golden algae and diatoms) were predominant in lakes 01428UEUT and 01538UEUT and in the surface and deep samples from Lake 01682LNRS. In contrast, Cryophyta was the predominant taxon of phytoplankton below the thermocline of Lake 01682LNRS. Green algae (Chlorophyta) were present in all of the lakes, but never made up more than 29% of total the total number of cells in a sample. Chlorophyta are often preferred food for higher aquatic organisms that feed on plankton, and heavy phytoplankton grazing may be one reason for its lack of numerical dominance in the Project area. Blue-green algae (cyanobacteria) were not abundant in any of the samples, and dinoflagellates and euglenoids were uncommon to rare.
- **Zooplankton:** Mean zooplankton density and biomass were highest in Lake 01428UEUT and lowest in Lake 01682LNRS. Both density and biomass were similar between Lake 01538UEUT and Lake 01682LNRS. Lake 01428UEUT has the lowest mean Secchi depth (3.5 m; i.e., highest turbidity), followed by Lake 01538UEUT (4.8 m) and Lake 01682LNRS (5.6 m). This suggests that zooplankton abundance in these headwater lakes is driven by lake morphometry and transparency. Rotifers were the predominant zooplankters by density in all three lakes.
- **Benthics macroinvertebrates (BMI): During BMI sampling 115 samples were collected and analysed** from across the ALSA and ARSA and characteristed inter and intra site variation as well as interannual variation in the BMI community. For streams, among-site variation is most pronounced, followed by interannual variation, while within-site variation is lowest. The BMI communities within the ALSA and ARSA closely reflect site conditions related to altitude, productivity (i.e., periphyton density and biomass), stream size, and the amount of silt in the stream. While a number of sites had a replicate sample suggesting

some form of impariment, BI-06 in lower chedakuz was the only site that was divergent from a reference condition, as determined through BEAST (Benthic Assessment of Sediment) analysis. Over half the sample sites had similar BMI communities suggesting suitability for future monitoring.

- **Fish and fish habitat**: Surveys of stream fish habitat were conducted to identify, characterize, and quantify the available habitat for fish within the ALSA, and at stream crossings along the transmission line and road access corridors. This revealed a habitat distribution pattern typical of the central BC interior—steep, sub-alpine headwaters of naturally poor quality fish habitat, in general, draining to lower gradient reaches of higher quality habitat that flow into large, overwintering lakes (e.g., Tatelkuz Lake). No major fish barriers were identified during the surveys (some partial impediments were identified, e.g. steep cascades), with fish habitat widely distributed and access available into headwater drainages within the ALSA and affected drainages.

Streams in the samples in the LSA are typically 5 m in channel width, low gradient (1.5 %), shallow (0.3 m wetted depth) with riffle and glide dominant with few pools (16 %). Within the ALSA the Davidson Creek watershed has the most stream length and fish habitat area, notwithstanding only portions of Chedakuz Creek are within the ALSA. Subsequently it provides the most habitat of all watersheds for spawning and juvenile rainbow trout (approximately 30% within the ALSA) but no adult foraging. However, it only provides 8% of the suitable habitat for Kokanee spawning and incubation, whereas lower Chedakuz Creek provides about 65%. The quality of overwintering habitat for fish was assessed at 25 stream sites and in three headwater lakes in 2012 and 2013. Sites in the lower reaches of streams tended to have good overwintering habitat (e.g., Davidson Creek mainstem and a ponded section of Turtle Creek) but other sites at higher elevations were rated as poor (e.g., surveyed headwater sites in Davidson Creek and Turtle Creek). The lake surveys revealed that overwintering fish habitat in Lake 01682LNRS is poor quality below 4.0 m due to the presence of low DO concentrations, yet the quality improves at shallower depths. Snake Lake offers poor overwintering habitat owing to its shallow depth and low DO concentrations. In contrast, overwintering habitat in Lake 01538UEUT is good at all depths. Two years of sampling show that there is a range of overwintering habitat quality in streams and lakes in the ALSA, and that the quality of overwintering habitat at most sites varies between years.

Twelve species of fish were captured in the ALSA, including Kokanee (*Oncorhynchus nerka*), Rainbow Trout (*Oncorhynchus mykiss*), Lake Chub (*Couesius plumbeus*), Longnose Sucker (*Catostomus catostomus*), Brassy Minnow (*Hybognathus hankinsoni*), Mountain Whitefish (*Prosopium williamsoni*), Burbot (*Lota lota*), Longnose Dace (*Rhinichthyes cataractae*), Slimy Sculpin (*Cottus cognatus*), Northern Pikeminnow (*Ptycheilus oregonensis*), Largescale Sucker (*Catostomus macrocheilus*), and White Sucker (*Catostomus commersonii*).

Fish species distribution is highest further down watersheds. Rainbow trout are the most widely distributed species with Kokanee typically closer to rearing lakes and lower in the watersheds in the ALSA e.g., lower Davidson Creek, mid-lower Creek 661. No kokanee we observed or captured in the Fawnie Creek watershed whereas longnose sucker was absent from stream on the north side of Mt. Davidson i.e., Turtle, Davidson and 661 creeks. Approximately 775,000 fish were enumerated in

Tatelkuz Lake but accoustic methods supported by calibration by fishing. Of these, approximately 80 % were kokanee and 15 % rainbow trout.

Of federal aquatic species at risk only two species were captures in the vicinity of the Blackwater deposit and tailings area; the Brassy Minnow and the Rocky Mountain Capshell. The Brassy Minnow (Pacific Group) is a blue-listed species in BC and is classified as sensitive or vulnerable (BC CDC 2015) and was captured in Tatelkuz Lake and along the transmission line corridor. The Rocky Mountain Capshell is also provincially bluelisted and being a bivalve was collected in 1 sample from Lake 16 at the top of the Davidson Creek watershed. Blue-listed taxa are at risk, but are not extirpated, endangered or threatened. Both species are not ranked by the COSEWIC or listed under SARA. These species have not been identified in the Project's Section 79(1) notice under *SARA*.

Kokanee and Rainbow Trout were the most common species counted, however, once fish distribution was determined sampling methods targeted these species. Data on the geographic distribution of fish in the study area are summarized in Figure 1.4-6. For the purposes of this assessment it is assumed fish are present the areas where fish presence/absence hasn not been assessed.

Different populations of Kokanee and Rainbow Trout were identified on the basis of four factors: genetic relatedness; proximity to overwintering habitat; location of partial impediment to fish migration; and geograhic disribution, including that of young-of-the year fish, which indicates spawning areas. The Project area contains three populations of Kokanee: one population inhabits Kuyakuz Lake and spawns in tributaries of the lake and the main channel of Chedakuz Creek downstream from the lake (Figure 1.4-6); two populations inhabit Tatelkuz Lake, one spawning in August in one set of creeks and the other spawning in September in a different set of creeks (AMEC 2013c, 2013f). Whereas immature Kokanee are mainly found in lakes, Rainbow Trout are the predominant species in streams of the Project area. Seven possibly distinct populations of Rainbow Troutwere proposed in the baseline studies, however, they are all closurely related (AMEC 2013c, 2013f): one population from the lower reaches of Davidson Creek near Tatelkuz Lake; one population from the headwater reaches of Davidson Creek; one population each in Turtle Creek and Creek 661; and three populations in Creek 705. During the baseline surveys, Rainbow Trout were also found in Tatelkuz Lake, the headwater lake of Davidson Creek (Lake 01682LNRS), and the two headwater lakes of Creek 705 (Lake 01538UEUT and Lake 01428UEUT; Figure 1.4-6). Rainbow Trout do not inhabit Snake Lake owing to a low concentration of dissolved oxygen in winter and poor surface drainage connectivity.

#### *1.4.1.11 Wetlands*

Wetlands and associated ecosystems are characterized and considered in the tailings and waste rock managment alternatives assessment process. In particular, the loss of wetland habitat/ecosystems and the presence of rare and endangered plants/wildlife associated with the wetlands are significant factors that are considered in the candidate alternative selection process.

As part of wetland mapping and classification for the Project, 127 wetland-related field surveys within the wetland local study area (WLSA) and wetland regional study area (WRSA) were completed in 2011 and 2012. Wetland resources comprised approximately 3,333 ha (12% by area) of the WLSA (AMEC 2013i). Approximately 453 ha (14% by area) of the mine site footprint were

classified as wetlands with the most common wetland class identified as swamps (approximately 11%; Figure 1.4-7).

Twenty-one distinct wetland ecosystems were classified within the WRSA. Of the 21 wetland types encountered within the WRSA, 11 are listed as threatened (red-listed) or of special concern (blue-listed) in BC, with six (blue-listed) identified within the mine site footprint (representing 2.3% of the mine site footprint; AMEC 2013b). A Wetland Compensation Plan will be required for threatened or special-concern wetlands affected by the Project.

### 1.4.2 Human Environment Setting

Project components are situated in both the Cariboo and Bulkley Nechako Regional Districts. The mine site components at the mine site (including open pit, ore processing facilities, tailings storage facility (TSF), waste rock dumps, water management facilities, borrow sites, offices, workforce accommodation camps, warehouses and mechanical repair shop), the mine access road, air strip, freshwater supply system (FSS), freshwater pipeline and portions of the transmission line are located wihin the Cariboo Regional District (CRD). The northern portion of the proposed 140 km transmission line passes through the Bulkley Nechako Regional District (BNRD).

There is one ranch within a 20 km radius of the mine site: Mills Ranch at Tatelkuz Lake. The communities nearest to the Project are dependent on forestry and the public sector for income and employment, with less reliance on mining and agriculture. Prince George is the regional hub with air service from major centres.

The construction, operation and closure of the Project's tailings and waste rock storage facilities have the potential to affect the socio-economic environment, including the use of Crown tenures. These activities may also interfere with heritage sites, including sites of archaeological, historical, and paleontological significance.

The Project and its components extend through areas accessed by commercial interests, the public, and Aboriginal groups. The Project has been designed to avoid private land and, through consultation with stakeholders, the Project footprint has been modified to minimize effects on range, guide outfitter, and trapping tenures. The mine site area does not cross or overlap any federal or provincial parks, protected areas or Agricultural Land Reserves.

The transmission line and the Kluskus FSR extend from the mine site to Highway 16 (Yellowhead Highway), which connects more populated areas, including Vanderhoof and Fraser Lake. Vanderhoof is a district municipality with a population of approximately 4,500 residents (Figure 1.4-8). The major industries are lumber and agriculture. Community facilities include schools,health centre, Royal Canadian Mounted Police (RCMP) detachment, and fire hall. Vanderhoof also provides regional services for smaller rural communities nearby.

The village of Fraser Lake between Burns Lake and Vanderhoof along the Yellowhead Highway has approximately 1,300 residents. Fraser Lake is close to the Endako mine, which suspended operation in December 2014 due to weak molybdenum prices. Forestry is the main industry is the area. Community services include a school, health centre, RCMP detachment, and fire hall.

#### *1.4.2.1 Parks and Protected Areas*

There are no National Historic Sites, Marine Conservation Areas, Wildlife Areas, or migratory bird sanctuaries in the vicinity of the proposed mine site, nor any overlap with national and provincial parks or protected areas. Entiako Provincial Park is located approximately 26 km northwest of the mine site (Figure 1.4-8).

#### *1.4.2.2 Non-Traditional Land Use*

The Vanderhoof Land and Resource Management Plan (Vanderhoof LRMP) was approved by the BC government in 1997 (Minister of Forests 1997). The LRMP covers 1.38 million ha of Crown land and includes provisions relating to commercial and recreational access and uses. The Vanderhoof LRMP establishes several Resource Management Zones (RMZs). The mine site footprint is located mostly in the Davidson Creek RMZ 17, which is designated as "Resource Development Emphasis", and borders on Multi-value Emphasis Zones (AMEC 2013g). The intent of the Davidson RMZ 17 is to: balance resource development with wildlife, Aboriginal, and recreational values through appropriate access management; limit access to the whole area south of the Kluskus-Ootsa FSR (which is associated with resource development); and manage the northwest zone to restrict access and provide a buffer for critical caribou winter range that lies further west (Minister of Forests 1997).

There are four guide outfitting tenures in the general Project area; certificate No601039 overlaps the Blackwater deposit (Figure 1.4-9). There are five registered traplines in the general Project area; TR0512T027 overlaps the Blackwater deposit (Figure 1.4-9).

Four range tenures occur in the Project area, although none of them overlap the Blackwater deposit (Figure 1.4-10). The recreational sensitivity and significance has also been classified for the general project area; although the Blackwater deposit occurs within an area of unclassified recreational sensitivity and significance. The area immediately to the south of the deposit is classified as having moderate sensitivity and high significance for recreation (Figure 1.4-10).

**Figure 1.4-7**
**Wetlands Mine Site, Local, and Regional Study Areas and Wetlands Resources**

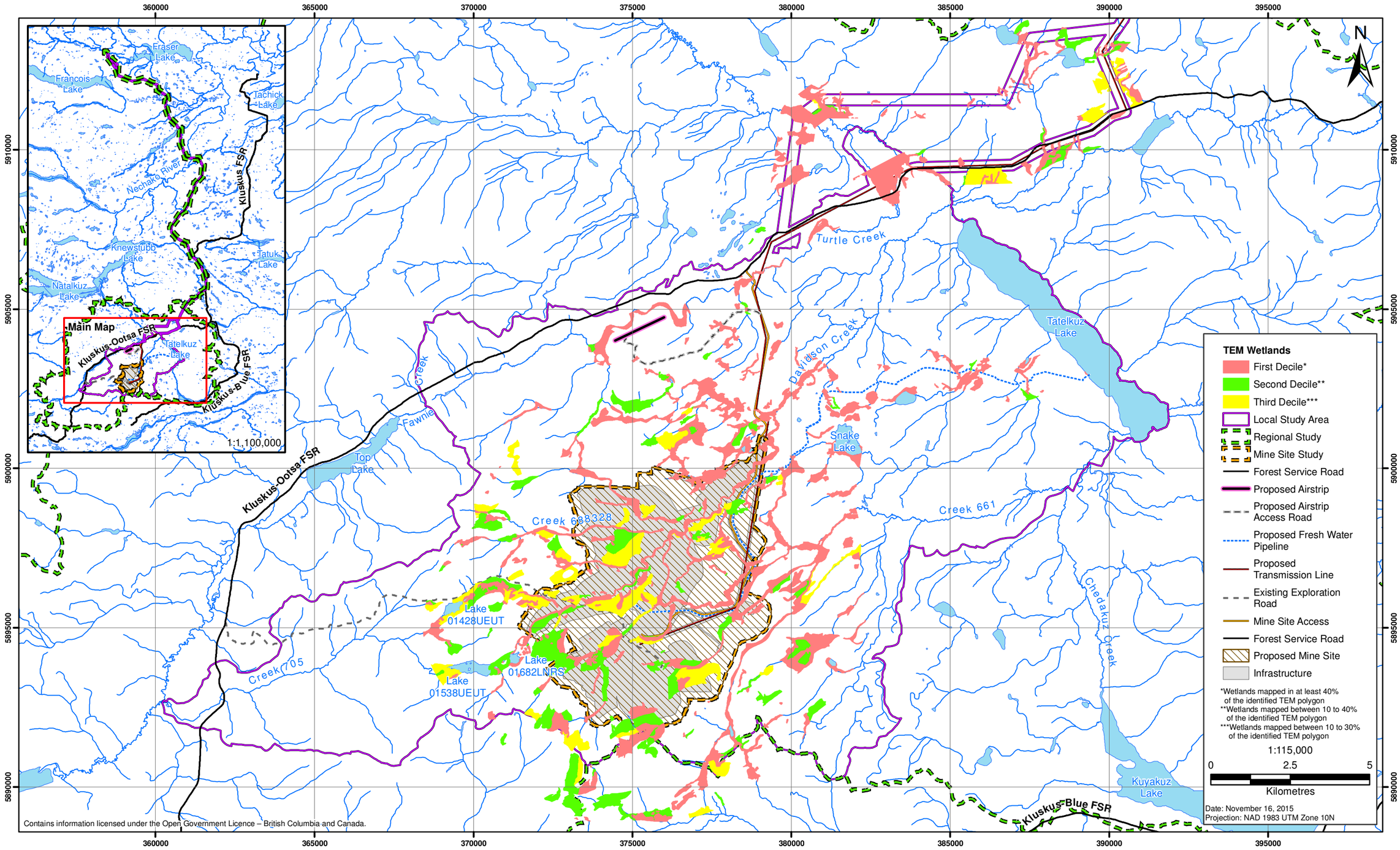


**Figure 1.4-8**

**Parks and Protected Areas**

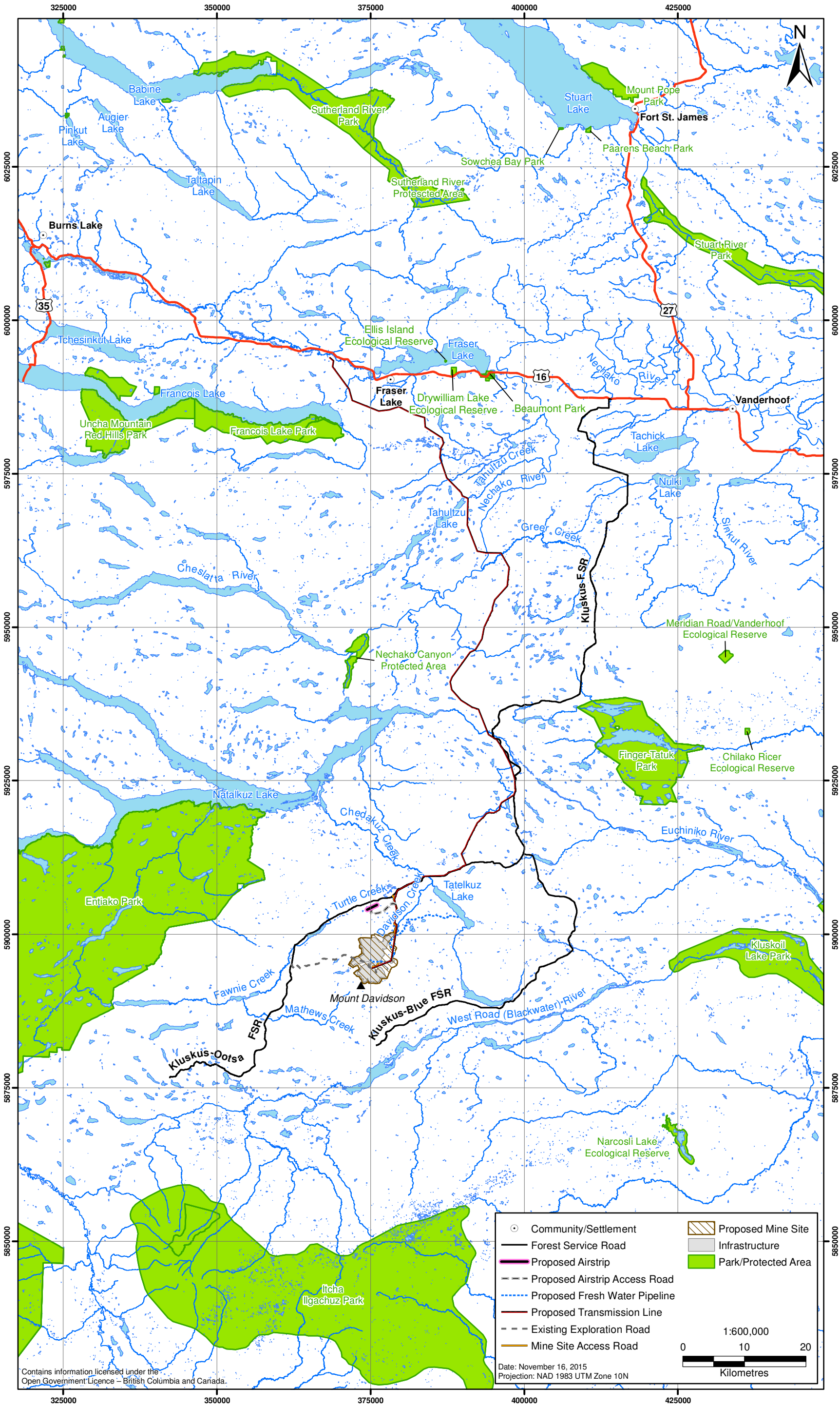


**Figure 1.4-9**
**Guide Outfitter and Trapline Tenures**

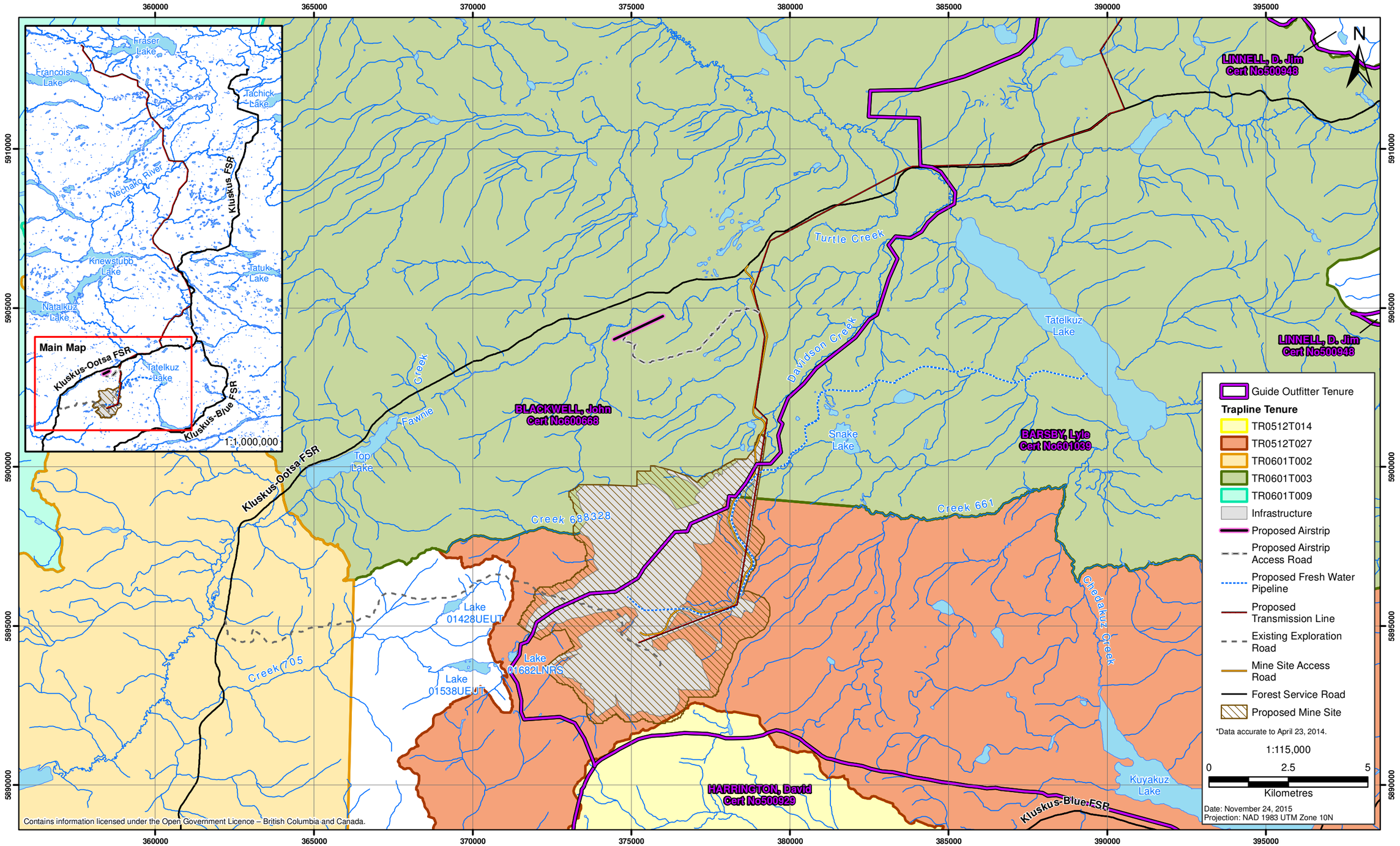
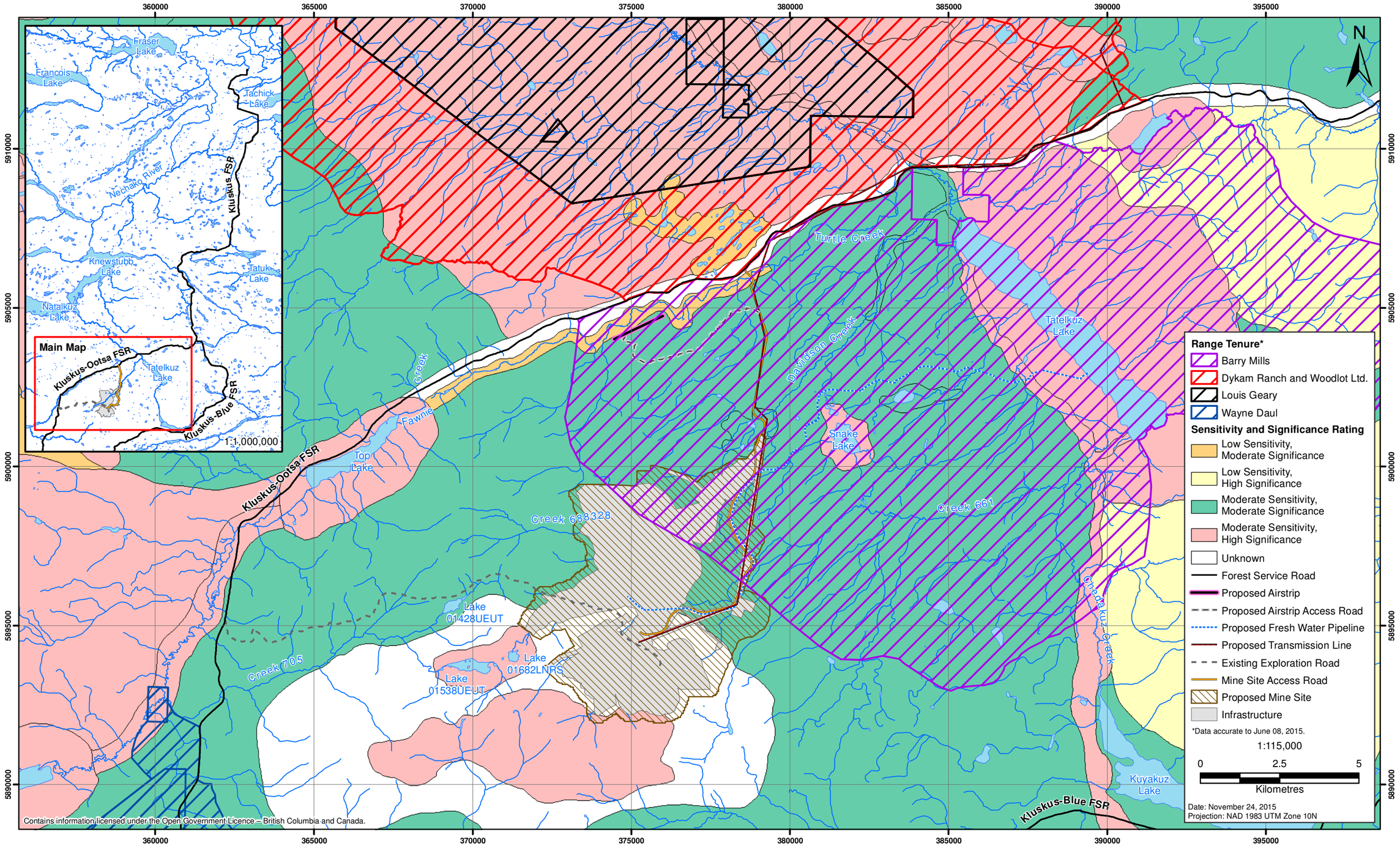


**Figure 1.4-10**
**Range Tenues and Recreational Sensitivity and Significance Ratings**



#### *1.4.2.3 Heritage*

An archaeological impact assessment (AIA) was conducted for the Project under *Heritage Conservation Act* (*HCA;* 1996b) Heritage Inspection Permit 2012-0295; the findings of the AIA are provided in the Archaeology 2013 Baseline Report (Appendix 8.1A of the Application/EIS). In addition, a paleontological assessment was conducted for the Project, the results of which have also been summarized in Appendix 8.1A).

The AIA of the mine site footprint included a total of 1,423 subsurface tests within 77 areas identified as having moderate or high archaeological potential. Subsurface testing and pedestrian surveys identified three prehistoric archaeological sites: FhSe-73, FhSe-74, and FhSf-4. Site FhSe-73 consists of an isolated artifact (a chalcedony flake) and a cache pit, FhSe 74 consists of an artifact scatter of dacite and obsidian flakes and shatter, and FhSf-4 consists of a single chert scraping tool. Historic features, including the remains of a historic cabin, 73 blazed trees, and eight culturally modified trees post-dating 1846 AD were also observed; these features are not protected by the *HCA*. No paleontological sites were identified within the mine site.

### 1.4.3 Aboriginal Setting

The Mine Site's Aboriginal Setting is provided in Figure 1.4-11.

#### *1.4.3.1 Lhoosk'uz Dene Nation*

Lhoosk'uz Dene Nation (LDN) is affiliated with the Carrier-Chilcotin Tribal Council (CCTC). The main LDN community is Kluskus Village (IR #1), located 173 km west of Quesnel, BC. The Band office is located in Quesnel, BC.

LDN completed a traditional land use study (TLUS) in September 2013 although the data are not available to include in this report for confidentiality reasons. LDN also reviewed the Application/EIS; the information used in this assessment is derived from both the TLUS and the Application/EIS. However, the report was reviewed for potential inclusion in this analysis which indicated typical LDN land and resource patterns of use in areas adjacent to the Project including major waterbodies (e.g., Tatelkuz Lake, Chedakuz Creek and to the immediate south and east of the peak of Mt. Davidson to and along the Blackwater River). The Proponent has committed to integrate TLU information into the final project design, execution, management plan development, permitting and monitoring, as available and appropriate.

Historically, the LDN territories were owned by four primary descent family groups (*sadeku*). The territories were split into four family Keyoh that were the exclusive traditional use areas that sustained each family under the direction of the most senior family male (*detso*). The Keyoh were used for all traditional use activities, including hunting, trapping, fishing, and plant harvesting.

LDN harvest moose, deer, beaver, duck, bear, marten grouse and smaller animals within their traditional territory. Caribou is also hunted, but accessing caribou range is more costly, so fewer LDN participate in this hunt. LDN has identified that hunting occurs on the south side and summit of Mount Davidson, and near Chedakuz Creek and Tatelkuz Lake. One provincially registered

trapline (TR0512T027) held by LDN members is overlapped by the Project area, including the mind site, access road, and portions of the freshwater supply pipeline and transmission line. Based on an interview with the holder of trapline TR0512T027, the line has not been used for 20 years. LDN-held trapline TR0512T014 is adjacent to the Project area and is currently used.

LDN fish for trout, kokanee, and suckers in Tatelkuz Lake, as well as for kokanee in Davidson Creek. They noted that Tatelkuz Lake is a preferred location to fish for trout. Other fishing locations include Kuyakuz Lake, Chedakuz Creek, the Twin Lakes (location unknown), and a little creek (not named) near km 104 of the Kluskus Forestry Service Road (FSR). LDN typically eat fish with three to four meals per week.

Plants and berries gathered by LDN include soapberries, spruce pitch and tips, pine, willow (green and red), wild celery, wild onion, wild mushrooms, strawberry runners and strawberries, blueberries, raspberries, Saskatoon berries, cranberries, kinnikinnick, Oregon grape, bear berries (used as eye medicine), poplar bark, and poplar buds (Indigenous Work Force 2013). LDN pick plants around Tatelkuz Lake and towards the river to the east of Tatelkuz Lake. Plant gathering is also conducted along trails, including the Messue Wagon Trail. Interviewees noted that sometimes balsam and spruce bark are harvested near Vanderhoof (outside of the RSA and LSA) for flu medicine (LDN Elders pers. comm.).

LDN have identified Kuyakuz Mountain and an area on the northeast shore of Tatelkuz Lake as sacred locations (Andrew Leach & Associates 2008). Both sites are areas where ceremonial activities may occur. The east end of Tatelkuz Lake was traditionally used for cremation of family members, and LDN use the site for praying. LDN use historic trails, including the Messue Wagon Trail that connects IR #28 to the Knewstubb Lake in the north and the West Road (Blackwater River)/Alexander Mackenzie (Grease) Trail and the West Road/Blackwater River in the south. Canoeing and boating were popular activities on Tatelkuz Lake (LDN Elders pers. comm). LDN have indicated that LDN residents at Tatelkuz Lake IR #28 source drinking water from Davidson Creek.

Based on consultation and engagement activities with LDN, the Proponent has gained an understanding of LDN Aboriginal rights and interests related to the Project, which are presented in the EA Application (New Gold 2015, Chapter 15; Table 1.4-6). Consultation reports, which summarize consultations undertaken with LDN by New Gold, and issues raised by LDN and the Proponent responses to the issues, was sent to LDN in April 2014 and November 2014, for review and comment. No comments were provided by the LDN on these reports. Based on consultations undertaken during the pre-Application stage of the EA process, LDN has expressed concerns about the potential effects of the Project on downstream water quality and effects on water users, and fish and fish habitat in Tatelkuz Lake, Tascha Lake, Davidson Creek and Nechako Reservoir (New Gold 2015, Chapter 17).

These issues have been included and evaluating in this assessment through the pre-screening criterion that no waste storage (tailings and PAG/NAG3 waste rock) candidate overlap a fish-bearing lake; the evaluation of environmental hazards (primarily related to water quality from ML/ARD) within the high level risk assessment; and the evaluation of candidate's impacts to water quality and quantity, fish and fish habitat, wildlife and wildlife habitat, heritage, registered traplines, and LDN current use of lands and resources for traditional (CULRTP) purposes within the MAA.

**Figure 1.4-11**

**Aboriginal Setting**



**Table 1.4-6. Lhoosk'uz Dene Nation Aboriginal Rights and Interests**

| Current Use | Potential Issue | Potential Environmental Effect |
|---|---|---|
| Hunting | Effects on caribou | Changes in migration patterns or habitat that may affect abundance and distribution of caribou. |
| | Effects on migratory birds and mammals that may access water in the tailings ponds | Changes in habitat or populations of trapped species that may reduce resources. |
| Trapping | Effects on registered traplines and LDN trapping areas | Potential reduction in access or availability of land for trapping. |
| Fishing | Effects on fish and fish habitat from water quality changes;<br>Effects from changes in water quality on furbearers and animals trapped for food | Changes in water quality or sediment that may affect fish populations or animals that rely on these resources. |
| | Effects on LDN fishing from the loss of fish and fish habitat | Loss of fish and fish habitat on the mine site and loss of access by fish to the headwaters of Davidson Creek and Creek 661. |
| Plant harvesting | Potential displacement and contamination of berry-picking sites | Potential loss or change in access to areas for plant harvesting and potential contamination from dust. |
| Use of cultural and traditional sites | Effects on cultural and traditional use sites | Potential disturbance or changes in access to traditional and archaeological sites. |

The LDN has expressed concern regarding potential effects on trapping (New Gold 2015, Chapter 17). In the early twentieth century the provincial government began to licence trappers and record locations and extent of traplines. Some provincially-registered traplines followed the boundaries of the Keyoh. However, provincially-registered traplines and Keyoh are not identical. Additionally, the LDN has identified potential effects to heritage sites as an issue of concern (New Gold 2015, Chapter 17).

#### *1.4.3.2 Ulkatcho First Nation*

The main Ulkatcho First Nation (UFN) community and Band office is located at Anahim Lake (also referred to as Ulkatcho Lake), which is about 350 km west of Williams Lake. Historically, the people of Ulkatcho lived on the shore of Gatcho Lake, (located approximately 150km south of the Project near Itcha Ilgachuz Provincial Park). The Ulkatcho people are a subgroup of the Carrier, and are related extensively by intermarriage to both the Nuxalk of Bella Coola and Chilcotins, and share territory with the Nuxalk.

UFN continue to participate in fishing, trapping, hunting, berry and mushroom picking, as well as plant gathering. These activities have continued for generations, as evidenced in the *Ulkatcho First Nation Traditional Land Use and Ecological Knowledge of the proposed New Gold Inc. Blackwater Project* (referred to as the UFN TK/TLU) (DM Cultural Services Ltd. 2013). The UFN TK/TLU includes an "intensity of use map" (DM Cultural Services Ltd. 2013) that documents use of the area in numbered grids. The UFN TK/TLU has been considered to build understanding of current use activities.

The UFN TK/TLU study identifies hunting and trapping activities occurring in the Project footprint area (DM Cultural Services Ltd. 2013). The TK/TLU identifies hunting along the transmission line ROW and near Tatelkuz Lake. UFN hunt and/or trap for moose, deer, and caribou, lynx, squirrel, timber wolf, rabbit, and beaver, as well as ducks and geese. Hunting and trapping areas were also identified near Kuyakuz Lake, Chedakuz Creek, Mount Davidson (referred to as *Tillie* by UFN), and near Moose Lake, as well as near Kluskus Lake. Geese and ducks are hunted along Chedakuz Creek and near Kuyakuz Lake. No traplines registered to UFN members were identified. The UFN website notes that moose and caribou (traditional sources of food and trade for the Ulkatcho people) populations have recently declined, due to increases in predatory animals such as wolves and grizzly bears.

The UFN TK/TLU study identifies Chedakuz Creek, Tatelkuz Lake, Kuyakuz Lake, Moose Lake, and Johnny Lake as areas of fishing use near the Project area. There is a UFN fish camp at the north end of Kuyakuz Lake. Species fished include suckers, lingcod, and trout. Steelhead and salmon are also taken, likely in the Blackwater River watershed as these species have not been recorded in the streams and lakes of the aquatic local study area.

The UFN TK/TLU study indicates UFN members pick berries (e.g., raspberries and blueberries), mushrooms and food other plants (wild celery) around Tatelkuz Lake, Kuyakuz Lake, Moose Lake, Johnny Lake, and Tsacha Lake. The UFN specifically identified wild celery and blueberries as gathered around the Project area, although specific gathering locations were not provided in order to protect the gathering locations.

A trail, campsite, and a place name are identified within the Project area. The precise locations of the trail and campsite are not identified. A trail in the vicinity of Tatelkuz Lake is identified in the UFN TK/TLU study, and may refer to the Messue Wagon Trail, although it is not named in the TK/TLU study. A trail on the east side of Tatelkuz Lake is also identified, which connects with the Messue Wagon Trail. Mount Davidson, named *Tillie* by the UFN, is the location of trails and campsites considered by UFN to be sensitive either cultural or economically.

An Exploration Agreement between the Proponent and the UFN includes provisions for consultation and meeting protocols, and data confidentiality. As a result of the consultation activity initiated in 2011 (which included community meetings, written correspondence, and presentations) the Proponent has gained an understanding of UFN Aboriginal rights and interests related to the Project, which are summarized in the EA Application (New Gold 2015, Chapter 15; Table 1.10-2). The Proponent held community meetings to present Project information, the results of environmental studies, and to obtain concerns or issues with respect to Aboriginal interests and rights. At these meetings, UFN confirmed the importance of protecting confidential information in UFN reports provided to the Proponent. Consultation reports, which summarize consultations undertaken with UFN by New Gold, issues raised by UFN, and the Proponent responses to the issues were sent to UFN in April 2014 and November 2014 for review and comment. No comments were provided by the UFN on these reports.

The UFN have expressed concerns about the potential effects of the Project on mountain caribou and the designated ungulate winter range (UWR) and the consequent impact on their right to hunt (UWR; New Gold 2015, Chapter 17). Table 1.4-7 provides additional detail with respect to issues and

concerns raised during consultation with UFN related to potential effects of the Project on UFN Aboriginal rights and interests. Table 15.6-2 of the Application/EIS (New Gold 2015) identifies potential effects on UFN Aboriginal rights and interests and proposed measures to mitigate effects. These issues have been included and evaluated in this assessment through the pre-screening criterion that no waste storage (tailings and PAG/NAG3 waste rock) candidate overlap a fish-bearing lake; the evaluation of environmental hazards (primarily related to water quality from ML/ARD) within the high level risk assessment; and the evaluation of candidate's impacts to water quality and quantity, fish and fish habitat, wildlife and wildlife habitat, heritage, and UFN CULRTP purposes within the MAA.

**Table 1.4-7. Ulkatcho First Nation Aboriginal Rights and Interests**

| Current Use | Potential Issue | Potential Environmental Effect |
|---|---|---|
| Hunting | Effects on caribou | Effects on caribou herds and the UWR and impacts on caribou habitat. |
| | Effects on ungulate hunting (other than caribou) | Reduction in habitat or changes in herds and ranges and increased access for non-Aboriginal hunters.. |
| Trapping | Effects on UFN trapping | Potential reduction in access or availability of land for trapping. |
| Fishing | Concerns were raised regarding changes in drainage patterns, flows and volumes of water, redirection of watercourses and waterbodies, degradation of water quality (and related effects on fish, fish habitat, potable water users, and wildlife). | Potential change in water and sediment quality.<br>Potential change in surface water flow. |
| | Concerns were raised regarding environmental damage from chemical spills or leaching. | Potential change in water and sediment quality. |
| Plant harvesting | Mushroom collection | Potential loss or change in access to areas for morel mushroom and plant harvesting. |
| Use of cultural/ traditional sites | Burial sites potentially impacted by the Project | Burial sites disturbed or destroyed by ground disturbance. |
| | Concerns regarding loss of UFN peoples' ability to practice seasonal rounds during exploration and development and of older generations to transfer traditional culture and knowledge to younger generations due to disruption of traditional rounds. | Disruption of ability to practice seasonal rounds and transfer traditional cultural knowledge to younger generations. |
| | Interest in protecting historic areas, such as CMTs and unmarked graves | Potential disturbance to historic and sacred sites. |

#### *1.4.3.3 Skin Tyee First Nation*

Skin Tyee First Nation (STN) is located in the Central Interior of BC near Francois Lake, to the west of Prince George. In 1960, the Decker Lake, Francois Lake, Maxim Lake, and Skin Tyee Bands

merged to form the Omineca Band. The Omineca Band divided into the Nee-Tahi-Buhn and Broman Lake Bands in 1984, and in 2000, the Skin Tyee Band separated from the Nee-Tahi-Buhn Band.

In September 2015, the STN provided the Proponent with the Skin Tyee First Nation Traditional Land Use Study for New Gold Inc.'s Proposed Blackwater Project (STN TLUS; DM Cultural Services Ltd. 2015a), which documents STN knowledge and use of lands and resources near the Project. TLUS includes an "intensity of use map" (DM Cultural Services Ltd. 2015a) that documents use of the area in numbered grids. The TLUS has been considered in the understanding of current use activities.

The STN TLUS identified up to six hunting areas[4] within the Project footprint, where STN hunt for bull moose, moose and deer. STN hunt moose, deer and grizzly bear within the southern area of the transmission, as well as around Davidson Creek and Chedakuz Creek. Near Tatelkuz Lake, STN hunt moose, deer and grizzly bear. Other areas for hunting include Tsacha Lake, Johnny Lake, Moose Lake, Top Lake, Laidman Lake, and Klukus Lake (DM Cultural Services Ltd. 2015b). The TLUS indicates that STN currently hunt and trap moose, deer, lynx, badger, coyote, fox, rabbit, grizzly bear, beaver and otter (DM Cultural Services Ltd. 2015). STN indicate that deer and moose are hunted in the region between Tatelkuz Lake and Laidman Lake. Regions in the western and southern shores of Tatelkuz Lake support several land use sites. No STN registered traplines were identified near the Project. It has been noted by STN that trapping is no longer a viable livelihood due to the decline of furbearers and this activity has decreased substantially (Enbridge 2010; STN representatives pers. comm.).

Secondary sources indicate that STN members fish in the Morice River and its tributaries (Enbridge 2010). STN have also identified fishing locations at Nadina River, Owen Creek and Uncha Lake. The TLUS notes that Tsacha Lake and Johnny Lake are fishing areas. No fishing areas are identified in the STN TLUS map (DM Cultural Services Ltd. 2015b).

Fish harvested by STN include, but are not limited to, bull trout, lake trout, char, Chinook, Kokanee and Coho salmon, Dolly Varden, ling cod, rainbow trout, steelhead, suckers, northern pike minnow, prickly sculpin, slimy sculpin and whitefish (DM Cultural Services Ltd. 2015). STN indicated that spring salmon are caught with nets, and that trout are caught by angling or with nets. Fish are typically preserved by drying, canning, or smoking (STN representatives pers. comm.).

The STN TLUS indicates that STN gather plants (e.g., berries and medicinal plants) around Davidson Creek and Chedakuz Creek and near Tatelkuz Lake STN gather soapberry, huckleberry, silkberry, blueberry, raspberry, strawberry, gooseberry, high bush cranberry, wild rice, wild onion, cow parsnip, black tree lichen, and rosehips (STN representatives pers. comm.; Enbridge 2010; DM Cultural Services Ltd. 2015). Plants used for medicine include birch, thistle, Labrador tea, juniper, kinnikinnick, chokecherries, devil's club, spruce gum/pitch, pine, bulrushes, Sitka alder, red alder or mountain alder, mountain ash, yarrow, bearberry or black twinberry, tamarack, fireweed, strawberry, raspberry, red willow, spruce, moss, yellow hemlock, and Indian hellebore (Enbridge 2010; DM Cultural Services Ltd. 2015). Plants used for other cultural purposes include cottonwood,

[4] The STN TLUS indicates that many of the sites overlap and may be displayed in multiple grids, therefore it is not possible to get an accurate number of recorded sites.

red willow, spruce, poplar, birch, and moss. Transportation routes are also sites of food and medicinal plant gathering.

The STN TLUS identifies sacred and gathering places as well as historic and currently used trails. The report notes that transportation routes are an intrinsic part in the trapping, hunting, and seasonal harvesting. The transportation corridors include overland routes as well as routes via rivers, lakes and creeks. The TLUS describes a transportation route between Tatelkuz Lake and Kuyakuz Lake, as well as between Johnny Lake and Fawnie Dome. The TLUS indicates that transportation routes near Tatelkuz Lake are used to access moose hunting areas in the southern part of the STN traditional territory. Other transportation routes are noted in areas around Davidson Creek. Historic tails are identified near these lakes, as well as near Kuyakuz Lake, Tatelkuz Lake, Mount Kuyakuz, and Fawnie Creek. Campsites and gathering areas are identified around Tatelkuz Lake and Mount Tatelkuz. Fishing and hunting occur near campsites and gathering locations. One culturally significant named place[5] in the southern portion of the Project footprint is noted in the STN TLUS, although the location is not included in the STN TLUS map. None of the specific locations or routes of trails, campsites, gathering areas, placenames are noted in the STN TLUS.

New Gold's approach to consultation with STN is based on their Cooperation Agreement. The Agreement describes how the parties will communicate, how information will be shared between the two parties, and provides a framework to guide the collection and use of confidential information provided by STN. The Proponent continues to provide Project information and updates on an ongoing basis and to meet with the STN to further discuss potential effects and concerns. Table 1.4-8 outlines issues and concerns raised by STN in the TLUS provided in September 2015 (DM Cultural Services 2015) related to potential effects of the Project on STN Aboriginal rights and interests.

**Table 1.4-8. Skin Tyee First Nation Aboriginal Rights and Interests**

| Current Use | Potential Issue | Potential Environmental Effect |
|---|---|---|
| All Current Use Activities | Damage and/or access restrictions to terrestrial and waterway transportation corridors | Potential change in access to terrestrial or waterway transportation corridors |
| Hunting and Trapping | Access restrictions or change in timing to access STN hunting and trapping areas within and around the Project footprint | Potential change in access to STN hunting and trapping areas |
| | Loss of quantity of harvestable resources; decrease in population of wildlife | Potential change in available wildlife |
| | Loss of quality of harvestable resources (e.g., accidents and spills; contamination of water bodies, watershed and air shed) | Potential change in quality of wildlife |
| | Disruption of critical life stages and/or critical habitat for animals (i.e., nesting, migration routes); change in species morphology over time | Potential change in life stages and/or critical habitat for wildlife |

[5] Once a space or geographic area receives a placename that is connected to a person, event, story, or legend, it is recognized within the cultural landscape of the STN (DM Cultural Services Ltd. 2015).

| Current Use | Potential Issue | Potential Environmental Effect |
|---|---|---|
| | Behavioural shift animal populations away from traditional territory | Potential change in animal behaviour resulting in fewer species within the traditional territory |
| Fishing | Access restrictions or change in timing to access STN fishing and resource harvesting areas | Potential change in access to STN fishing areas |
| | Loss of quantity of fish resources; loss of fish populations; increased fish mortality | Potential change in availability of fish resources |
| | Loss of quality of harvestable resources (e.g., accidents and spills; contamination of water bodies, watershed and air shed) | Potential change in quality of fish resources |
| | Disruption of critical life stages and/or critical habitat for fish (i.e., spawning); change in fish morphology over time | Potential change in life stages and/or critical habitat for fish |
| | Behavioural shift of fish populations away from traditional territory | Potential change in fish populations away from traditional territory |
| Gathering | Loss of quantity of harvestable resources | Potential change in quantity and quality of harvestable plants |
| | Decrease in productivity and diversity of habitats/ecosystems (i.e., wetlands, old growth forests) | Potential change in productivity and diversity of habitats/ecosystems |
| | Introduction of invasive species | Introduction of invasive species |
| | Change in soil structure, stability, composition and richness | Potential change in water and soil quality |
| | Change in species morphology over time | Potential change in ecosystems |
| Other Cultural and Traditional Land uses | Change in timing or complete loss of access to spiritual sites, habitation areas and historical sites | Potential change in access to historic, habitation and sacred sites |
| | Disturbance, damage and/or destruction of gravesites, petroglyph, CMT and areas holding placenames, resulting in the removal of a place from the traditional landscape | Potential disturbance to historic and sacred sites |
| All Current Aboriginal Use Activities | Decrease in visual quality/viewscapes | Decrease in visual quality/viewscapes |
| | Increase competition for resources with recreational users | Potential change in access that allows increase use of area by recreational users |
| | Disruption of the cultural transmission of knowledge between older and younger generations | Disruption of ability to practice seasonal rounds and transfer traditional cultural knowledge to younger generations |
| | Decreased desire to undertake traditional practices in an industrial setting | Decreased desire to undertake traditional practices in an industrial setting |

These issues have been included and evaluated in this assessment through the pre-screening criterion that no waste storage (tailings and PAG/NAG3 waste rock) candidate overlap a fish-bearing lake; the

evaluation of environmental hazards (primarily related to water quality from ML/ARD) within the high level risk assessment; and the evaluation of candidate's impacts to water quality and quantity, fish and fish habitat, wildlife and wildlife habitat, terrain and soil, terrestrial ecosystems, heritage, and STN CULRTP purposes within the MAA.

#### *1.4.3.4 Saik'uz First Nation*

The main Saik'uz First Nation (SFN) community is located on Stony Creek IR #1, located 9 kilometres (km) southeast of Vanderhoof. Clustalach IR#5 (SFN) is located approximately 1.8 km to the east of the Kluskus FSR (ERM 2015). In June 2015, the SFN provided the Proponent with the Saik'uz Traditional Land Use and Occupancy Study (TLUOS; J. Thomas 2015), which provides a "robust preliminary description of the use of the lands and resources by the SFNs' members" (J. Thomas 2015).

Traditional land use and subsistence living is of great importance to SFN members residing in the area. Members participate in hunting, fishing, and gathering (SFN Chief and Council representatives' pers. comm.; SFN member pers. comm.). Representatives noted that, for many people, participating in the traditional economy is necessary to their ability to sustain themselves.

A registered trapline (trapline TR0711T007) is associated with a larger keyoh (approximately 77 square kilometres [km²] in size), and is located near Big Bend Meadow and the Kenney Dam (Keyoh holder pers. comm). It is crossed by a portion of the proposed transmission line and part of the existing Kluskus FSR. The keyoh has been used for generations and holds special value for its owners, who refer to the keyoh as a "bank book" or a "store." The keyoh owners consider themselves as stewards with a responsibility to take care of the keyoh in a sustainable way. The keyoh provides its owners with a connection to both culture and history. A second provincially-registered trapline (TR0712T009) is held by an SFN member and the Kluskus FSR crosses through it (approximately between Nulki Peak and Nulki Lake).

SFN members hunt and trap throughout their traditional territory. Animal kill sites identified in the SFN TLUOS include moose, caribou, elk, deer, black bear, porcupine, muskrat, rabbit, beaver and lynx. Based on the map in the TLUOS, densities of moose kill sites appear to occur around and to the south of SFN reserves, as well as along waterways, including Greer Creek. The kill sites represent only a portion of the larger habitat required to maintain healthy wildlife populations (J. Thomas 2015). Grouse, geese, grebes, and ducks are also harvested, along with the eggs of these birds. SFN members do not typically hunt grizzly bears. Caribou used to be harvested but they are no longer in the area (SFN Elder pers. comm.). Animals trapped include marten, squirrel, lynx, black bear, muskrat, rabbit, fisher, wolf, coyote, and weasels. SFN members also harvest smaller animals in the keyoh, including squirrels. Saddle blankets are made from the moose hair. Interviewees noted that the moose population is being affecting by excessive hunting pressure from non-Aboriginal hunters. A SFN member noted that the hunting of calves has added additional pressure on populations. The Saik'uz TLUOS (J. Thomas 2015) notes a total of 275 trapping sites within the study area. Different species are harvested depending on the season, including beaver, mink, lynx, marten, muskrat, wolverine, rabbit, porcupine, and squirrel.

Although salmon fishing has slowed down due to poor salmon returns and regulatory limitations, salmon (particularly sockeye) continue to be a species of importance to the SFN (SFN Chief and Council representatives pers. comm.; SFN Elders pers. comm.). Elders and youth fish for spring, sockeye and pink salmon at Wedgewood and Finmoore (to the north of and outside of the project footprint). Fishing for White sturgeon in the Nechako River is also an important food source. One SFN member owns a salmon fishing camp at Wedgewood. Favoured fishing locations include Nechako River, Greer Creek, Swanson Creek, Big Bend Creek, Ormond Lake, Oona Lake, Fraser Lake and Nautley River (all to the north of and outside of the project footprint) (Cranny 1986; Carrier Sekani Tribal Council 2006; Coastal Gaslink 2014). Fishing for whitefish, trout, suckers, and char was reported to occur in and around Cluculz Lake (to the east and outside of the project footprint) in the mid-1980s (Cranny 1986).

SFN TLUOS (J. Thomas 2015) identifies additional fish species that are harvested, including Dolly Varden, kokanee, Arctic grayling, ling cod and sturgeon; the fishing locations for these species are not specified in the report. Over 1,000 fish kill sites are identified in the SFN TLUOS report (J. Thomas 2015). The Nechako River, which is crossed by the Project's proposed transmission line, is a popular river to catch spring and other types of salmon, while Kokanee are fished in a variety of lakes.

Based on the TLUOS and consultations with SFN, SFN members gather plants throughout their traditional territory. The TLUOS identifies 968 plant and wood gathering sites. An Upper Fraser Fisheries Conservation Alliance report (2009) indicates that SFN gather nuts and berries. Plant gathering is important throughout the year, especially in the spring, as a cleanse, when large amounts of greens are consumed, including nettles and fiddleheads. During the winter, stinging nettles (which are high in iron) and fresh grasses are consumed. SFN members also gather huckleberries, soapberries, strawberries, and medicinal plants such as elderberry. Indian tea is typically harvested in marshy areas, and Labrador tea is made by members. Spruce, pine, and alder are harvested. SFN have indicated that medicinal plants must be harvested from areas that are untouched, and a smudge ceremony must be held before these plants can be picked. Smudge ceremonies are used to cleanse areas of physical or cultural negative energy, and typically involve the burning of certain herbs. The smoke is rubbed or brushed over the body and/or area to be cleansed.

The SFN TLUOS report (J. Thomas 2015) identifies fixed cultural sites, including but not limited to birth sites, settlements, burial sites, death sites, gathering places, cache pits, Cottonwood-canoe sites, ceremonial sites and sacred sites. Areas near Corkscrew Road are considered to have sacred water for spiritual cleansing, as well as drinking water.

SFN members engage in medicine gathering and culture camps at Wedgewood and Finmoore – to the north and outside of the project footprint (Carrier Sekani Tribal Council 2006). A number of historic trails are located to the north of the project footprint, including a trail from Vanderhoof airport north to Stuart River Trail from Laketown IR #3 to Tatuk Lake, a trail from Nulki Lake to Bella Coola (Grease Trail), a trail from Nulki Lake to Cluculz Lake to Fort George, and a trail from Tatuk Lake to Bobtail Lake (Coastal Gaslink 2014).

The SFN TLUOS report (J. Thomas 2015) identifies the collection of earth materials at 48 sites, as well as drinking water locations.

Based on consultation and engagement activities with SFN, the Proponent has gained an understanding of SFN Aboriginal rights and interests related to the Project, which are summarized in the EA Application (New Gold 2015, Chapter 15). Consultation reports, which summarize consultations undertaken with SFN by New Gold, and issues raised by SFN and the Proponent responses to the issues, were sent to SFN in April 2014 and November 2014, for review and comment. The SFN and technical advisors have been meeting with New Gold to discuss and address their concerns with the Project. Consultation efforts with SFN to date have not identified current uses within the area of the proposed mine site.

Table 1.4-9 outlines issues and concerns based on the recommendations provided by SFN in the TLUOS (J. Thomas 2015) that relate to potential effects of the Project on SFN Aboriginal rights and interests that are relevant to this assessment (i.e., focused on the Mine Site). These issues have been included and evaluating in this assessment through the pre-screening criterion that no waste storage (tailings and PAG/NAG3 waste rock) candidate overlap a fish-bearing lake; the evaluation of environmental hazards (primarily related to water quality from ML/ARD) within the high level risk assessment; and the evaluation of candidate's impacts to water quality and quantity, fish and fish habitat, wildlife and wildlife habitat, heritage, and SFN CULRTP purposes within the MAA.

**Table 1.4-9. Saik'uz First Nation Aboriginal Rights and Interests**

| Current Use | Potential Issue | Potential Environmental Effect |
|---|---|---|
| All Current Aboriginal Uses | Concern about tailings dam breach (i.e., Mt Polley) | Potential tailings dam breach |
| | Concern about quality of drinking water | Potential change in water quality |
| Hunting and Trapping | Potential exacerbation of hunting pressures on moose as a result of increase access | Potential change in availability of moose as a result of increased access and competition in the area |
| | Potential effect on bears (especially black bears) | Potential effect on bears |
| Fishing | Concern about impact to creeks and lakes with connect fish and wildlife species | Potential change in fish quality and quantity |
| Gathering | Protect old growth forests | Potential change to ecosystem |
| | Potential contamination of food and medicinal plant gathering areas downstream of the project | Potential change in the quality of harvested plants |
| | Concern about trespassing on plant harvesting sites | Potential change in access to harvesting areas |
| Other Cultural and Traditional Land Uses | Destruction to cabins | Potential disturbance to habitation sites |
| | Concern about cultural and heritage sites | Potential disturbance to historic and sacred sites |

#### *1.4.3.5 Nadleh Whut'en First Nation*

The Nadleh Whut'en Band, formerly the Fraser Lake Band, was renamed Nadleh Whut'en First Nation (NWFN) in 1990. NWFN primarily reside on three reserves located between Fraser Lake and the Nechako River, along the banks of the Nadleh River, and another reserve on the south shore of Fraser Lake (ERM 2015).

Fishing is an important NWFN activity (Carrier Sekani Tribal Council 2006; Coastal Gaslink 2014; Firelight Group 2014); fish, specifically sockeye salmon, is a staple food for NWFN (Hudson 1983; Cranny 1986; PTP ASEP Training Society 2010). Species fished by NWFN members include salmon, Steelhead Trout, Dolly Varden, and Rainbow Trout. Several NWFN IRs are located at the sites of historical fish harvesting locations, including Canyon Lake IR #7, Ormonde Creek IR #8, Fraser Lake IR#2, Nautley IR#1, and Seaspunkut IR#4 correspond to historic fishing stations of the NWFN people.

NWFN members hunt throughout their traditional territory (Carrier Sekani Tribal Council 2006; PTP ASEP Training Society 2010; Coastal Gaslink 2014). Hunting provides food staples for the NWFN people. Animals hunted include moose, deer, bears and small game (Hudson 1983; Cranny 1986; PTP ASEP Training Society 2010). The NWFN appears to direct a high degree of hunting effort in areas to the north of Highway 16, including areas such as the Sutherland River Valley and Ormond Lake (Carrier Sekani Tribal Council 2006; Firelight Group 2014).

In addition to general trapping activities undertaken throughout NWFN traditional territory, one NWFN member holds a provincially-registered trapline (TR0712T036) of which the transmission line overlaps by 0.67% (i.e., overlapped area/total trapline area).

NWFN gather plants which help to sustain them over the winter (Carrier Sekani Tribal Council 2006; Coastal Gaslink 2014; Firelight Group 2014). Berries harvested include service berries, raspberries, soapberries, black currents, Saskatoon berries, thimble berries and huckleberries (Carrier Sekani Tribal Council 2006). Plants are collected for their leaves, bulbs and roots (Hudson 1983). Other plants harvested include, but are not limited to: fir, aspen, red willow, sage, fireweed, wild rose. Many of these plants are used for medicinal purposes (Carrier Sekani Tribal Council 2006). A review of available information identified NWFN plant gathering sites to the north of Fraser Lake, Barlow Road, Ormond Creek, Ormond Lake, Sutherland River/Valley, Angly Lake, and Top Lake (Carrier Sekani Tribal Council 2006; Coastal Gaslink 2014).

A review of secondary sources identified a number of trails, habitations, and sacred sites. One trail, the Cheslatta Trail (or Tset'ladak t'seti in Carrier), crosses through NWFN traditional territory and the proposed transmission line (Coastal Gaslink 2014). The Trail is an ancient land route from the Dakelh villages of Belhk'achek and Sdughachola on Cheslatta Lake to Nadleh Village on Fraser Lake. It was used by the Dakelh people as a major trade, travel and communication line, until the construction of the Alcan Kenney Dam in 1952 caused flooding of the Cheslatta River and Cheslatta Lake, forcing the Cheslatta people from their lakeside villages. From Nadleh, the trail would have passed through the modern day Beaumont Provincial Park and across Highway 16, then south of Drywilliams Lake (Snipview.com 2009).

The Proponent has met with NWFN representatives to provide project updates and discuss capacity funding, proposed agreements and the proposed transmission line. The NWFN raised concerns related to potential impacts on NWFN food fish (e.g., Spring Salmon) due to water flow as it leaves the Project. In response, the Proponent provided NWFN with shape files of the Project and a map outlining the water flow direction. While the water flow from the Project area does travel in the direction of NWFN IRs and traditional territory, no aquatic effects from normal operations of the TSF are expected from the Project due to the distance of the Project from the Nechako River, which is approximately 45 km downstream where the river joins the Nechako reservoir.

Based on consultation and engagement activities with NWFN, the Proponent has gained an understanding of NWFN Aboriginal rights and interests related to the Project, which are summarized in the EA Application (New Gold 2015, Chapter 15). Consultation reports, which summarize consultations undertaken with NWFN by New Gold, and issues raised by NWFN and the Proponent responses to the issues, was sent to NWFN in April 2014 and November 2014, for review and comment. NWFN provided comments on the consultation activities identified in the November 2014 report in a December 8, 2014 letter to the EAO. In the letter, the NWFN requested a revision to the description of the July 4, 2014 and October 27, 2014 meetings in the November 2014 consultation report, and indicated there were insufficient resources to conduct a TK/TLU study, and a lack of resources and consultation to determine potential adverse effects and proposed mitigation measures including accommodation. Consultation efforts with NWFN (including technical consultants) to date have not identified NWFN current uses within the area of the proposed mine site.

#### *1.4.3.6 Stellat'en First Nation*

The Stellat'en First nation (StFN) community of Stellako is located on the western shore of Fraser Lake, 160 km to the west of Prince George.

StFN members hunt throughout their traditional territory and hunting trips are used to both "optimally and opportunistically" harvest species (e.g., grouse or rabbit may be harvested on a moose hunting trip (Triton 2014:46; Firelight Group 2015). StFN hunt moose, deer, and black bear, and other species (Triton 2014). Despite arriving relatively recently to the area, "moose is predominant and is the most sought after animal" (Triton 2014:46). Additionally, various species of birds – used for both subsistence and ceremonial purposes – are culturally valued and sought (Triton 2014). Interview respondents noted that hunting has been adversely affected by forestry practices and other activities, such as the development of roads (Triton 2014). Some respondents were concerned that pipelines may negatively affect prime areas by destroying habitat or facilitating access (Triton 2014). The StFN Land and Resource Use Study (LRUS) (Triton 2014) does not identify specific hunting locations. The Proponent is consulting with StFN about its preferred methods to share information about hunting practices that may be affected by the Project and to develop methods to mitigate any potential adverse effects.

Beaver and muskrat were trapped and used for both food and fur. Additionally, wolverine is an important fur-bearing species (Triton 2014). Ducks and geese, in addition to small game, are also trapped and hunted (Triton 2014). Interviews conducted with the holder of trapline TR0712T039 (which overlaps the northern section of the proposed transmission line alignment) indicate that some Stellat'en members continue to trap. Economic benefits from trapping are low, but representatives noted that it provides opportunities to engage in traditional and cultural activities (Holders of trapline TR0712T039 pers. comm.). The StFN LRUS (Triton 2014) does not identify specific trapping locations.

Fishing remains important to the StFN. Triton (2014) noted "there were slightly more references to fishing than to hunting" during interviews. Fishing and fish processing are important subsistence activities, but also constitute important social practices as they are often associated with social gatherings and interactions. The importance of fishing and wealth of aquatic resources in the area make preservation of water quality a concern for the StFN. StFN harvest salmon, char, whitefish and

trout for food, and other species (e.g., suckers and minnows) are harvested for bait or food for domestic animals. StFN communities use rivers (e.g., the Nechako, the Endako and Stellako rivers) and lakes (e.g., Fraser and Francois lakes) to support fishing practices. The StFN LRUS does not identify specific fishing locations (Triton 2014).

StFN harvest plants for food and medicine. There are many important species of berries (e.g., soapberries, huckleberries, blueberries, raspberries, thimbleberries, blackberries, currants, gooseberries, saskatoon berries, and cranberries), bulbs and stems (e.g., various species of lily, water plantain, bulrush, cattail, and spring-beauty), and, historically, edible tree lichens. These species provide many different nutrients to the StFN diet. Triton (2014:39) note "there are many areas of contemporary and intense use that lie within the proposed transmission line due to the proximity of the alignment to the Stellaquo reserve and the habitat quality it crosses." The StFN LRUS (Triton 2014) does not identify specific plant gathering locations (Triton 2014).

There are a number of sacred sites in the StFN traditional territory listed on their website including the following:

- Grandfather's Trails (Atsiyan Buhati): these trails are networks around the Carrier (Dakelh) land that connect to the Grease Trails where the Carrier would meet coastal Aboriginal groups to trade for oolichan and coastal goods.
- Women's Song Place (Tse Koo Shun K'ut): this is a sacred site for women to use when attaining their spiritual powers. These sites are treated with great respect by Stellat'en people, and were used by Stellat'en ancestors to acquire spiritual powers for the betterment of the Stellat'en people and their environment. This site is believed to be near Fraser Lake.
- Red Rock (Tselkin K'ut): near Tse Koo Shun K'ut, is an extinct volcano, complete with a lava cone. This is where Stellat'en men go to attain their spiritual powers to become shaman or dreamers. This site is believed to be near Fraser Lake.
- Binta Lake: a part of the network of lakes and rivers that Stellat'en people used to hunt and fish on their territory.

The StFN LRUS also identifies cultural uses including culturally modified trees and minerals. The Cheslatta Trail crosses through StFN traditional territory and the StFN LRUS indicates that the trail was an important travel, information and trade route (Proponent Version; Triton 2014; Figure 7.2.7-6 of the 2014 EA Application).

The Proponent has met with StFN to discuss potential project effects and identify opportunities for participation in the EA. Based on StFN concerns related to the proposed Stellako River transmission line crossing, the crossing was adjusted to reduce impacts on sensitive wildlife habitat. The StFN have raised concerns about potential effects on caribou and their winter range and regarding impacts to registered trapline holders. Water quality is a concern of the StFN. While the water flow from the Project area does travel in the direction of StFN traditional territory, no aquatic effects from normal operations of the TSF are expected from the Project due to the distance of the Project from the Nechako River.

Based on consultation and engagement activities with StFN, the Proponent has gained an understanding of StFN Aboriginal rights and interests related to the Project, which are summarized in the EA Application (New Gold 2015, Chapter 15). Consultation reports, which summarize consultations undertaken with StFN by New Gold, and issues raised by StFN and the Proponent responses to the issues, was sent to StFN in April 2014 and November 2014, for review and comment. No comments were provided by StFN on the reports. Consultation efforts with StFN to date have not identified StFN current uses within the area of the proposed mine site.

Table 1.4-10 outlines issues and concerns raised by the StFN in the TLUS (Triton 2014) and the Stellat'en First Nation Socio-economic Baseline Report (Firelight Group 2015) that relate to potential effects of the Project on StFN Aboriginal rights and interests. These issues have been included and evaluating in this assessment through the pre-screening criterion that no waste storage (tailings and PAG/NAG3 waste rock) candidate overlap a fish-bearing lake; the evaluation of environmental hazards (primarily related to water quality from ML/ARD) within the high level risk assessment; and the evaluation of candidate's impacts to water quality and quantity, fish and fish habitat, wildlife and wildlife habitat, heritage, and StFN CULRTP purposes within the MAA.

**Table 1.4-10. Stellat'en First Nation Aboriginal Rights and Interests**

| Current Use | Potential Issue | Potential Environmental Effect |
|---|---|---|
| All Current Aboriginal Uses | Concern with alignment of transmission line | Potential change to accessing areas for StFN traditional practices |
| | Impact of changes to the environment on physical, emotional, mental, and spiritual health | Potential changes to human health |
| | Concern about cumulative effects | Potential effects of Project |
| | Disruption in ability to transfer traditional ecological knowledge | Disruption in ability to transfer traditional ecological knowledge |
| | Increased pressure on resources as a result of introduction of workers in the area (including pressure on water, housing and waste management) | Potential changes in availability of resources for harvesting as a result of increased pressure/competition by non-Aboriginals |
| | Ability to continue traditional practices | Potential changes to traditional practices |
| Hunting, Trapping, Fishing, and Gathering | Concern about access to harvesting areas or delayed/lengthened travel to access hunting areas | Potential changes to accessing areas for StFN hunting |
| | Concern about surface and ground water quality | Potential changes to water quality |
| | Concern about quality of reclamation to bring area back to natural state | Concern about quality of reclamation to bring area back to natural state |
| Hunting | Contamination of moose and other wildlife | Potential changes to quality of moose |
| Hunting and Trapping | Loss of wildlife and wildlife habitat | Potential changes in the quantity of available wildlife |
| Trapping | Impact to trapline capacity | Potential changes in the capacity of StFN trapline |

*(continued)*

| Current Use | Potential Issue | Potential Environmental Effect |
|---|---|---|
| Fishing | Concern about the watershed's ability to sustain fish | Potential changes to fish habitat |
| | Contamination of salmon | Potential changes to quality of salmon |
| | Loss of fish and fish habitat | Potential changes to quantity of fish and fish habitat |
| Gathering | Potential effect on rare or endangered species | Potential effect on rare or endangered species |

#### *1.4.3.7 Nazko First Nation*

Nazco IR#20 is the main Nazko First Nation (NFN) reserve and is located 100 km west of Quesnel on the Nazko Highway #59 in the interior of British Columbia. The band office is in Quesnel.

The Euchiniko and Blackwater watersheds are areas used by the NFN, as noted in a letter to the BC EAO in 2013 (NFN 2013). The letter notes that Nazko people have a long-standing history of use in the northwest corner of their traditional territory.

Members of NFN identified that moose were actively hunted, but there has been a decline in their populations. NFN members also actively fish within their traditional territory, and members identified that kokanee is a sustenance resource.

Based on consultations and engagement activities, the Proponent has gained an understanding of NFN Aboriginal rights and interests related to the Project. The NFN have raised concerns related to effects on Chinook salmon fishing, trapping, and hunting by the NFN IRs near Trout Lake (e.g., Trout Lake Alec IR #16 and Trout Lake Jonny IR #15). These activities occur outside the Project area and will not be affected by the Project.

In a letter to the BC EAO, dated September 19, 2013, the NFN raised concerns related to asserted title and rights over components of the Project based on archaeological resources and historic documentation of the occupancy of the land. The NFN asserts that it should be consulted on the potential effects from the Project that could affect the resources that are critically important for NFN traditional practices.

The NFN expressed concerns about effects from dust on the watershed and more specifically on Kokanee Salmon—a sustenance resource—and on medicinal plants. The group also expressed concern about moose mortality and declining populations as a further decline may compromise their availability for hunting. Table 15.7-2 of the EA Application (New Gold 2015) identifies potential effects on NFN Aboriginal rights and interests (and are summarized in Table 1.4-11 below). Consultation efforts with NFN to date have not identified NFN current uses within the area of the proposed mine site. These issues have been included and evaluating in this assessment through the pre-screening criterion that no waste storage (tailings and PAG/NAG3 waste rock) candidate overlap a fish-bearing lake; the evaluation of environmental hazards (primarily related to water quality from ML/ARD) within the high level risk assessment; and the evaluation of candidate's

impacts to water quality and quantity, fish and fish habitat, wildlife and wildlife habitat, heritage, and NFN CULRTP purposes within the MAA.

**Table 1.4-11. Nazko First Nation Aboriginal Rights and Interests**

| Current Use | Potential Issue | Potential Environmental Effect |
|---|---|---|
| Hunting | Impact to caribou hunting | Potential effects to caribou habitat and forage range; changes in range patterns |
| | Impact to moose hunting | Reduction in habitat or changes in herds and ranges |
| Gathering | Contamination to medicinal plants | Dust contamination of medicinal plants |
| Fishing | Change in quality of fish (Kokanee, Chinook Salmon) | Changes in water quality or sediment that may affect fish populations |

#### *1.4.3.8 Tsilhqot'in National Government*

The Tsilhqot'in National Government (TNG) represents the Tsilhqot'in communities of Tl'etinqox (Anaham), Esdilagh (Alexandria), Yunesit'in (Stone), Tsi Deldel (Alexis Creek), Tl'esqox (Toosey) and Xeni Gwet'in (Nemiah) (TNG 2014). Tsilhqot'in traditional territory covers approximately 9,668,294 ha and is overlapped by the mine site and 28 km of the transmission line.

Important sources of Tsilhqot'in ethnography include Teit (1909), Farrand (1899, 1910), Ray (1942), and Lane (1953, 1981). Traditionally, the Tsilhqot'in people occupied and utilized lands and resources in the Chilcotin River drainage and the upper reaches of the Homalco, Klinaklini, and Dean Rivers (Lane 1981). They engaged in hunting, trapping, fishing, and plant gathering for their subsistence. Elk, deer, caribou, mountain goats and sheep were primarily hunted, though moose has replaced elk more recently in their territory. Trapped species include marmot, hare, beaver, muskrats and porcupine. They also harvested ducks, geese, ptarmigan, and grouse. Important fish include trout, whitefish, suckers, and Kokanee and sockeye salmon. The sockeye salmon run on the Chilcotin River occur in mid-July, when Tsilhqot'in people gathered at fishing sites along the Chilcotin and Chilko rivers. Plant foods were important diet supplements, and berries and roots were gathered in sufficient quantities for winter storage. A number of the Tsilhqot'in practice, to varying degrees, their traditional subsistence lifestyle based on hunting, fishing, and gathering.

To date there is no publically available evidence of Tsilhqot'in use of lands and resources in project footprint area. Current use of lands and resources in the Xeni Gwet'in (Nemiah) area was outlined during the *Tsilhqot'in v. British Columbia* (2014) litigation. Use of the Fish Lake area was characterized in the Prosperity Mine EA Application (Taseko Mines Ltd. 2009). No information about TNG seasonal round has been provided to the Project.

The Proponent has met with TNG to discuss the Project, made presentations to TNG and met with members in accordance with TNG engagement process requirements. Based on consultations undertaken with TNG to date, TNG have not identified Tsilhqot'in use of lands and resources in the area of the proposed mine site.

#### *1.4.3.9 Métis Nation British Columbia*

Métis people are of mixed First Nations and European ancestry, and are recognized as a distinct Aboriginal population in Canada (Métis Nation British Columbia n.d.). Métis people trace their descent to the 18th century fur trade, which resulted in the intermarrying of European men and Aboriginal women. Their children, a mixed-race population, grew and formed separate communities distinct from both other Aboriginal groups and Europeans. The collective Métis groups refer to themselves as the Métis Nation.

The Métis population in BC numbers approximately 59,000 across the province. The majority of BC Métis people reside in urban areas, and they represent approximately 30% of the total Aboriginal population in British Columbia (Métis Nation British Columbia n.d.).

The Métis Nation BC (MNBC) is the governing Nation for Métis people living in British Columbia, and represents one of five governing members of the Métis National Council. MNBC provides governance and support for 35 Chartered Communities in seven regions: Vancouver Island, Lower Mainland, Thompson/Okanagan, Kootenays, North Central, Northwest, and Northeast. A Regional Director leads each region.

In the North Central Region of BC, where the Project is located, there are four Métis Chartered Communities: the Cariboo Chilcotin Métis Association, North Cariboo Métis Association, Prince George Métis Community Association, and the New Caledonia Métis Association. Engagement and consultation activities with the MNBC began in October 2012. The MNBC asserted harvesting rights around the proposed Project area in letters to the Agency on November 23, 2012 and on January 20, 2013. The MNBC expressed concerns regarding current traditional harvesting activities (hunting, fishing, and plant harvesting) occurring in the proposed Project area that could be negatively affected by the Project (MNBC 2012); however, no specific information was provided. The MNBC also submitted a letter to BC EAO on November 8, 2013 providing general information about their use of Northern BC. Métis described that members hunt and trap deer, elk, moose, and small game. Consultation efforts with MNBC to date have not identified specific Métis hunting locations. It is not known if the Métis currently fish in any of the lakes, rivers, and streams in the Project area. It is currently unknown if Métis gather plants or use areas for other cultural or traditional purposes. If this information becomes available, the Project will consider integrating it into Project design, Project design, execution, management plans development, permitting, and monitoring.

# 2. ABORIGINAL AND GOVERNMENT AGENCY ENGAGEMENT

New Gold has consulted government agencies and Aboriginal groups on the proposed methodology and preliminary findings related to the tailings alternative assessment as described below:

**June 11, 2015 –** New Gold held a teleconference with the BC EAO, CEA Agency, and Ministry of Environment (MOE) to seek feedback on the proposed methodology for the assessment (refer to Appendix A for a summary of issues presented at the meeting). Key points raised include:

- Confirmation from New Gold that the tailings evaluation options being considered at that time were all located in the Davidson Creek and Creek 661 watersheds, but that the evaluation would be expanded to consider alternatives over a wider geographical area.
- Anticipation from New Gold that lake disposal option will not be carried forward in the assessment beyond pre-screening and into the multiple accounts analysis given public and Aboriginal concerns related to use of a lake to store tailings and the anticipated difficulty in permitting the option.
- Confirmation from New Gold that the risk assessments will consider the likelihood and consequences of potential failures of the tailings storage facility option. The detailed risk assessment (Failure Mode Effects Analysis) will be used to identify the best available practices.
- Request to New Gold to provide a thorough rationale for each step of the assessment

**June 12, 2015 –** New Gold met with the EAO, CEA Agency and BC Ministry of Energy and Mines (MEM) to present the proposed approach of the assessment (refer to Appendix A for a summary of issues presented at the meeting). Key points raised include:

- Confirmation from New Gold that the assessment approach is adapted from EC's (2011) *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* and incorporates high level and detailed (Failure Mode Effects Assessment) risk assessments.
- Agreement from MEM that options that are not technically or economically feasible should be screened out at the pre-screening step, as the Project would not be viable.
- Recommendation from MEM that TSF siting and water balance be revisited.

**July 2, 2015 –** New Gold distributed a memorandum to the Working Group members (which includes participation by all Aboriginal groups listed on Schedule B) to provide an overview of New Gold's approach to the evaluation of alternative tailings technologies. This memorandum described the screening criteria for assessing the 'fatal flaws' of the candidate alternatives, plans for government and Aboriginal consultation and figures and tables illustrating the proposal approach and risk assessment descriptions.

**July 20, 2015 –** New Gold reviewed the proposed approach to the assessment with the NWFN, StFN, SFN, Carrier Sekani Tribal Council (CSTC), EAO, CEA Agency and MEM. The purpose of the teleconference was to review the proposed methodology to evaluating alternative tailings technologies. New Gold reviewed the criteria for siting the TSF which included avoiding: ungulate winter range, placement of tailings within a lake due to environmental and permitting concerns, discharge of surface water to the environment during operations, direct impacts to rare or threatened species, and drainage to the Blackwater River (see full list of criteria referenced with July 24 memo in Appendix B). At this meeting, New Gold committed to including Aboriginal rights and interests in the approach and evaluation criteria.

**July 24, 2015** - Following the July 20, 2015 meeting and in response to discussion, a revised memorandum, dated July 24, 2015 was circulated to the Working Group. This memorandum was an update to the July 2, 2015 memorandum and included how effects on potential effects on Aboriginal rights and interests would be considered in the assessment, namely, that potential effects on aboriginal rights and interest would be assessed and informed by the conclusion reached for relevant health, social, heritage and environmental evaluation criteria including current use of lands and resources for traditional purposes, heritage, water quality, fish and fish habitat, wildlife and wildlife habitat and vegetation.

**August 13, 2015 –** New Gold presented pre-screening results and study approach to MEM; BC Ministry of Forest, Land and Natural Resource Operations (FLNRO); BC Ministry of Jobs, Tourism, Skills and Trade (BC JTST); EAO, EC, Natural Resource Canada (NRCan); LDN; NWFN; as well as the Regional District of Bulkley Nechako and the District of Fort St. James (refer to Appendix A for a summary of issues presented at the meeting). Key points raised include:

- Highlighting from EAO the need to address social aspects in the high level risk assessment but comment from EC regarding possible removal of social criteria as they are considered in the pre-screening criteria.

**October 8 and 13, 2015 –** Two Working Group (WG) meetings were held on October 8 and 13, 2015. Participation at the October 8 2015 Working Group meeting included MOE, FLNRO, MEM (Major Mines Permitting Office – MMPO), CEA Agency, NRCan, Health Canada (HC), EC, LDN, NWFN, SFN, and the District of Vanderhoof. Participants at the October 13, 2015 Working Group meeting included the EAO, MEM, FLNRO, CEA Agency, Ministry of Aboriginal Relations and Reconciliation (BC MARR), NWFN and District of Vanderhoof. The purpose of the October 8 meeting was for New Gold to present the results of the pre-screening assessment, the multiple account analysis (MAA) and the Failure Modes and Effects Assessment (FMEA). Discussion at this meeting followed on the presentation provided by New Gold on October 8, 2015 (refer to Appendix A for a summary of issues presented at the meetings). Key points raised include:

- Confirmation from New Gold that based on the results of the MAA, the Slurry Tailings and Submerged PAG in upper Davidson Creek is the BAT for the Project. The FMEA documented the Best Available Practices (BAP), and identified and characterized risks from accidents, failures of an engineered system, and malfunctions.

- Confirmation by New Gold from a question by EC that one of the sensitivity analyses would include a focus on Aboriginal Current Use.
- Note from MEM that information and a rationale should be provided for the high level risk assessment.

Where available, meeting minutes from the above meetings are included in Appendix B. Additional information regarding consultation with Aboriginal groups can be found in Appendix C.

# 3. METHODOLOGY

The assessment methodology broadly follows the process outlined in the *Guidelines* but has been augmented by incorporating a high-level risk assessment in the pre-screening step, and a FMEA step to identify BAP. Risk assessment is better suited for screening the candidate technologies based on key technical hazards and consequences associated with potential failures. Multiple accounts analysis (MAA), as outlined in the *Guidelines*, has been employed to select the BAT option for the Project based on physical stability, environmental, health, social, heritage and economic values as well as technical and financial criteria. A failure modes effects assessment (FMEA) was then utilized to further mitigate the residual risk of the BAT option and define BAP for the Project.

The steps can be summarized as follows:

- **Step 1 – Identification of Candidate Alternative Sites and Technologies**:

  Concepts (candidates) for management of mine waste were developed based on topographical maps of the project area. The candidates are interspersed within an area of approximately 35 km by 30 km. Candidate sites were roughly bounded by the Blackwater River to the south, the Nechako Reservoir to the north, Tatelkuz Lake to the east, and Entiako Provincial Park to the west. The tailings technology applied at each candidate site was chosen based on site specific constraints and professional judgement.

- **Step 2 – Pre-screening Assessment**:

  Criteria were developed based on technical, environmental, and social site constraints to pre-screen the candidates to remove those with obvious deficiency and create a set of appropriate and manageable, sufficiently detailed alternatives. The objective of this step is to optimize the decision making process by not evaluating alternatives that have obvious deficiencies or employ the same technologies that have similar risk profiles. The process of evaluating alternatives with obvious deficiencies is referred to as a "fatal-flaw analysis". The fatal flaw analysis removes from further consideration the alternatives that are non-compliant with certain minimum specifications developed for the Project.

- **Step 3 – High-level Risk Assessment (HLRA)**:

  Candidates considered to have significant risk to the Project were screened out from further assessment based on safety (physical stability), environmental and technical execution hazards. The lowest risk candidate for each tailings technology (slurry, paste and filtered tailings) and the most "physically stable" candidate, to address the recommendations in the *Panel Report* (Section 9.3.3, IEEIRP 2015), were advanced to the multiple accounts analysis (MAA).

- **Step 4 – Multiple Accounts Analysis (MAA):**

  An MAA was used to determine best available technology for the Project through a rigorous evaluation of the physical stability, technical, environmental, human environment, and

Project economics considerations for each short-listed candidate. The MAA performed in this report is adapted from the *Guidelines* (physical stability was pulled into its own account) and entails the following 4 steps:

- **Step A: Alternatives Characterization** entails the thorough characterization of the short-listed candidate alternatives. Site-specific characterization criteria are developed for each candidate within five broader categories ("accounts"): physical stability, technical, environmental, human environment (i.e., socio-economic factors), and Project economics. Characterization criteria were selected to provide a factual, objective basis for comparison among the selected candidates.
- **Step B: Multiple Accounts Ledger** entails the development of a ledger that seeks to differentiate among candidates and provides the basis for scoring and weighting of criteria as described in Step C. Sub-accounts and indicators were chosen and described based on the characterization criteria presented in Step A. Only those sub-accounts and indicators that differentiate candidates are presented for evaluation. Indicators are a sub-level that often allows sub-accounts to be decomposed to a degree that allows measurability. Like sub-accounts, the indicators have been chosen from the Project's valued components; the *Guidelines*; the recommendations of the Mt Polley Review Panel; and professional judgement.
- **Step C: Value-based Decision Process** entails taking the list of accounts, sub-accounts, and indicators and assessing the combined impacts for each of the candidates under review. All indicators, sub-accounts, and accounts are scored and weighted, and merit ratings for each alternative are quantified. Scoring involves the development of quantitative or qualitative scales for each indicator, such that each indicator can be assigned a rank on the scale. Weighting involves comparing indicators, sub-accounts, and accounts among alternatives by introducing value bias by applying a weighting factor to each indicator, sub-account, or account. Weighting factors allow the ability to assign relative importance of crieria.
- **Step D: Sensitivity Analysis** entails reducing bias and subjectivity of the initial assessment (step C) by evaluating different value systems. To test the sensitivity of the value-based decision making process, different weightings are assigned to those indicators, sub-accounts, and accounts according to a range of value systems

- **Step 5 – Failure Modes Effects Assessment (FMEA):**

  A FMEA was completed to identify and characterize risks from accidents, failures of an engineered system or malfunctions. This FMEA evaluated risks specific to the TSF concept identified to be the BAT for the Project. The FMEA evaluated risk management practices outlined in the Project's Application/EIS, and other practices expected to be applied during the Project's permitting phase. The FMEA also identified areas where additional mitigations and contingencies, based on BAP for tailings management, could be implemented to minimize identified risks.

- **Step 6 – Best Available Practices Risk Management Measures:**

  Best Available Practices were identified to reduce residual Project risks identified during the FMEA. These measures included additional design elements, operational practices, and contingencies that reduce risk.

- **Step 7 – Assessment of Aboriginal Rights and Interests:**

  Description of how the TSF concept identified as BAT/BAP for the Project may infringe on Aboriginal rights and interest; specifically from impeded access, reduced resource availability, reduced resource quality, and other factors that could interfere with the exercise of Aboriginal rights.

# 4. STEP 1 – CANDIDATE LOCATIONS AND TECHNOLOGIES

Step 1 of this analysis entails identification of initial tailings and PAG/NAG3 waste storage sites and technologies. Concepts (candidates) for management of mine waste were developed based on topographical maps of the project area (KP 2015). The candidates are interspersed within an area of approximately 35 km by 30 km as shown on Figure 4-1. Candidate sites were roughly bounded by the Blackwater River to the south, the Nechako Reservoir to the north, Tatelkuz Lake to the east, and Entiako Provincial Park to the west. The tailings technology applied at each candidate site was chosen based on site specific constraints and professional judgement. Some candidate sites considered multiple tailings technologies, if appropriate, and others only considered a single technology. Twenty-three concepts were developed (Figure 4-1; Table 4-1). The candidates were developed based on topographical maps of the Project and local area with the aim of identifying suitable terrain for the tailings technology, minimizing the size of the upstream catchment and providing sufficient storage capacity (tailings and PAG/NAG3 waste rock) for the duration of the Project.

Detailed description of the tailings storage concept, location, method of waste delivery, and pre-screening result for each candidate is provided in Appendix D. The following section summarizes the "fatal-flaw" analysis that was used to screen the candidates for high-level risk assessment.

**Figure 4-1**

**Candidate Tailings Disposal Locations and Site Constraints**

ERM

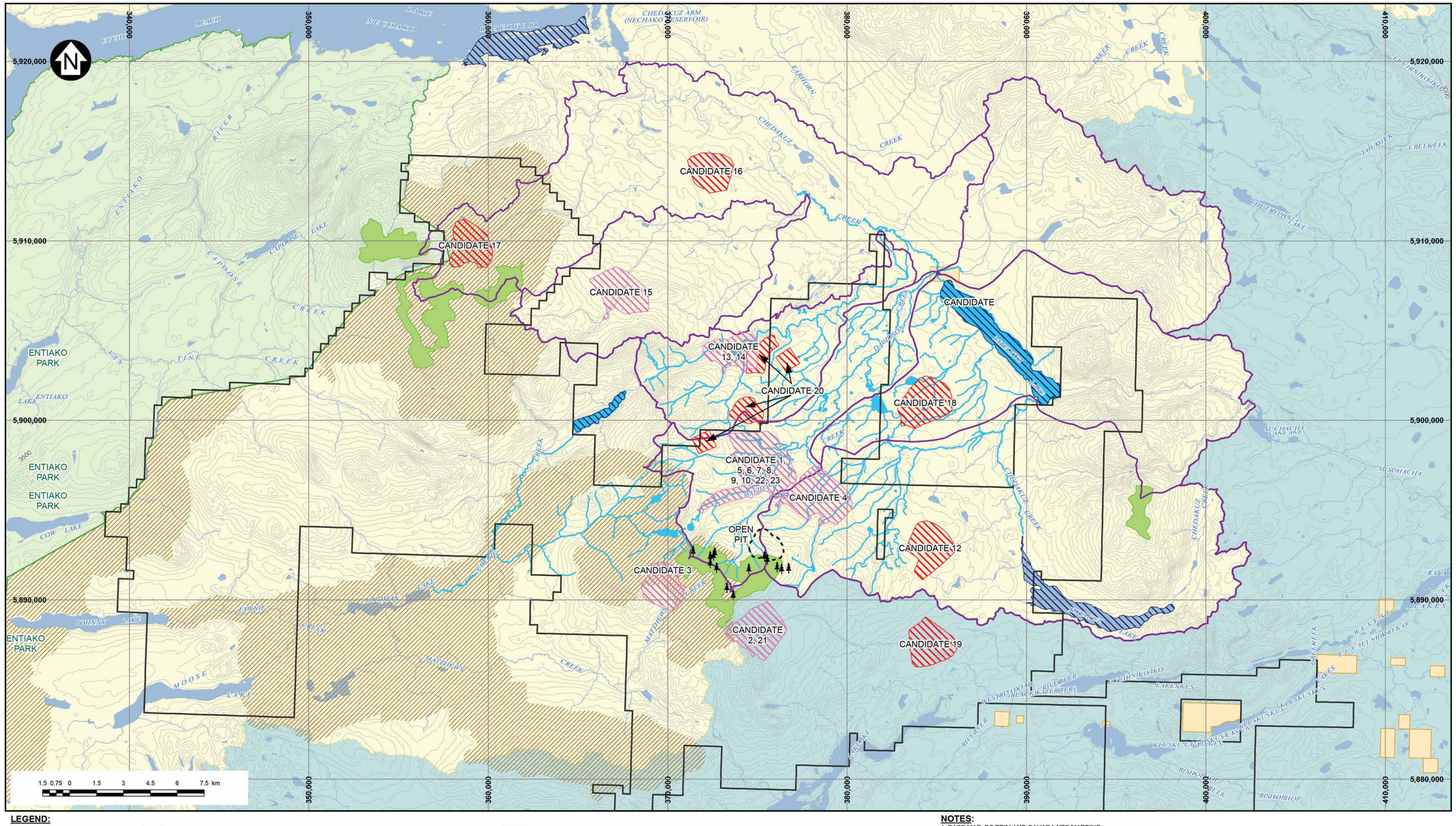

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EUCHIL
REACH
RIVER
ENTIAKO
CAPOOSE
LAKE
CREEK
TINE
VAN
ENTIAKO
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ENTIAKO
PARK
ENTIAKO
PARK
COW
LAKE
JOHNNY
LAKE
FAWNIE
CREEK
MOOSE
LAKE
LANDMAN
LAKE
CAMP
CREEK
MATTHERS
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CREEK
EARTHORN
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CHEDAKUZ
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DAMBOO
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**Table 4-1. Candidate Tailings Disposal Alternatives**

| Candidate Alternatives | Location | Tailings Storage Technology | PAG/NAG 3 Disposal[1] | Storage Configuration |
|---|---|---|---|---|
| 1 | Upper reaches of the Davidson Creek catchment | Thickened-slurry tailings | Submerged co-disposal with tailings | Storage of thickened-slurry tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment; the impoundment will be created in a staged manner consisting of two nested TSF sites (Sites C and D). |
| 2 | South side of Mount Davidson in the upper reaches of an unnamed tributary of the Blackwater River | Thickened-slurry tailings | Submerged co-disposal with tailings | Storage of thickened-slurry tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment; the impoundment will be created by constructing two large dams on the east and west sides, and will be constrained by natural topography to the north and south. |
| 3 | West side of Mount Davidson within the headwaters of Mathews Creek | Thickened-slurry tailings | Submerged co-disposal with tailings | Storage of thickened-slurry tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment; the impoundment will be created by constructing two large dams on the north and south sides, and will be constrained by natural topography to the east and west. |
| 4 | Located on the north slope of Mount Davidson in the upper reaches of the Creek 661 watershed | Thickened-slurry tailings | Submerged co-disposal with tailings | Storage of thickened-slurry tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment; the impoundment will be created by constructing a three-sided main dam wrapping the facility, and is constrained by topography to the southwest. |
| 5 | Top of the Davidson Creek catchment | Filtered tailings | On-land co-disposal with tailings | Filtered tailings and PAG/NAG3 waste rock will be stacked on-land in a single combined waste pile in a partially saturated condition; waste rock and filtered tailings will be disposed of together leading to a mixed mass of tailings and waste rock. |
| 6 | Upper reaches of the Davidson Creek catchment | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a side hill arrangement in a partially saturated condition; PAG/NAG3 waste rock will be submerged in an impoundment positioned downstream of the filtered tailings waste pile and will be contained by a dam across Davidson Creek. |
| 7 | Upper reaches of the Davidson Creek catchment | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a heaped valley fill arrangement in a partially saturated condition; PAG/NAG3 waste rock will be submerged in an impoundment positioned downstream of the filtered tailings waste pile and will be contained by a dam across Davidson Creek. |

*(continued)*

| Candidate Alternatives | Location | Tailings Storage Technology | PAG/NAG 3 Disposal[1] | Storage Configuration |
|---|---|---|---|---|
| 8 | Upper reaches of the Creek 661 catchment | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a partially saturated condition in a side hill arrangement; PAG/NAG3 waste rock will be submerged in an impoundment positioned in the adjacent Davidson Creek catchment located to the northwest of the filtered tailings waste pile and will be contained by two small dams and one large dam across Davidson Creek. |
| 9 | Upper reaches of the Davidson Creek catchment | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a side hill arrangement in a partially saturated condition; PAG/NAG3 waste rock will be submerged in an impoundment positioned directly upstream of the filtered tailings waste pile and will be contained by two small dams and one large dam across Davidson Creek. |
| 10 | Upper reaches of the Davidson Creek catchment | Ultra-thickened (paste) tailings | Submerged co-disposal with tailings | Paste tailings and PAG/NAG3 waste rock will be permanently stored in a saturated condition in one impoundment; impoundment will be created by constructing two small dams and one large dam (Main Dam) across Davidson Creek. |
| 11 | Lake (or combination of lakes) surrounding the Project location | Slurry tailings | Submerged disposal in separate impoundment | Slurry tailings will be pumped to more than one nearby lake, as none of the nearby lakes have sufficient capacity to store life of mine tailings; PAG/NAG3 waste rock will be submerged in an impoundment positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |
| 12 | West of Kuyakuz Lake in the upper reaches of the Chedakuz Creek catchment | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a partially saturated condition in a side hill arrangement; PAG/NAG3 waste rock will be submerged in an impoundment positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |
| 13 | Upper reaches Turtle Creek catchment | Thickened-slurry tailings | Submerged disposal in separate impoundment | Thickened-slurry tailings will be permanently stored in a saturated condition in a TSF away from the mine site; PAG/NAG3 waste rock will be submerged in an impoundment positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |

*(continued)*

| Candidate Alternatives | Location | Tailings Storage Technology | PAG / NAG 3 Disposal[1] | Storage Configuration |
|---|---|---|---|---|
| 14 | Upper reaches Turtle Creek catchment | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a partially saturated condition in a side hill arrangement and positioned to the south of Turtle Creek; PAG/NAG3 waste rock will be submerged in an impoundment positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |
| 15 | Upper reaches of an unnamed catchment north of Turtle Creek | Thickened-slurry tailings | Submerged disposal in separate impoundment | Thickened-slurry tailings will be permanently stored in a saturated condition in a TSF north of Turtle Creek; PAG/NAG3 waste rock will be submerged in an impoundment positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |
| 16 | Lower reaches of the Chedakuz Creek catchment | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a partially saturated condition in a heaped arrangement and positioned to the west of Chedakuz Creek; PAG/NAG3 waste rock will be submerged in an impoundment positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |
| 17 | Upper reaches of an unnamed tributary to lower Chedakuz Creek | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a partially saturated condition in a valley-fill arrangement near Chedakuz Creek; PAG/NAG3 waste rock submergence impoundment will be positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |
| 18 | South of Tatelkuz Lake in the middle reaches of several unnamed drainages reporting directly to Tatelkuz Lake | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a partially saturated condition in a side hill arrangement south of Tatelkuz Lake; PAG/NAG3 waste rock will be submerged in an impoundment positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |

*(continued)*

| Candidate Alternatives | Location | Tailings Storage Technology | PAG / NAG 3 Disposal[1] | Storage Configuration |
|---|---|---|---|---|
| 19 | Southwest of Kuyakuz Lake in the upper reaches of an unnamed tributary to the Blackwater River | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a partially saturated condition in a side hill arrangement southwest of Kuyakuz Lake; PAG/NAG3 waste rock will be submerged in an impoundment positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |
| 20 | Davidson Creek and Turtle Creek catchments | Filtered tailings | On-land disposal in separate impoundment | Filtered tailings will be stacked in four separate waste piles spread over a distance of 5 km in Davidson and Turtle Creek catchments in order to avoid major surface drainages; PAG and NAG3 waste rock will be stored an engineered surface containment located in upper reaches of Davidson Creek and Creek 661. |
| 21 | South side of Mount Davidson in the upper reaches of an unnamed tributary of the Blackwater River | Filtered tailings | Submerged disposal in separate impoundment | Filtered tailings will be stacked in a waste pile on land in a partially saturated condition in a side hill arrangement on the south side of Mount Davidson; PAG/NAG3 waste rock will be submerged in an impoundment positioned near the mine site area and will be contained by two small dams and one large dam across Davidson Creek. |
| 22 | Top of the Davidson Creek catchment | Filtered tailings | On-land disposal in separate impoundment | Filtered tailings and PAG/NAG3 waste rock will be stacked on-land in separate waste piles in a partially saturated condition; PAG and NAG3 waste rock will be stored in an engineered surface containment located west of the open pit excavation. |
| 23 | Upper reaches of the Davidson Creek catchment | Thickened-slurry tailings | On-land disposal in separate impoundment | Storage of thickened-slurry tailings in saturated condition in one impoundment; tailings impoundment will be created by constructing a two-sided main dam, and is constrained by topography to the south and west; PAG and NAG3 waste rock will be stored in an engineered surface containment located west of the open pit excavation. |

*Source: Knight Piésold, 2015, Alternatives Technology Options Study, VA101-457/15-1*

[1] PAG/NAG3 Waste Rock disposal technique: 'submerged' in an impoundment, or placed in an 'on-land' dump

# 5. STEP 2 – PRE-SCREENING ASSESSMENT

Step 2 pre-screens the candidates to create a set of appropriate and manageable, sufficiently detailed alternatives. The objective of this step is to optimize the decision making process by not evaluating alternatives that have obvious deficiencies or employ the same technologies that have similar risk profiles. The process of evaluating alternatives with obvious deficiencies is referred to as a "fatal-flaw analysis". The fatal flaw analysis removes from further consideration the alternatives that are non-compliant with certain minimum specifications developed for the Project.

## 5.1 PRE-SCREENING CRITERIA

Candidates which provide a YES response to at least one of the following pre-screening criteria have deficiencies which warrant removal of the candidate from further analysis:

1. Will the candidate result in deposition of tailings into a fish-bearing lake?
2. Will the candidate be located in the Blackwater River watershed?
3. Will the candidate be located in an area of Ungulate Winter Range?
4. Will the candidate encroach on provincially or federally designated lands and/or private lands?
5. Will the candidate have insufficient capacity to store waste produced during the mine life?
6. Will the candidate render collection and treatment of surface discharges impractical or improbable?

Table 5-1 provides a summary of the application of these criteria to each candidate option. Rationale for selection of the criteria and which candidates meet the criteria are provided below.

### 5.1.1 Will the Candidate Result in Deposition of Tailings into a Fish-bearing Lake?

Environment Canada notes in the initial context of the *Guidelines* that:

> *Natural water bodies frequented by fish shall be avoided to the extent practicable for the long-term disposal of mine waste; and that mine waste shall be managed to ensure the long-term protection of Canada's terrestrial and aquatic environment.*

In the interest of preserving large water bodies frequented by fish and in concordance with the *Guidelines*, New Gold has chosen to eliminate any candidate option that makes use of a fish bearing lake for tailings storage.

Canadidate 11 meets this criterion and is eliminated from further consideration in this assessment (Table 5-1).

### 5.1.2 Will the Candidate be Located within the Blackwater River Watershed?

The Blackwater River is a Heritage River under the BC Heritage Rivers System (MOE 2010). The BC Heritage Rivers System showcases outstanding examples of a representative range of BC's most important waterways. Although, not having legal status, the designation serves to provide greater emphasis on river-related values during land-use planning and to protect the special values of the river. The Heritage Rivers system aims to raise awareness on the importance of healthy river systems and to build public support for stewardship of designated rivers. New Gold respects the intended purpose of the Heritage River designation and has chosen not to develop mine infrastructure within the Blackwater River drainage.

Candidates 2, 19, and 21 meet this criterion and are therefore excluded from further consideration in this assessment (Table 5-1).

### 5.1.3 Will the Candidate be Located in an Area of Ungulate Winter Range?

Ungulate Winter Range (UWR) is defined as an area that contains habitat that is necessary to meet the winter habitat requirements of an ungulate species. Sections 9 and 12 of the Government Actions Regulation (BC Reg 582/2004) of the *Forest and Range Practices Act* (1996) outline the regulatory authority for establishing UWR. Caribou UWRs have legally established objectives with which most commercial and industrial operations must meet.

The Project is adjacent to the Tweedsmuir-Entiako Northern Caribou Ungulate Winter Range, which is key winter habitat used by the Tweedsmuir-Entiako Northern Caribou herd (Ecofor 2013). These Northern Caribou are listed on Schedule 1 of the Canadian *Species at Risk Act* (2002c) as Threatened. The legal direction for the Tweedsmuir-Entiako Northern Caribou herd comes from the document *Order – Ungulate Winter Range #U-7-012* dated December 30, 2005 (the Order). Mineral exploration and development activities are exempt from requirements to manage Northern Caribou through Section 6 of the Order:

> *[T]he general wildlife measures outlined in Schedule 1 do not apply for the purposes of exploration, development and production activities when these activities have been authorized for the purpose of subsurface resource exploration, development or production by the Mineral Tenure Act, the Coal Act, the Mines Act, the Petroleum and Natural Gas Act, the Pipeline Act or the Geothermal Resources Act.*

In concordance with the Northern Caribou Management Plan developed by New Gold (Ecofor 2013), and recognizing the importance Aboriginal groups place on caribou (see Section 1.4.3), New Gold has chosen to eliminate any candidate that overlaps with UWR from further consideration.

Candidates 3 and 17 overlap UWR, and are therefore excluded from further consideration in this assessment (Table 5-1).

### 5.1.4 Will the Candidate Encroach on Provincially or Federally Designated Lands and/or Private Lands?

New Gold has chosen to eliminate any candidate that overlaps with provincially or federally designated lands (e.g., provincial parks and protected areas, federal parks, Indian Reserves) and/or private lands (e.g., fee simple lands) from further consideration.

None of the candidates overlap provincially or federally designated lands and/or private lands.

### 5.1.5 Will the Candidate have Insufficient Capacity to Store Waste Produced During the Mine Life?

The use of several distinct tailings storage facilities to manage mine waste for the Project was considered grounds for exclusion of that candidate from further consideration. This practice, unless it is based on a good rationale such as separation of tailings streams or distance between satellite ore bodies, increases the construction, operational, and closure and post-closure complexities and risk of accidents/failures (e.g., tailings pipeline breaks) for the Project.

Candidates 11 and 20 do not have sufficient capacity to store life of mine waste and would therefore require separate TSFs and are excluded from further consideration in this assessment.

### 5.1.6 Will the Candidate Render Collection and Treatment of Surface Discharges Impractical or Improbable?

The location and layout of a candidate should not position mine facilities in a way that eliminates the ability to capture and treat, if necessary, the tailings facility site runoff generated during the design flood event. Excess inflow to the TSF may result in a discharge of tailings pond supernatant that could reasonably be expected to require treatment during operations prior to release. Moreover, runoff has the capacity to mobilize tailings solids into suspended sediment, and if the runoff cannot reasonably be collected then tailings mobilization to the downstream receiving environment could occur.

Candidates 8, 9, 18, and 20 were considered to meet this criterion and were excluded from further consideration in this assessment.

### 5.1.7 Pre-Screening Results

Ten of the candidates met one or more of the above criteria, and are therefore excluded from further consideration in this assessment. Candidates 2, 3, 8, 9, 11, 17, 18, 19, 20, and 21 met at least one of the pre-screening criteria. Thirteen candidates passed the pre-screening step and were carried through to Step 3 – High Level Risk Assessment. Candidates 1, 4, 5, 6, 7, 10, 12, 13, 14, 15, 16, 22, and 23 were carried forward.

The results of the pre-screening assessments are summarized in Table 5-1.

**Table 5-1. Pre-screening Assessment Results**

| Candidate | Will the candidate deposit tailings in fish-bearing lake? | Will the candidate be located in the Blackwater River watershed? | Will the candidate be located in an area of UWR? | Will the candidate encroach on provincially or federally designated lands and/or private lands? | Will the candidate have insufficient capacity to store waste produced during the mine life? | Will the candidate render collection and treatment of surface discharges impractical or improbable? | Remove from further evaluation? |
|---|---|---|---|---|---|---|---|
| 1 | No | No | No | No | No | No | No |
| 2 | No | Yes | No | No | No | No | Yes |
| 3 | No | No | Yes | No | No | No | Yes |
| 4 | No | No | No | No | No | No | No |
| 5 | No | No | No | No | No | No | No |
| 6 | No | No | No | No | No | No | No |
| 7 | No | No | No | No | No | No | No |
| 8 | No | No | No | No | No | Yes | Yes |
| 9 | No | No | No | No | No | Yes | Yes |
| 10 | No | No | No | No | No | No | No |
| 11 | Yes | No | No | No | Yes | No | Yes |
| 12 | No | No | No | No | No | No | No |
| 13 | No | No | No | No | No | No | No |
| 14 | No | No | No | No | No | No | No |
| 15 | No | No | No | No | No | No | No |
| 16 | No | No | No | No | No | No | No |
| 17 | No | No | Yes | No | No | No | Yes |
| 18 | No | No | No | No | No | Yes | Yes |
| 19 | No | Yes | No | No | No | No | Yes |
| 20 | No | No | No | No | Yes | Yes | Yes |
| 21 | No | Yes | No | No | No | No | Yes |
| 22 | No | No | No | No | No | No | No |
| 23 | No | No | No | No | No | No | No |

# 6. STEP 3 - HIGH LEVEL RISK ASSESSMENT

The purpose of the Step 3 - High Level Risk Assessment (HLRA) is to compare the relative risks for similar candidates, and to identify the best candidate (i.e., lowest risk) for the different tailings technologies evaluated here (KP 2015; Appendix D). The two technology categories are:

- Slurry tailings, consisting of the remaining thickened-slurry and paste candidates (Candidates 1, 4, 10, 13, 15, and 23); and
- Filtered tailings, consisting of the remaining filtered candidates (Candidates 5, 6, 7, 12, 14, 16, and 22).

A third category is included, notwithstanding the above, that considered the most "physically stable" candidates. These candidates involve filtered tailings technology where PAG/NAG3 waste rock will be disposed of in an on-land dump, and water will be stored separately from mine waste (Candidates 5 and 22). This category directly addresses the foremost importance of physical stability of Section 9.3.3 of the *Panel Report* (IEEIRP 2015).

This third category also addresses the three principles of BAT through mechanical dewatering and placement of tailings, and separation of mine waste and water management facilities. The three BAT principles are found in Section 9.3.1 of the *Panel Report* (IEEIRP 2015).

1. Eliminate surface water from the impoundment.
2. Promote unsaturated conditions in the tailings with drainage provisions.
3. Achieve dilatant conditions throughout the tailings deposit by compaction.

Storage strictly in this manner will not prevent the onset of acidic drainage conditions, but rather will rely on collection and treatment to manage the associated environmental risks.

## 6.1 RISK ASSESSMENT METHODOLOGY

The HLRA performed for this assessment defines risk as the product of likelihood and consequence. Likelihood and consequence definitions used for the HLRA are provided in Tables 6.1-1 and 6.1-2 respectively. The ultimate consequence rating for each hazard was based on the worst rating in each category.

**Table 6.1-1. Likelihood Categories for High Level Risk Assessment**

| Score | Descriptor | | Frequency |
|---|---|---|---|
| 1 | Very Rare | Possible but only in extreme circumstances | Less than one event per 1000 years |
| 2 | Unlikely | Has not happened but could | Less than one event per 100 years |
| 3 | Possible | Could happen and has happened elsewhere | Less than one event per 20 years |
| 4 | Likely | Could easily happen | Less than one event per year |
| 5 | Almost Certain | Happens often | More than one event per year |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project, Alternatives Technology Options Study. VA101-457/15-1*

**Table 6.1-2. Consequence Categories for High Level Risk Assessment**

| Score | Descriptor | Environment | Aboriginal Rights and Title | Business | Damage Loss |
|---|---|---|---|---|---|
| 1 | Insignificant | Limited short-term effect in small or previously disturbed areas | There is no change in the abundance of resources or to the availability of land typically accessed for the purpose of undertaking traditional Aboriginal land use activities | < 6 hour production delay | < $0.5 M |
| 2 | Minor | Small short-term effect on part of ecosystem | There is no change in the abundance of resources or to the availability of land typically accessed for the purpose of undertaking traditional Aboriginal land use activities | > 6 hour < 24 hour production delay | $0.5 - $2 M |
| 3 | Moderate | Moderate short-term effects affecting part of ecosystem | An area of land (including waterbodies) or a natural resource typically accessed by an Aboriginal group for the purpose of pursuing land use activities is unavailable in the short- to medium-term | > 1 day < 1 week production delay | $2 - $10 M |
| 4 | Major | Serious medium-term environmental impact, affecting whole ecosystem | An area of land (including waterbodies) or a natural resource typically accessed by an Aboriginal group for the purpose of pursuing land use activities is unavailable for an extended period of time | > 1 week < 1 month production delay | $10 - $50 M |
| 5 | Catastrophic | Irreparable damage, very serious long-term impairment, affecting whole ecosystem | An area of land (including waterbodies) or a natural resource typically accessed by an Aboriginal group for the purpose of pursuing land use activities is unavailable for the foreseeable future | > 1 month production delay | > $50 M |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project, Alternatives Technology Options Study. VA101-457/15-1*

## 6.2 HAZARD IDENTIFICATION

Candidates were analyzed based on specific defined hazards applying to each alternative with respect to safety, environment, and technical execution. The hazards applying to each candidate were grounded in specific engineering and environmental issues which will pose the greatest risks. Each candidate was evaluated against reasonably similar hazards to create a meaningful comparison of relative risk:

- **Safety –** Potential for loss of containment of mine waste and/or mine water for all options for tailings and waste rock management. This hazard is often described as a dam breach for a water containing facility; however a similar hazard also exists for a waste pile (tailings and/or waste rock). Safety of the waste pile will consider downstream impacts and resulting consequences of failure to provide a consistent basis of comparison with a tailings

impoundment. Safety hazards were considered separately for mining dams, filtered tailings waste piles, and water retaining dams:

- **Mining Dams –** Loss of containment resulting from failure of a mining dam confining tailings and/or waste rock and water could lead to discharge of free water from the facility. Free water will then mobilize solids, including tailings and/or waste rock from the impoundment and construction material from the dam itself. Failure of an earthen dam typically occurs over a matter of minutes to hours with a flood wave rising as the breach develops, peaking at some point during discharge and then receding as the flood wave subsides. A flood wave will propagate downstream of the dam causing significant erosion and inundating the downstream receiving environment.
- **Filtered Tailings Waste Piles –** Tailings slumping could occur from loading of an inadequately compacted or high moisture content area of filtered tailings, slope failure, and foundation failure. A significant storm event could also cause erosion with runoff mobilizing tailings from the waste pile. The resulting consequences downstream will depend on the magnitude of the movement or the storm event, and the infrastructure downstream of the waste pile.

  Any water collection ponds located downstream of a filtered tailings waste pile will be at risk of overtopping due to tailings slumping, displacement of water, and a resulting wave. Loss of containment of a water pond due to overtopping from a tailings slump could also lead to release of the slumped tailings solids. A storm event generating runoff from the waste pile could lead to the release of tailings solids downstream if the storm event exceeds the storage capacity of the downstream water management structures.
- **Water Retaining Dams –** Loss of containment of a water retaining dam due to piping, slope failure, foundation failure, or earthquake deformation could lead to discharge of mine water. The free water will mobilize construction material from the dam itself. The failure will cause a flood wave that will propagate downstream of the dam causing significant erosion and inundating the downstream receiving environment. The resulting failure will be similar to a mining dam, but without significant mobilization of mine waste material. The downstream consequences will be due to the impacts from the quality of water released and from flooding and downstream erosion.

- **Environment –** The hazard considered for each candidate was based on the potential for unplanned loss or discharge of effluent. This hazard applies to all candidates and includes unplanned spilling from an environmental control dam spillway, unplanned discharge from a water treatment facility and/or tailings pipeline rupture leading to loss of tailings to the environment. In particular, the risk of ML/ARD was evaluated.
  - **ML/ARD –** In the Application/EIS, PAG waste rock generated through mining is to be flooded within about 1 year in order to prevent ARD. NAG3 waste rock is to be flooded within about 3 to 5 years to minimize ML. The acid generating potential of the PAG waste rock and significant ML release from NAG3 waste rock can be mitigated by submergence (i.e., reduction of oxygen transfer). The study includes options for comparison that consider subaerial and unsaturated storage of these waste rock types in on-land mine waste piles. Storage in this latter manner will not prevent the onset of acidic drainage and

metal leaching conditions, but rather will rely on collection and treatment to manage the environmental risks associated with these candidates. The consequences of failure to collect or properly treat contaminated water are exacerbated for these candidates.

- **Technical Execution** – The hazard considered for each candidate was based on the application of complex technology resulting in an inability to meet design criteria. A single hazard related to the majority of the candidates and involved difficult implementation of the design due to a failure of tailings management, distribution and/or placement. This hazard includes the difficulty associated with co-disposal of mine waste rock with tailings if applicable.

## 6.3 HIGH LEVEL RISK ASSESSMENT RESULTS

### 6.3.1 Risk Summaries

Tables 6.3-1 and 6.3-2 present summaries of the risk assessment for the 13 candidates being assessed in the HLRA.

### 6.3.2 Risk Results

#### *6.3.2.1 Thickened Slurry Candidates*

Summaries of the risk scores for safety, environment, and technical execution are presented in Table 6.3-3. Candidate 1 has the lowest total risk score of the slurry tailings candidates, as well as the lowest risk score for each of the hazard categories. Candidate 1 will advance to the MAA.

#### *6.3.2.2 Filtered Candidates*

Summaries of the risk scores for safety, environment, and technical execution for filtered candidates are presented in Table 6.3-4. Candidate 7 has the lowest overall score (tied with Candidate 22; see Section 6.3.2.3) and the lowest score with respect to the environmental hazard. Candidate 7 was the selected filtered tailings candidate to carry into the MAA.

#### *6.3.2.3 Physical Stability Candidates*

Summaries of the risk scores for safety, environment, and technical execution for on-land candidates are presented in Table 6.3-5. Candidate 22 has the lowest overall score and the lowest score with respect to the technical execution. Candidate 22 was the selected filtered tailings candidate to carry into the MAA.

#### *6.3.2.4 Paste Candidate*

The results of the HLRA were presented to the WG in a meeting on August 13, 2015. A request was provided to New Gold by Ministry of Energy and Mines (MEM) following that meeting to consider including Candidate 10 in the MAA because it could be argued that the paste option differs from the other thickened-slurry and filtered tailings technologies. Therefore, New Gold included Candidate 10 into the subsequent MAA analyses.

**Table 6.3-1. High Level Risk Assessment: Risk Assessment Summary – Thickened Slurry/Paste Tailings Candidates**

| Candidate | | Safety | Environment | Technical Execution | Summary[1] |
|---|---|---|---|---|---|
| 1 | Likelihood | A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the dam impounding tailings and PAG waste rock will pose the greatest safety risk for the candidate. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment was classified as **very rare (1)** because it is designed for maximum credible events (MCE and PMF) and the tailings beach will provide separation of the supernatant pond from the dam. | A loss of dam runoff and seepage from the seepage collection pond downstream of the TSF will pose the greatest environmental risk for the candidate. A loss of effluent from the seepage collection pond downstream of the TSF will require a storm event greater than allowed for in design storage requirements and will require that the effluent during that storm is of degraded quality. The likelihood was classified as **unlikely (2)** corresponding to a discharge during a storm event with a return period greater than 1 in 100 years. | A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk for the candidate. A beach will be developed upstream of the dam while maintaining an appropriate level of freeboard. Issues with development of the beach could occur during the mine life, especially during the early years of operation of Site D, and were classified as **likely (4)**. | |
| | Consequence | A discharge of mine waste and water causing a flood wave has the potential to create irreparable damage and serious long term impairment to the downstream environment due to the presence of PAG/NAG3 materials within the impoundment. This could leave the area directly downstream unavailable for traditional land use activities for the foreseeable future and have short- to medium-term effects further downstream. The consequence of occurrence was classified as **catastrophic (5)**. | Submergence within the TSF will limit the ML and ARD potential of the PAG/NAG3 waste rock thereby controlling seepage quality. Any elevated parameters of concern would be heavily diluted by inflows. The potential consequences would be short term and limited to a small area of Davidson Creek and were classified as **minor (2)**. | Tailings discharge locations could be easily modified or alterations to the spigot locations implemented to manage the beach location while operations continue. The consequences were classified as **insignificant (1)**. | |
| | Risk rating[2] | **5** | **4** | **4** | **13** |
| 4 | Likelihood | A flood wave in Creek 661 and Tatelkuz Lake resulting from a breach of the mining dam impounding tailings and PAG waste rock will pose the greatest safety risk for the candidate. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment was classified as **very rare (1)** because it is designed for maximum credible events (MCE and PMF) and the tailings beach will provide separation of the supernatant pond from the dam. | A loss of dam runoff and seepage from one of the seepage collection ponds downstream of the TSF will pose the greatest environmental risk for the candidate. A loss of effluent from the seepage collection ponds will require a storm event greater than allowed for in design storage requirements and will require that the effluent during that storm is of degraded quality. The likelihood was classified as **possible (3)** corresponding to a discharge during a storm event with a return period greater than 1 in 20 years. | A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk for the candidate. A beach will be developed upstream of the dam while maintaining an appropriate level of freeboard. Issues with development of the beach could occur during the mine life due to the rate of rise and shape of the facility, and were classified as **likely (4).** | |
| | Consequence | A discharge of mine waste and water causing a flood wave has the potential to create irreparable damage and serious long-term impairment to the downstream environment due to the presence of PAG/NAG3 materials within the impoundment. This could leave the area directly downstream unavailable for traditional land use activities for the foreseeable future and have short to medium term effects further downstream. The consequence of occurrence was classified as **catastrophic (5)**. | Submergence within the TSF will limit the ARD potential of the PAG waste rock thereby controlling seepage quality. The potential consequences would be short term and limited to a small area of Creek 661 and were classified as **minor (2).** | Tailings discharge locations could be modified but the shape of the facility cannot without substantial business impacts. The consequence was classified as **minor (2)** representing periodic day long shutdowns to regain control of beach development | |
| | Risk rating | **5** | **6** | **8** | **19** |
| 10 (Paste) | Likelihood | A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the dam impounding paste tailings and PAG/NAG3 waste rock will pose the greatest safety risk. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment could be considered rare because it is designed for maximum credible events (MCE and PMF); however, it is somewhat more susceptible to failure since there is no tailings beach and embankment deformation impacting available freeboard could result in an overtopping failure. Therefore, the likelihood was classified as **unlikely (2)**. | A loss of dam runoff and seepage from the seepage collection pond downstream of the waste rock submergence impoundment will pose the greatest environmental risk for the candidate. The likelihood was classified as **unlikely (2)** corresponding to a discharge during a storm event with a return period greater than 1 in 100 years. | A failure to achieve the design level of thickening will pose the greatest technical risk for the candidate. A reduction in the level of thickening could result in generation of supernatant water at the surface of the facility leading to a larger than anticipated pond volume. It is expected that difficulties with thickening will be **likely (4)**, occurring multiple times through the mine life. | |
| | Consequence | A discharge of mine waste and water causing a flood wave has the potential to create irreparable damage and serious long term impairment to the downstream environment due to the presence of PAG/NAG3 materials within the impoundment. This could leave the area directly downstream unavailable for traditional land use activities for the foreseeable future and have short to medium term effects further downstream. The consequence of occurrence was classified as **catastrophic (5)**. | Any elevated parameters of concern would be heavily diluted by inflows. The potential consequences would be short term and limited to a part of Davidson Creek and were classified as minor **(2)**. | The effect of reduced thickening will be **minor (2)**, as short delays to production may be required for maintenance of the plant. The TSF could be dewatered to manage excess water or the location of spigots changed to provide better coverage of PAG/NAG3 waste rock in the event of thickening issues. | |
| | Risk Rating | **10** | **4** | **8** | **22** |

*(continued)*

| Candidate | | Safety | Environment | Technical Execution | Summary[1] |
|---|---|---|---|---|---|
| 13 | Likelihood | The candidate will have a TSF located in the upper reaches of Turtle Creek, with a second impoundment near the mine site for submergence of PAG/NAG3 waste rock. A flood wave in Davidson Creek or Turtle Creek and lower Chedakuz Creek resulting from a breach of either facility will pose the greatest safety risk for the candidate. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment could be considered rare because it is designed for maximum credible events (MCE and PMF); however, it is somewhat more susceptible to failure since there are two facilities separated by a large distance. Therefore, the likelihood was classified as **unlikely (2)**. | A loss of tailings from the pipeline leading to the storage facility on Turtle Creek will pose the greatest environmental risk for the candidate. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered **possible (3)**. | A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk for the candidate. A beach will be developed upstream of the dam while maintaining an appropriate level of freeboard. Issues with development of the beach could occur during the mine life and were classified as **likely (4)**. | |
| | Consequence | The consequence of occurrence was classified as **catastrophic (5)** due to the potential for loss of mine waste and water. | A loss of tailings could result in **moderate (3)** impacts with short to medium term effect on the local ecosystem and impacts to traditional land use activities. | Tailings discharge locations could be easily modified or alterations to the spigot locations implemented to manage the beach location while operations continue. The consequence was classified as **insignificant (1)**. | |
| | Risk Rating | **10** | **9** | **4** | **23** |
| 15 | Likelihood | The candidate will have a TSF located in the upper reaches of an unnamed catchment north of Turtle Creek, with a second impoundment near the mine site for submergence of PAG/NAG3 waste rock. A flood wave in Davidson Creek and/or Chedakuz Creek resulting from a breach of either facility will pose the greatest safety risk. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment could be considered rare because it is designed for maximum credible events (MCE and PMF); however, it is somewhat more susceptible to failure since there are two facilities separated by a large distance. Therefore, the likelihood was classified as **unlikely (2)**. | A loss of tailings from the pipeline leading to the TSF will pose the greatest environmental risk for the candidate. The pipeline route is long and traverses multiple catchments. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered **likely (4)**. | A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk for the candidate. Issues with development of the beach could occur during the mine life and it was classified as **likely (4).** | |
| | Consequence | The consequence of occurrence was classified as **catastrophic (5)** due to the potential for loss of mine waste and water. | A loss of tailings could result in **moderate (3)** impacts with short to medium term effect on the local ecosystem and impacts to traditional land use activities. | Tailings discharge locations could be easily modified or alterations to the spigot locations implemented to manage the beach location while operations continue. The consequence was classified as **insignificant (1)**. | |
| | Risk Rating | **10** | **12** | **4** | **26** |
| 23 | Likelihood | A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the tailings dam will pose the greatest safety risk for the candidate. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment was classified as **very rare (1)** because it is designed for maximum credible events (MCE and PMF) and the tailings beach will provide separation of the supernatant pond from the dam. | A failure of the water treatment system for the on-land PAG/NAG3 waste rock dump would pose the greatest environmental risk for the candidate. A discharge of untreated or inadequately treated effluent was classified as **possible (3)** due to the potential for rapidly changing or variable water quality or quantity coming off a dump with the potential for acid drainage. | A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk. Issues with development of the beach could occur during the mine life and it was classified as **likely (4)**. | |
| | Consequence | This could leave the area directly downstream unavailable for traditional land use activities for the foreseeable future and have short to medium term effects further downstream. The consequence of occurrence was classified as **catastrophic (5)**. | A discharge of mine water from has the potential to create short to medium term effects Davidson Creek through a slug of mine water and consequences were classified as **moderate (3)**. | Tailings discharge locations could be easily modified or alterations to the spigot locations implemented to manage the beach location while operations continue. The consequence was classified as **insignificant (1)**. | |
| | Risk Rating | **5** | **9** | **4** | **18** |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project, Alternatives Technology Options Study. VA101-457/15-1*

[1] *Summary risk = safety risk rating + environmental risk rating + technical execution risk rating*

[2] *Risk rating = likelihood score x consequence score*

**Table 6.3-2. High Level Risk Assessment: Risk Assessment Summary – Filtered Tailings Candidates**

| Candidate | | Safety | Environment | Technical Execution | Summary[1] |
|---|---|---|---|---|---|
| 5 | Likelihood | A loss of containment of the process water pond will pose the greatest safety risk for the candidate. This could occur from slumping of the tailings and waste rock pile leading to overtopping of the process water pond dam, or from failure of the dam itself. The likelihood of failure was classified as **unlikely (2).** | A loss of effluent from the process water pond downstream of the TSF will pose the greatest environmental risk for the candidate. A loss of effluent from the water management pond will require a storm event greater than allowed for in design storage requirements and/or failure of a water treatment system. The pond was designed to contain a 1 in 200 year storm event, and to pass any larger events through a spillway. The likelihood was classified as **unlikely (2).** | A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for the candidate. Tailings produced and maintained at moisture content approximately equal to optimum will be imperative for field compaction. Tailings dewatering at the mill will be impacted by consistency of the grind, mineralogy, and solids content delivered to the filter plant. Transport of filtered tailings to the waste pile will require a seamless operation reliant on truck and conveyor transport. Precipitation events during placement in the field will potentially increase moisture content of the tailings and inhibit compaction. Issues with tailings filtering, transport, placement, and compaction were classified as **likely (4)**. | |
| | Consequence | A discharge of mine water from the dam has the potential to create serious medium-term effects to Davidson Creek through a slug of mine water and flood wave erosion. This could leave the area directly downstream unavailable for traditional land use activities for an extended period of time but should be recoverable because the failure will not lead to a release of mine waste materials to the environment. The consequence of occurrence was classified as **major (4)**. | A release of ML and ARD runoff has the potential to occur with storage of PAG/NAG3 waste rock on land. A discharge of mine water from the dam has the potential to create short to medium term effects on Davidson Creek through a slug of mine water and consequences were classified as **moderate (3).** | Weather conditions are expected to have a greater impact during the winter months when precipitation falls as snow, and could impact short term operations and long-term stability. Areas not meeting design requirements could result in re-work to meet specifications. The filtered tailings will be co-disposed with PAG/NAG3 waste rock, which increases the potential for delays in placement due to complications in waste disposal planning. These issues were classified as a **major (4)** consequence corresponding to the potential for a production delay between one week and one month. | |
| | Risk rating | **8** | **6** | **16** | **30** |
| 6 | Likelihood | A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the dam impounding PAG/NAG3 waste rock will pose the greatest safety risk for the candidate. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment could be considered rare because it is designed for maximum credible events (MCE and PMF); however, it is somewhat more susceptible to failure since there is no tailings beach and embankment deformation impacting available freeboard could result in an overtopping failure. The likelihood was classified as **unlikely (2)**. | A loss of dam runoff and seepage from the seepage collection pond downstream of the submergence impoundment will pose the greatest environmental risk for the candidate. A loss of effluent from the seepage collection pond downstream of the TSF will require a storm event greater than allowed for in design storage requirements and will require that the effluent during that storm is of degraded quality. The likelihood was classified as **unlikely (2)** corresponding to a discharge during a storm event with a return period greater than 1 in 100 years. | A failure to meet design specifications for filtered tailings will pose the greatest technical challenge. Issues with tailings filtering, transport, placement, and compaction were classified as **likely (4)**. | |
| | Consequence | A discharge of mine waste and water causing a flood wave has the potential to create irreparable damage and serious long term impairment to the downstream environment due to the presence of PAG/NAG3 materials within the impoundment. This could leave the area directly downstream unavailable for traditional land use activities for the foreseeable future and have short to medium term effects further downstream. The consequence of occurrence was classified as **catastrophic (5)**. | Submergence within the impoundment will limit the ARD and ML potential of the PAG/NAG3 waste rock thereby controlling seepage quality. The location of the tailings waste pile in a sidehill arrangement slightly increases the potential for degraded seepage quality at the time of the event. Any elevated parameters of concern would be heavily diluted by inflows. The potential consequences would be short to medium term and limited to a part of Davidson Creek and were classified as **moderate (3)**. | These issues were classified as a **moderate (3)** consequence corresponding to the potential for a production delay between one day and one week. | |
| | Risk Rating | **10** | **6** | **12** | **28** |
| 7 | Likelihood | A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the dam impounding PAG/NAG3 waste rock will pose the greatest safety risk for the candidate. The likelihood was classified as **unlikely (2)**. | A loss of dam runoff and seepage from the seepage collection pond downstream of the submergence impoundment will pose the greatest environmental risk for the candidate. The likelihood was classified as **unlikely (2)** corresponding to a discharge during a storm event with a return period greater than 1 in 100 years. | A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for the candidate. Issues with tailings filtering, transport, placement, and compaction were classified as **likely (4)**. | |
| | Consequence | The consequence of occurrence was classified as **catastrophic (5)** (see rating for Candidate 6). | Any elevated parameters of concern would be heavily diluted by inflows. The potential consequences would be short term and limited to a part of Davidson Creek and were classified as **minor (2).** | These issues were classified as a **moderate (3)** consequence corresponding to the potential for a production delay between one day and one week. | |
| | Risk Rating | **10** | **4** | **12** | **26** |

*(continued)*

| Candidate | | Safety | Environment | Technical Execution | Summary[1] |
|---|---|---|---|---|---|
| 12 | Likelihood | An impoundment will be positioned near the mine site area for PAG/NAG3 waste rock submergence. A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the impoundment will pose the greatest safety risk. The likelihood was classified as **unlikely (2)**. | A loss of tailings from the pipeline leading to the storage facility will pose the greatest environmental risk for the candidate. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered **possible (3)**. | A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for the candidate. Issues with tailings filtering, transport, placement, and compaction were classified as **likely (4)**. | |
| | Consequence | The consequence of occurrence was classified as **catastrophic (5)** due to the potential for loss of mine waste and water. | A loss of tailings could result in **moderate (3)** impacts with short to medium term effect on the local ecosystem and impacts to traditional land use activities. | These issues were classified as a **moderate (3)** consequence corresponding to the potential for a production delay between one day and one week. | |
| | Risk Rating | **10** | **9** | **12** | **31** |
| 14 | Likelihood | An impoundment will be positioned near the mine site area for PAG/NAG3 waste rock submergence. A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the impoundment will pose the greatest safety risk for the candidate. The likelihood was classified as **unlikely (2)**. | A loss of tailings from the pipeline leading to the storage facility on Turtle Creek will pose the greatest environmental risk for the candidate. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered **possible (3)**. | A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for the candidate. Issues with tailings filtering, transport, placement, and compaction were classified as **likely (4)**. | |
| | Consequence | The consequence of occurrence was classified as **catastrophic (5)** due to the potential for loss of mine waste and water. | A loss of tailings could result in **moderate (3)** impacts with short to medium term effect on the local ecosystem and impacts to traditional land use activities. | These issues were classified as a **moderate (3)** consequence corresponding to the potential for a production delay between one day and one week. | |
| | Risk Rating | **10** | **9** | **12** | **31** |
| 16 | Likelihood | The candidate will have a filtered tailings waste pile located in the lower reaches of the Chedakuz Creek catchment, with an impoundment near the mine site for submergence of PAG/NAG3 waste rock. A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the impoundment will pose the greatest safety risk. The likelihood was classified as **unlikely (2)**. | A loss of tailings from the pipeline leading to the storage facility on Turtle Creek will pose the greatest environmental risk for the candidate. The pipeline route is long and traverses multiple catchments. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered **likely (4)**. | A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for the candidate. Issues with tailings filtering, transport, placement, and compaction were classified as **likely (4)**. | |
| | Consequence | The consequence of occurrence was classified as **catastrophic (5)** due to the potential for loss of mine waste and water. | A loss of tailings could result in **moderate (3)** impacts with short to medium term effect on the local ecosystem and impacts to traditional land use activities. | These issues were classified as a **moderate (3)** consequence corresponding to the potential for a production delay between one day and one week. | |
| | Risk Rating | **10** | **12** | **12** | **34** |
| 22 | Likelihood | A loss of containment of the process water pond will pose the greatest safety risk for the candidate. This could occur from slumping of the filtered tailings pile leading to overtopping of the process water pond dam, or from failure of the dam itself. The likelihood of failure was classified as **unlikely (2)** because the process water pond is susceptible to additional failure potential as a result of the tailings pile, and because embankment deformation impacting available freeboard could result in an overtopping failure. | A loss of dam runoff and seepage from the process water pond downstream of the TSF will pose the greatest environmental risk for the candidate. A loss of effluent from the water management pond will require a storm event greater than allowed for in design storage requirements and/or failure of a water treatment system. The pond was design to contain a 1 in 200 year storm event, and to pass any larger events through a spillway. A loss of ML and ARD runoff has the potential to occur as storage of PAG waste rock on land will lead to ARD. The likelihood was classified as **unlikely (2).** | A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for the candidate. Issues with tailings filtering, transport, placement, and compaction were classified as **likely (4)**. | |
| | Consequence | A discharge of mine water from the dam has the potential to create serious medium-term effects to Davidson Creek through a slug of mine water and flood wave erosion. This could leave the area directly downstream unavailable for traditional land use activities for an extended period of time but should be recoverable because the failure will not lead to a release of mine waste materials to the environment. The consequence of occurrence was classified as **major (4)**. | A discharge of mine water from the dam has the potential to create short to medium term effects Davidson Creek through a slug of mine water and consequences were classified as **moderate (3)**. | These issues were classified as a **moderate (3)** consequence corresponding to the potential for a production delay between one day and one week. | |
| | Risk Rating | **8** | **6** | **12** | **26** |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project, Alternatives Technology Options Study. VA101-457/15-1*

*[1] Summary risk = safety risk rating + environmental risk rating + technical execution risk rating*

*[2] Risk rating = likelihood score x consequence score*

**Table 6.3-3. Summary of High-Level Risk Assessment Scores – Thickened Slurry Candidates**

| Candidate | Safety | Environment | Technical Execution | Total Score |
|---|---|---|---|---|
| 1 | 5 | 4 | 4 | 13 |
| 4 | 5 | 6 | 8 | 19 |
| 10 | 10 | 4 | 8 | 22 |
| 13 | 10 | 9 | 4 | 23 |
| 15 | 10 | 12 | 4 | 26 |
| 23 | 5 | 9 | 4 | 18 |

*Source: Knight Piésold Ltd. 2015.* Blackwater Gold Project, Alternatives Technology Options Study. VA101-457/15-1

**Table 6.3-4. Summary of High-Level Risk Assessment Scores – Filtered Candidates**

| Candidate | Safety | Environment | Technical Execution | Total Score |
|---|---|---|---|---|
| 5 | 8 | 6 | 16 | 30 |
| 6 | 10 | 6 | 12 | 28 |
| 7 | 10 | 4 | 12 | 26 |
| 12 | 10 | 9 | 12 | 31 |
| 14 | 10 | 9 | 12 | 31 |
| 16 | 10 | 12 | 12 | 34 |
| 22 | 8 | 6 | 12 | 26 |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project, Alternatives Technology Options Study. VA101-457/15-1*

**Table 6.3-5. Summary of High-Level Risk Assessment Scores – Physical Stability Candidates**

| Candidate | Safety | Environment | Technical Execution | Total Score |
|---|---|---|---|---|
| 5 | 8 | 6 | 16 | 30 |
| 22 | 8 | 6 | 12 | 26 |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project, Alternatives Technology Options Study. VA101-457/15-1*

### 6.3.3 Summary

The HLRA identified four candidates with the lowest risk profile for each of the distinct tailings and waste rock technologies. The four candidates carried forward into the MAA are:

- Candidate 1 – Thickened slurry tailings with submerged PAG/NAG3 waste rock;
- Candidate 7 – Filtered 'dry stack' tailings with submerged PAG/NAG3 waste rock;
- Candidate 10 – Paste tailings with submerged PAG/NAG3 waste rock; and
- Candidate 22 – Filtered 'dry stack' tailings with PAG/NAG3 waste rock on land.

# 7. STEP 4 – MULTIPLE ACCOUNTS ANALYSIS

This section characterizes the potential effects from the four selected alternatives (from the pre-screening assessment) on selected Project's Valued Components (VCs) using a modified MAA methodology defined in EC's (2011) *Guidelines* (however, physical stability is pulled into a separate account), and based on the Canadian Environment Assessment Agency's (2013) *Operational Policy Statement Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012*. Since the VCs evaluate the potential effects on environmental, social, economic, heritage, and health aspects of the entire Project, they are not all necessarily relevant to the evaluation of tailings and PAG waste rock management alternatives. Table 7-1 provides a list of the Project's VCs and rationale for inclusion or exclusion for this assessment. This section includes descriptions of:

- Overview descriptions of the four short-listed candidate alternatives (Section 7.1);
- Characterization of the physical stability, technical, environmental, human environment, and Project economics considerations of each candidate (Section 7.2);
- Evaluation of the multiple accounts ledger (MAL) created from the above characterization (i.e., differentiating characterization criteria; Section 7.3);
- Base case value-based weighting and analysis of factors listed within the MAL (Section 7.4);
- Quantitative analysis to select the preferred alternative for the base case (Section 7.5); and
- Sensitivity analysis to evaluate different value systems (Section 7.6).

**Table 7-1. Consideration of Valued Components in the Multiple Accounts Analysis**

| Blackwater Gold Project Valued Component | Included in Assessment of Tailings and Waste Rock Management Alternatives | Rationale for Exclusion or Description of How Valued Component is Considered in the Analysis (*sub-account*: indicator(s)) |
|---|---|---|
| **Environment Valued Components** | | |
| Noise and vibration | Yes | *Climate and air quality*: noise and vibration |
| Climate change | Yes | *Climate and air quality*: sensitivity to climate change |
| Air quality | Yes | *Climate and air quality*: dust emissions |
| Surface water flow | Yes | *Surface water quantity*: loss of catchment area |
| Surface water quality | Yes | *Surface water quality*: storage of PAG material; seepage quantity; dam embankment area; operational discharge of treated water |
| Groundwater quantity | Yes | *Groundwater*: groundwater quantity (baseflow to downstream creeks) |
| Groundwater quality | Yes | *Groundwater*: groundwater quality |
| Wetlands | Yes | *Terrestrial ecosystems*: loss and risk to wetlands |
| Fish Habitat | Yes | *Fish, fish habitat and aquatic resources*: fish habitat |

*(continued)*

| Blackwater Gold Project Valued Component | Included in Assessment of Tailings and Waste Rock Management Alternatives | Rationale for Exclusion or Description of How Valued Component is Considered in the Analysis (*sub-account*: indicator(s)) |
|---|---|---|
| **Environment Valued Components *(cont'd)*** | | |
| Fish | Yes | *Fish, fish habitat and aquatic resources*: risks to non-CRA fisheries and aquatic resources. Risks to CRA fish species, and presence of rare and endangered aquatic species were characterized but were not found to be differentiating among alternatives and were not carried forward into the MAL |
| Physiography and topography | Yes | Considered under technical account, *Containment design*: style of containment |
| Terrain and soil | Yes | *Terrain and soil*: high quality soil |
| Ecosystem composition | Yes | *Terrestrial ecosystems*: loss and risk to wetlands, as a proxy |
| Plant species and ecosystems at risk | Yes | *Terrestrial ecosystems*: loss and risk to wetlands, as a proxy |
| Amphibians | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for species of conservation concern; toxicological risk to migratory birds, amphibians, and bats |
| Water birds | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for species of conservation concern; toxicological risk to migratory birds, amphibians, and bats |
| Forest and grassland birds | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for species of conservation concern; toxicological risk to migratory birds, amphibians, and bats; toxicological risk to terrestrial wildlife species |
| Moose | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for moose; toxicological risk to terrestrial wildlife species |
| Caribou | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for caribou; toxicological risk to terrestrial wildlife species |
| Grizzly bear | Yes | *Wildlife and wildlife habitat*: toxicological risk to terrestrial wildlife species |
| Furbearers | Yes | *Wildlife and wildlife habitat*: toxicological risk to terrestrial wildlife species |
| Bats | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for species of conservation concern; toxicological risk to migratory birds, amphibians, and bats |
| Invertebrates | Yes | *Wildlife and wildlife habitat*: toxicological risk to terrestrial wildlife species |
| **Social Valued Components** | | |
| Demographics | No | Any potential changes to demographics resulting from the alternatives are unlikely to be differentiating among alternatives. |

*(continued)*

| Blackwater Gold Project Valued Component | Included in Assessment of Tailings and Waste Rock Management Alternatives | Rationale for Exclusion or Description of How Valued Component is Considered in the Analysis (*sub-account*: indicator(s)) |
|---|---|---|
| **Social Valued Components** *(cont'd)* | | |
| Regional and community infrastructure | No | Any potential changes to regional and community infrastructure resulting from the various options are unlikely to be differentiating among alternatives. |
| Regional and local services | No | Any potential changes to regional and local services resulting from the various options are unlikely to be differentiating among alternatives. |
| Family and community well-being | No | Any potential changes to family and community well-being resulting from alternatives are unlikely to be differentiating among alternatives. |
| Non-traditional land and resource use | Yes | *Non-traditional land use*: agricultural and range tenures; registered traplines<br>*Public recreation*: overlap of areas with recreational sensitivity and significance<br>Guide outfitting licenses were characterized but were not found to be differentiating among alternatives and were not carried forward into the MAL |
| Current land use for traditional purposes | Yes | *Current use of lands and resources for traditional purposes* (CULRTP):was characterized individually for the following Aboriginal groups or governmental organizations: LDFN, NWFN, NFN, Métis, SFN, STN, StFN, UFN, and TNG. Each of these groups or organizations were characterized for: availability (abundance and distribution) of resources harvested by Aboriginal people; access to Aboriginal hunting areas and cultural sites; quality of resources harvested by Aboriginal groups; and quality of Aboriginal harvesters' experience. |
| Visual resources | No | As the Project is relataively isolated (>15 km) from local communities, as well as Indian Reserves, provincial parks, protected areas, and recreational areas, visual resources are not anticipated to be different among alternatives. Further no alternatives are within established areas of visual quality objectives (VQOs) which are derived from the physical characteristics and the social concern for the area and identified under the *Forest Practices and Range Act* (2002b). |
| **Heritage Valued Components** | | |
| Archaeological sites | Yes | *Heritage*: known archaeological sites |
| Historic heritage sites | No | No known historic heritage sites have the potential to overlap with candidate alternatives |
| Paleontological resources | No | No known paleontological resources exist in the Project area |

*(continued)*

| Blackwater Gold Project Valued Component | Included in Assessment of Tailings and Waste Rock Management Alternatives | Rationale for Exclusion or Description of How Valued Component is Considered in the Analysis (*sub-account*: indicator(s)) |
|---|---|---|
| **Human Health Valued Components** | | |
| Environmental exposures | Yes | *Human health*: potential health risks |
| Workers health and safety | No | Project activities will adhere to all applicable laws and standards including the provincial *Mines Act* (1996b) and Health Safety and Reclamation Code (BC MEMPR 2008). No new or novel construction, operational or closures practices are proposed for any alternative; as such worker health and safety concerns are not expected to be differentiating among the alternatives |
| **Economic Valued Components** | | |
| Provincial economy | No | Alternatives are unlikely to differentially impact the overall provincial economy as a result of initial capital costs; sustaining capital and operating costs and closure costs. During operations, the Project would pay annual taxes of $2.3 million per year |
| Regional and local employment and businesses | Yes | *Employment*: employment opportunities |
| Regional and local government finance | No | Overall, Project construction and operations will have net positive effects on regional and local finances. During operations, the Project would pay annual taxes of $2.3 million per year to the BC Surveyor of Taxes, with these funds being used to support the activities of the three regional districts in the Project area, as well as other regional districts in BC. These taxes will largely be independent of the alternative selected for the Project and this valued component will not be discussed further in this report. |

## 7.1 CANDIDATE DESCRIPTIONS

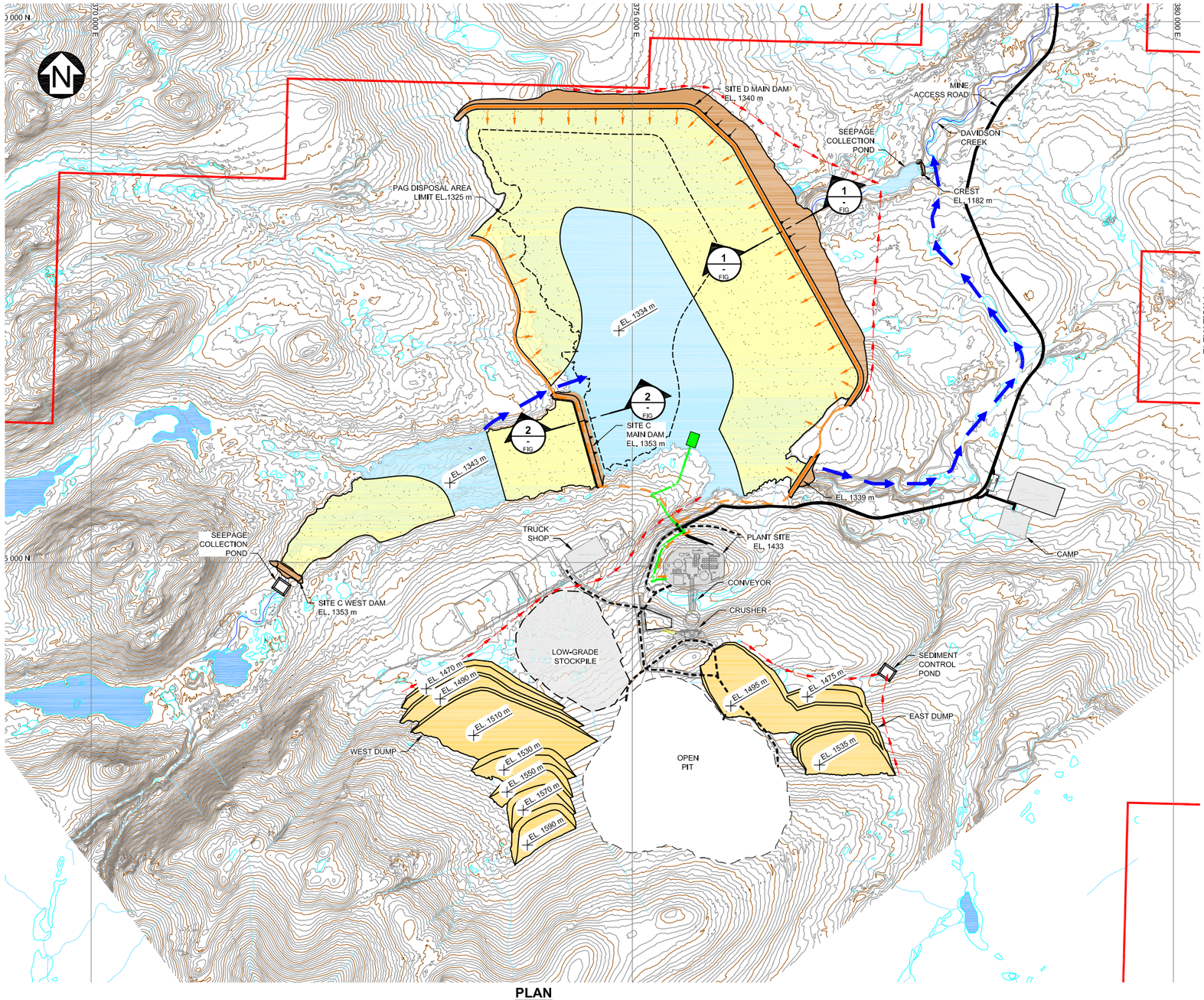
A summary of the four candidates evaluated in this MAA is provided below. Detailed descriptions of these candidates are included in Appendices B and C.

### 7.1.1 Candidate 1 – Thickened - Slurry Tailings / Submerged PAG/NAG3

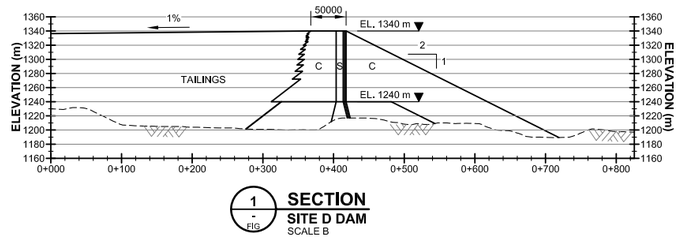
Candidate 1 is a thickened-slurry tailings alternative located in the upper reaches of the Davidson Creek catchment (ultimate arrangement is presented in Figure 7.1-1). The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The impoundment will be created in a staged manner consisting of two nested TSF sites. The facility was designed to permanently store tailings, PAG/NAG3 waste rock, and operational supernatant pond allowance, and capacity to contain the IDF with additional freeboard for wave run-up. The upper facility (Site C) will be constructed first with two dams to contain the first two years of tailings and waste rock.

**Figure 7.1-1**
**Candidate 1 – Slurry Tailings / Submerged PAG/NAG3**

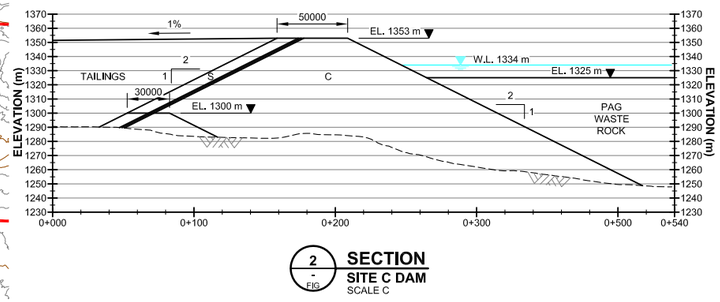
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**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




1 - FIG **SECTION**
**SITE D DAM**
SCALE B




2 - FIG **SECTION**
**SITE C DAM**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY (CLOSURE ONLY)
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD 83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

A third, larger dam will be constructed downstream to expand the impoundment into the lower facility (Site D) to contain the remaining 15 years of tailings and waste rock. A fourth, smaller saddle dam will be required late in mine life to maintain containment. The impoundment will form a valley fill type arrangement and will be constrained by natural topography to the south and west.

The TSF Site C Main and West Dams will be constructed to elevation 1353 m and TSF Site D Main and Saddle Dam constructed to elevation 1,340 m. Construction of the dams will require a total of 74 $Mm^3$, sourced from pit stripping and external borrow sources. The earth-rockfill dams will be comprised of a core zone, filter zone, transition zone and shell zone. Filter and transition material will be sourced from a nearby aggregate borrow. The majority of the core zone and shell zone material will come from the open pit. The maximum height of the Site D Main Dam will be approximately 140 m.

Process water will be stored on site within the TSF to maintain the saturated condition of the mine waste materials and will be split between two ponds; one within each disposal area. The normal operating pond allowance for each pond will be 10 $Mm^3$. Tailings slurry will be conveyed by gravity in a pipeline to the TSF and the pipeline route will remain within the TSF catchment at all times.

The dam safety hazard classification for the tailings facility is VERY HIGH based on the technical bulletin *Application of Dam Safety Guidelines to Mining Dams* (CDA 2014). These guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the tailings dams.

The following suggested design levels were adopted from the CDA guidelines for Candidate 1 during the operational phase:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF);
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE).

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF;
- EDGM – MCE.

Tailings will be thickened to approximately 50% solids at the process plant and delivered by gravity through a pipeline to either the TSF Site C or Site D. The tailings distribution system includes a fully installed standby pipeline for operational flexibility. Tailings spigots will be located regularly along the dam crests for subaerial discharge of the tailings slurry. The slurry will segregate upon deposition with the coarsest sand particles settling near the discharge spigots and finer sands settling farther down the slope. Even finer silt and clay sized tailings particles will be carried out into the supernatant pond in suspension and will settle over a longer period of time. The segregation of coarser material will facilitate development of extensive tailings beaches providing separation of

the containment dams from the supernatant pond. Beach slopes will develop at an approximate grade of 1% away from the discharge point.

The PAG and NAG3 waste rock disposal area will be developed at the same or similar rate of rise as the tailings in the TSF, with the final tailings level several meters higher to provide complete submergence of PAG waste rock. The tailings beach will provide a low permeability transition between the coarse, permeable waste rock in the centre of the TSF and the tailings embankments. The extensive tailings beaches will provide seepage control and are an indicator of dam safety.

Seepage will be primarily controlled by the low-permeability core zone and cut-off trenches constructed prior to the development of tailings beaches. Seepage passing through the main embankment will be collected in embankment drains and conveyed to a seepage collection pond (Environmental Control Dam; ECD) downstream of the main dam. Seepage will be recycled back to the TSF. A small amount of unrecoverable seepage passing the collection and recycle system has the potential to affect one watershed: Davidson Creek.

#### *7.1.1.1 Water Management*

The catchment area without modification is 45 $km^2$ (4,500 ha), sufficient to maintain a water balance under average conditions until late in mine life. A surplus condition was predicted to develop beginning in Year 11 due to increasing runoff from the expanding disturbed areas of the mine facilities, and also from the decreases in waste rock production and corresponding decreases of water storage in waste rock voids for mine rock stored within TSF Site D. This was identified as a desirable condition during the Feasibility Study (Knight Pièsold 2014b) with this surplus water used to accelerate open pit filling and limit the onset of acid rock drainage conditions in the pit walls. It was also identified as a surplus condition that was easily manageable with additional fresh water diversions.

The TSF operational pond capacity is sufficient to manage a reasonable range of surplus or deficit water conditions. Water levels and pond bathymetry will be monitored to confirm that the water balance assumptions are accurate and that an operational surface water discharge from the TSF will not occur until closure. As a contingency, non-contact surface water diversions can be created to divert runoff away from the TSF.

The reclaim water system will initially utilize a barge-mounted pump station sized to deliver 3,200 $m^3$/hr of reclaim water (28 $Mm^3$ per year). The reclaim barge will be anchored in TSF Site C during Years 1 and 2 of operations, and then moved to TSF Site D late in Year 2 for the remainder of mine operations and closure. A reclaim structure will be constructed in TSF Site C during Year 2 with an equivalent pumping capacity to the reclaim barge. A volume of approximately 20 $Mm^3$ of water reclaim will be required each year from the tailings ponds, and will be combined with water from open pit dewatering and freshwater make-up sources to support the milling process.

A closure spillway will be constructed between Site C and Site D in Year 3 to passively control the maximum pond elevation in TSF Site C. A closure spillway will be constructed from Site D to Davidson Creek in the final year of operations.

#### *7.1.1.2 Technical Execution*

There are many examples of the mining projects utilizing slurry tailings with ore processing throughputs higher than 60,000 TPD. The proposed tailings technology is considered proven and not subject to any major implementation challenges. Slurry tailings have a proven history of application in similar climate conditions as the project site. The tailings distribution and discharge strategy is unlikely to be affected in a significant way by any weather conditions. Extreme wet conditions can impact available storage capacity; however, this consideration was addressed in the design of the alternative. The technology is the most flexible from an operational standpoint. A fully installed backup distribution system and emergency discharge system were included in the design. Tailings discharge will not be the limiting factor for operational reliability.

#### *7.1.1.3 Closure*

Upon mine closure, surface facilities will be removed in stages and full reclamation of the TSF will be initiated. The closure plan is compatible with a premature closure event. General aspects of the closure plan include:

- Selective discharge of tailings around the facility during the final years of operations to establish and flatten the final tailings beach to facilitate surface water management and reclamation.
- Placing an oxide tailings cover up to 3 m thick on Site C beaches such that transition and sulphide tailings remain saturated over a wide range of precipitation conditions.
- Placing an oxide tailings/overburden cover up to 5 m thick on the Site D beach such that transition and sulphide tailings remain saturated over a wide range of precipitation conditions.
- Covering the exposed tailings beaches and PAG/NAG3 waste rock with approximately 30 cm of overburden.
- Establishing wetlands and revegetating the upland beaches.
- Pumping the tailings pond supernatant to the pit for about 18 years to expedite the development of the pit lake and flooding of the majority of PAG/NAG3 waste rock in the ultimate pit walls.
- Dismantling and removing the tailings and reclaim delivery systems and all pipeline structures, and equipment not required beyond mine closure.
- Constructing spillways and overflow channels.
- Removing the seepage collection pumpback systems at such time that suitable water quality for direct release is achieved.
- Establishing polishing wetlands for treatment of seepage.
- Removing and re-grading all access roads, ponds, ditches, and borrow areas not required beyond mine closure.
- Long-term stabilization of all exposed erodible materials.

The remaining NAG waste rock dump areas not progressively reclaimed will be reclaimed with overburden and re-vegetated. The low grade stockpile pad will be tested for contamination and removed and disposed of as required in the open pit or TSF. The pit will be allowed to flood and, upon filling, the pit lake will discharge via a constructed channel to the TSF and hence via a closure spillway to Davidson Creek. Seepage from the TSF will pass through constructed wetlands downstream of TSF Site D and hence to Davidson Creek.

Engineering reviews and inspections of the TSF will extend approximately 20 years into the closure period or until the TSF reaches a steady-state condition, with less frequent reviews and inspections thereafter.

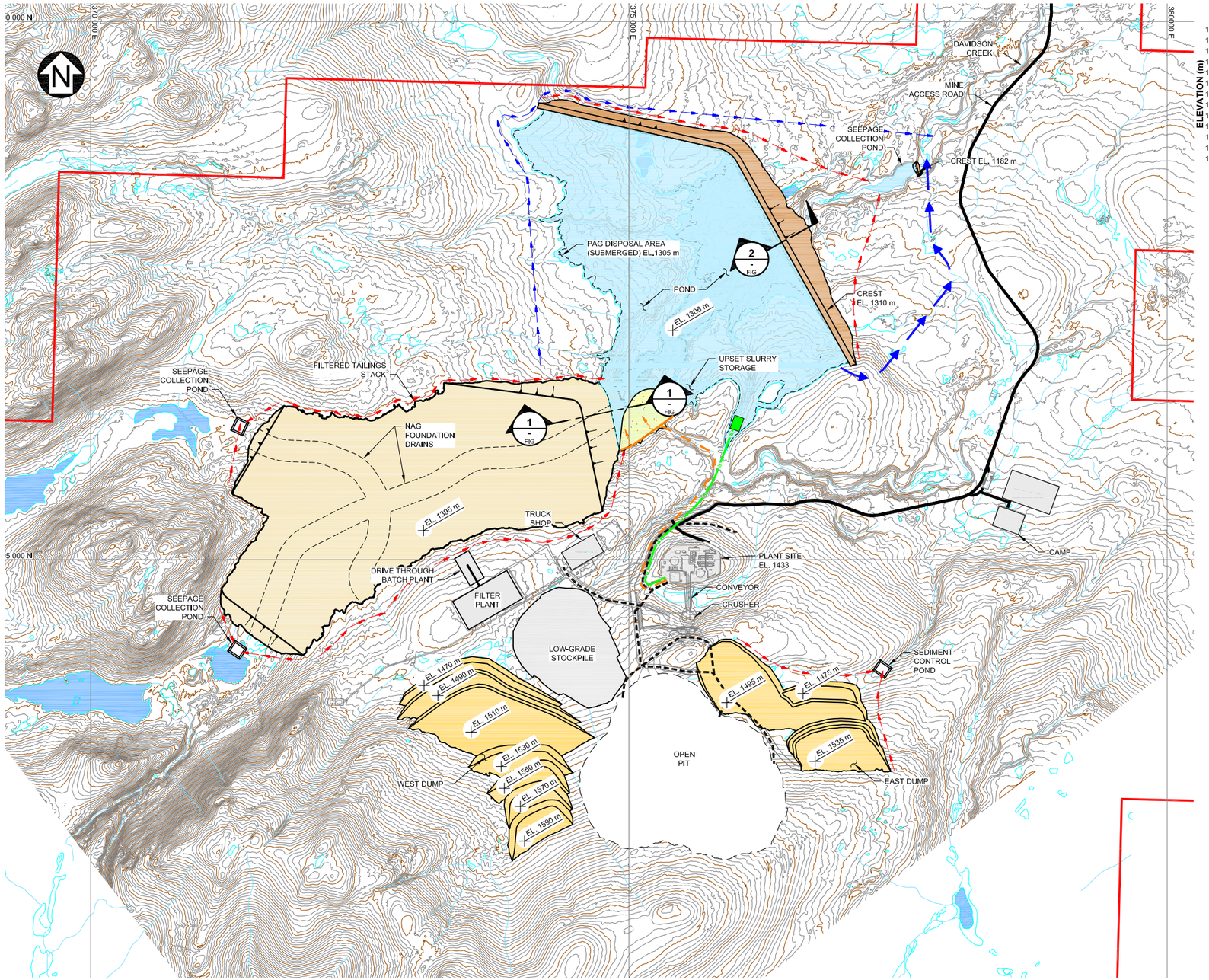
### 7.1.2 Candidate 7 – Filtered Tailings / Submerged PAG/NAG3

Candidate 7 is a filtered tailings alternative located in the upper reaches of the Davidson Creek catchment (ultimate arrangement is presented in Figure 7.1-2). The filtered tailings will be stacked in a waste pile on land in a heaped valley fill arrangement in a partially saturated condition. A PAG/NAG3 waste rock submergence impoundment will be positioned downstream of the filtered tailings waste pile. The submergence impoundment was design to permanently store PAG/NAG3 waste rock in a saturated condition and contain the process water pond with additional capacity to contain the IDF and freeboard for wave run-up. This impoundment will also manage storm water from the filtered tailings waste pile. The impoundment will be created by constructing a two-sided dam that is progressively expanded over the life of the mine. The impoundment will form a valley fill type arrangement and will be constrained by natural topography to the south and west. PAG/NAG3 waste rock stored in the impoundment will eventually buttress the toe of the filtered tailings waste pile.

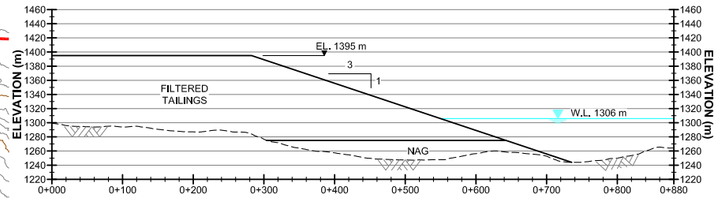
The centre of the tailings waste pile site is located 3.5 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filter plant approximately 1 km away as thickened slurry with a gravimetric solids content of 50%. Tailings will be filtered and then transported by conveyer to a truck load out building. Haul trucks will transport the filtered tailings to the stacking location where dozers will be used for placement and grading. A conveyor will be considered for placement in later years once a large working surface has been developed. Two areas of the tailings pile will be developed: a general area where tailings will be placed in 10 m thick platforms with surface grading and compaction to reduce infiltration and maintain trafficability, and a structural area with thinner lift thicknesses and compaction to maintain stability of the stack.

The filtered tailings waste pile will be constructed to elevation 1,395 m with a maximum height of approximately 145 m. The working surface of the pile at ultimate extents will be approximately 550 ha, and the rate of rise of the waste pile will be roughly 9 m per year. The filtered tailings waste pile rises approximately 40 m higher than the TSF Site C facility contemplated in Candidate 1 in the same location. This change will alter the seepage and surface water flow regime such that some of the runoff and seepage may now report to the west of the filtered tailings pile. Two seepage collection ponds will be required on the west side of the filtered tailings pile. The waste pile slopes will be reclaimed concurrent with development; however the working surface of the pile is a large area and will require reclamation at closure.

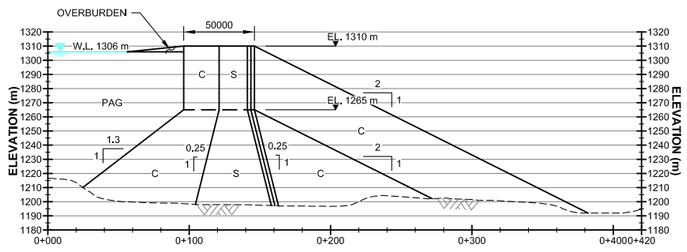
**Figure 7.1-2**
**Candidate 7 – Filtered Tailings / Submerged PAG Rock**




**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




**1 - FIG SECTION**
**FILTERED TAILINGS STACK**
SCALE B




**2 - FIG SECTION**
**PAG STORAGE DAM**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- FILTERED TAILINGS
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY (CLOSURE ONLY)
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE C 40 20 0 40 80 120 160 200 m
SCALE B 80 40 0 100 200 300 400 m
SCALE A 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

An assessment of the stability rating for the filtered tailings waste pile was carried out using the waste dump and stockpile stability rating system as described in the interim guidelines provided by the BC Mine Waste Rock Pile Research Committee (BCMWRPRC, 1991).

The waste pile was classified as Class III, Moderate Hazard. The submergence impoundment dam will be constructed to elevation 1,310 m. The dam safety hazard classification for the PAG/NAG3 waste rock submergence impoundment is VERY HIGH (CDA, 2014). The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the containment dams.

The following suggested design levels were adopted from the CDA guidelines for Candidate 7 during the operational phase:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF);
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE).

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF;
- EDGM – MCE.

Process water will be stored on site within the submergence impoundment to maintain the saturated condition of the PAG/NAG3 waste rock. The normal operating pond allowance will be 10 $Mm^3$. Process water will be retained by the dam, while maintaining minimum freeboard requirements, and reclaimed for use in the mill. The impoundment will include an 'upset' conditions slurry tailings storage area in the submergence facility for times when the filter plant cannot achieve the required tailings moisture content for placement in the waste pile.

Seepage from the submergence impoundment will be primarily controlled by the low-permeability core zone and cut-off trenches constructed in the containment dam. Seepage passing through the core zone will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main dam. Higher relative seepage rates are expected from the impoundment compared to Candidate 1 because this option lacks a tailings beach, which reduces seepage flows. Seepage will be recycled back to the TSF. Unrecoverable seepage rates to Davidson Creek are not expected to increase substantially and the seepage collection infrastructure in Davidson Creek is robust enough to manage the change.

Unrecoverable seepage by-passing the collection and recycle systems for the filter tailings waste pile and PAG/NAG3 submergence impoundment has the potential to affect two watersheds: Davidson Creek and Creek 705.

#### *7.1.2.1 Water Management*

The catchment area is 30 km$^2$ (3,000 ha) with diversion of undisturbed catchment areas upslope of the mine facilities. The water balance was predicted to be in a surplus condition throughout operations with a surplus of 3 Mm$^3$ to 6 Mm$^3$ per year. The surplus increases throughout operations due to runoff from the expanding disturbed areas of the mine facilities, and also from the decreases in waste rock production and corresponding decreases of water storage in waste rock voids for mine rock stored within the submergence impoundment.

Fresh water diversions have been included to the maximum practical extent in the design. The TSF operational pond capacity is sufficient to manage a reasonable range of surplus water conditions on an annual basis. The surplus will require a treated operational discharge to Davidson Creek throughout operations. The surplus site water will be used to accelerate open pit filling in closure and limit the onset of acid rock drainage conditions in the pit walls.

Surplus water management will require on-going monitoring, calibration of model predictions, and active management of water treatment to meet design objectives. Water levels and pond bathymetry will be monitored to confirm that the water balance assumptions are accurate and that permitted operational surface water discharge allowances meet requirements to manage the water balance on an inter-annual basis.

The reclaim water system will utilize a small barge-mounted pump station sized to deliver 700 m$^3$/hr of reclaim water (6 Mm$^3$ per year). The reclaim barge will be anchored in the submergence impoundment. A volume of less than 2 Mm$^3$ of water reclaim was predicted to be required each year from the process water pond for the first ten years of operations, and will be combined with water from tailings dewatering, open pit dewatering and fresh water supply to support the milling process. Water in the submergence impoundment after Year 10 may not be required for processing, and will be used only to maintain the saturated condition of the PAG/NAG3 waste rock.

A closure spillway will be constructed from the submergence impoundment to Davidson Creek in the final year of operations.

#### *7.1.2.2 Execution*

A filter plant capable of dewatering tailings at a rate of 60,000 TPD will require a building roughly 100 m by 30 m. Issues with tailings filtration plant will be expected at times due to changes in ore type, grind size, and also for unforeseen maintenance of critical components. An area will be designated in the submergence impoundment for emergency discharge where slurry tailings will be sent when the filter plant is not operational. Also, a general placement area within the filtered tailings waste pile will be required for 'upset' conditions when the filter plant produces tailings with less than optimal moisture content.

Filtered tailings material may have to be stockpiled and allowed to dry during adverse weather conditions or unforeseen truck maintenance in order to maintain production. Coordination and planning for weather conditions will be essential for development of a filtered tailings stack at this

production rate (60,000 TPD) and in the weather conditions common in central British Columbia. A covered live stockpile may be required in addition to the truck load out facility. A live stockpile with a one week capacity will be approximately 100 m in diameter and 25 m in height. Movement of any stockpiled material will subsequently impact the availability of trucks to manage normal tailings production.

Transport of tailings by truck using CAT 777 haul trucks will require approximately 40 trips per hour, 24 hours a day for 365 days a year to manage a nominal production of 60,000 TPD. The operation will require a loading arrangement that can reliably load trucks at a nominal rate of 1.5 minutes per truck. Any down time has the potential to impact mill operations. This will require an active truck fleet of 10 trucks for a haul with a round trip time of 15 minutes. The total truck fleet will have to be somewhat larger to manage temporary stockpiled material, for longer haul times, and for appropriate backup equipment during periodic and unforeseen maintenance needs. Trucks may need to be equipped with heated beds to prevent moist soil from freezing to the metal in the winter.

Filtration of tailings at a rate of 60,000 TPD will exceed anything within existing precedent; however the increase in scale of filtration alone is not insurmountable. The scale at which filtered tailings has been applied in similar site conditions is more concerning. Rainfall has the potential to reduce trafficability of the surface, making placement in areas difficult or impossible in certain cases. Winter conditions will pose a challenge for placement of the filtered tailings. Precipitation falls predominantly as snow throughout five months of the year. Accumulated snow will need to be removed prior to placement of subsequent tailings material. There is potential for entrainment of snow in the waste pile that could impact the stability of the pile in the short and long-term.

Placement of filtered tailings with a conveyor system might be simpler from a bulk material handling standpoint; however, a great deal of maneuvering will be required especially in the initial lifts. There may be an opportunity to move from trucking to a conveyor system in the later years of operation.

#### *7.1.2.3 Closure*

Upon mine closure, surface facilities will be removed in stages and full reclamation will be initiated. The closure plan is compatible with a premature closure event although it may require substantial earthworks to construct engineered covers. General aspects of the closure plan include:

- Covering PAG waste rock with approximately 1 m of overburden.
- Covering the filtered tailings waste pile with 2 m of overburden.
- Placement of an overburden wedge up to 5 m thick around the facility to separate the position of final pond from the impoundment dam crest.
- Constructing spillways and overflow channels.
- Establishing wetlands in the submergence impoundment and revegetating slopes.
- Pumping the tailings pond supernatant to the pit for about 29 years to develop the pit lake and flood the majority of PAG/NAG3 rock in the ultimate pit walls.

- Dismantling and removing reclaim delivery systems and all pipeline structures, and equipment not required beyond mine closure.
- Pumping seepage collection ponds located to the west of the filtered tailings waste pile to the submergence impoundment for approximately 30 years or until such time that suitable water quality is achieved.
- Removing the Davidson Creek seepage collection pumpback systems at such time that suitable water quality for direct release is achieved.
- Establishing polishing wetlands for treatment of seepage.
- Removing and re-grading all access roads, ponds, ditches, and borrow areas not required beyond mine closure.
- Long-term stabilization of all exposed erodible materials.

The remaining NAG waste rock dump areas not progressively reclaimed will be reclaimed with overburden and re-vegetated. The low grade stockpile pad will be tested for contamination and removed and disposed of as required in the open pit. The pit will be allowed to flood and, upon filling, the pit lake will discharge via a constructed channel to the submergence impoundment and hence via a closure spillway to Davidson Creek. Seepage from the submergence impoundment will pass through constructed wetlands downstream and hence to Davidson Creek.

Engineering reviews and inspections of the TSF will extend approximately 30 years into the closure period or until the TSF reaches a steady-state condition, with less frequent reviews and inspections thereafter. Longer term monitoring and maintenance may be required following the closure period to confirm that:

- PAG/NAG3 waste rock remains saturated and that outflows through seepage match inflows to the voids; and
- The filtered tailings waste pile remains partially saturated, the constructed cover is effective in limiting air entry into the void space and retarding acid generation.

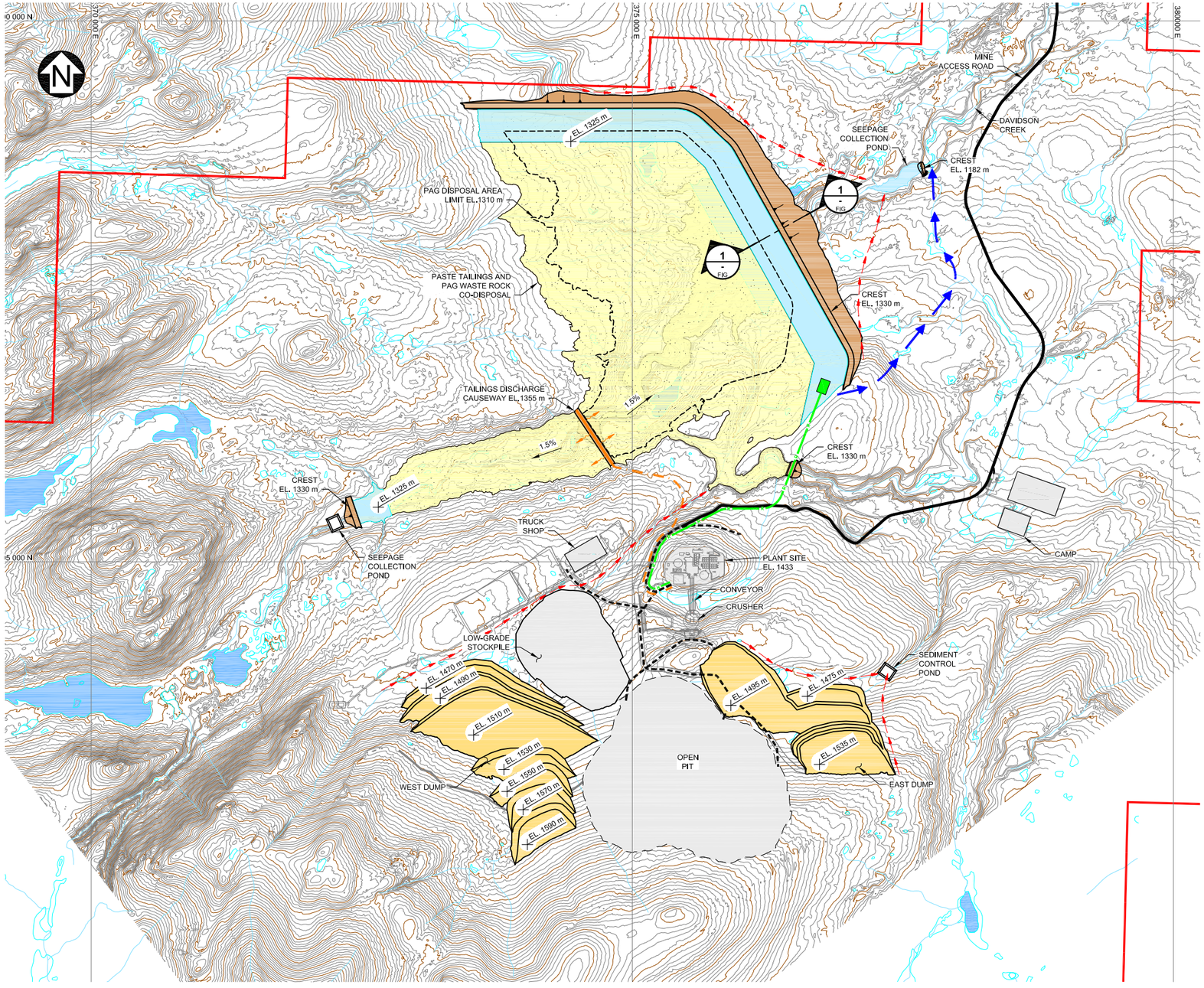
### 7.1.3 Candidate 10 – Paste Tailings / Submerged PAG/NAG3

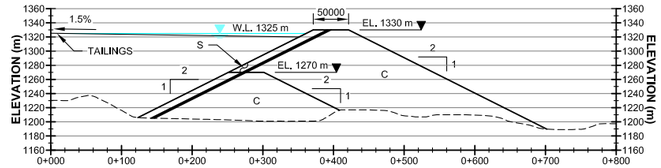
Candidate 10 is an ultra-thickened (paste) tailings alternative located in the upper reaches of the Davidson Creek catchment (ultimate arrangement is presented in Figure 7.1-3). The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The facility was designed to contain tailings, PAG/NAG3 waste rock, and the operational supernatant pond allowance, and capacity to contain the IDF with additional freeboard for wave run-up. The impoundment will be created by constructing three dams in the area previously described as Site D. The main dam will be a large two sided dam across Davidson Creek. Two smaller dams will be required on the west side of the impoundment and in a small saddle on the southeast side of the facility to maintain containment.

Paste tailings will be pumped in a pipeline to a central point in the TSF. Tailings will be deposited by top-down method of paste placement. Paste tailings will be discharged from a central point and will

settle at angle of repose sloping towards the containment dams. Water will be collected at the toe of the slope adjacent to the containment dams. The pipeline route will remain within the TSF catchment at all times.

**Figure 7.1-3**
**Candidate 10 – Paste Tailings / Submerged PAG Rock**




1 - FIG **SECTION**
**THICKENED TAILINGS DAM**
SCALE B

**LEGEND:**

- SLURRY TAILINGS
- MINE WATER
- FRESH WATER
- EMBANKMENT
- PAG WASTE ROCK
- NAG WASTE ROCK
- RECLAIM SYSTEM
- PUMPSTATION

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- SPILLWAY (CLOSURE ONLY)
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TAILINGS PIPELINE
- SLURRY TAILINGS DISCHARGE

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

The TSF dams will be constructed to elevation 1,330 m and the central discharge embankment will be raised to a final elevation of 1,355 m. Construction of the dams will require a total of 70 $Mm^3$, sourced from pit stripping and external borrow sources. The earth-rockfill dams will be comprised of a shell zone, transition and filter zones, and a low-permeability face. Filter and transition material will be sourced from a nearby aggregate borrow. The remainder of the material will come from the open pit. The maximum height of the main dam will be 130 m.

Process water will be stored on site in the TSF to maintain the saturated condition of the mine waste materials. The normal operating pond allowance will be 6 $Mm^3$. Process water will be retained by the dam, while maintaining minimum freeboard requirements, and reclaimed for use in the mill.

Alternatively, water could be decanted from the surface of the TSF and stored in a separate reclaim pond below the TSF. This will require construction of another large water retaining dam in an area downstream where there is increased risk of unrecoverable seepage due to the presence of naturally occurring higher permeability meltwater channels. Removal of water from the TSF will also negatively impact the reliability of initially flooding and subsequently maintaining PAG materials in a saturated condition. This alternative arrangement relates to the comparison of best practices for this particular technology, and will be evaluated further if the multiple accounts analysis indicates that Candidate 10 is the preferred option.

The dam safety hazard classification for the tailings facility is VERY HIGH (CDA, 2014). The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the tailings dams.

The following suggested design levels were adopted from the CDA guidelines for Candidate 10 during the operational phase:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF);
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE).

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF;
- EDGM – MCE.

Tailings will be thickened to approximately 65% solids at the process plant and delivered by gravity through a pipeline to the central discharge point in the TSF. The tailings distribution system will include a fully installed standby pipeline for operational flexibility. The paste will not segregate upon deposition and very little bleed water from the tailings discharge is expected. Tailings will settle at an approximate grade of 1.5% away from the discharge point. The PAG and NAG3 waste rock disposal area will be developed at the same or similar rate of rise as the tailings in the TSF.

Waste rock will be used to manage the location of paste deposition during most of operations; however, the final tailings level will be several meters higher to cover the PAG waste rock.

Seepage will be primarily controlled by the low-permeability face zone and cut-off trenches constructed prior to the development of tailings beaches. Seepage passing through the main embankment will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main embankment. Seepage will be recycled back to the TSF. Higher relative seepage rates are expected from the impoundment compared to Candidate 1 because this option lacks a tailings beach in front of the dam, which reduces seepage flows. Seepage rates are expected to be less than those expected for Candidate 7. Unrecoverable seepage passing the collection and recycle system has the potential to affect one watershed: Davidson Creek.

#### *7.1.3.1 Water Management*

The catchment area without modification is 43 $km^2$ (4,300 ha). The water balance was predicted to be in a surplus condition throughout operations with a surplus of 2 $Mm^3$ to 6 $Mm^3$ per year. The surplus increases throughout operations due to runoff from the expanding disturbed areas of the mine facilities, and also from the decreases in waste rock production and corresponding decreases of water storage in waste rock voids for mine rock stored within the TSF.

The surplus water will be managed with a combination of fresh water diversions and a treated operational discharge to Davidson Creek later in operations. The TSF operational pond capacity is sufficient to manage a reasonable range of surplus water conditions on an annual basis. The surplus site water will be used to accelerate open pit filling in closure and limit the onset of acid rock drainage conditions in the pit walls. Fresh water diversions could remove approximately 3 $Mm^3$ per year from the water surplus under average conditions.

Surplus water management will require on-going monitoring, calibration of model predictions, and active management of water treatment to meet design objectives. Water levels and pond bathymetry will be monitored to confirm that the water balance assumptions are accurate and that permitted operational surface water discharge allowances meet requirements to manage the water balance on an inter-annual basis.

The reclaim water system will utilize a barge-mounted pump station sized to deliver 1,600 $m^3$/hr of reclaim water (14 $Mm^3$ per year). The reclaim barge will be anchored in the TSF. A volume of less than 10 $Mm^3$ of water reclaim was predicted to be required each year from the process water pond, and will be combined with water from tailings dewatering, open pit dewatering and fresh water supply to support the milling process.

A closure spillway will be constructed from the TSF to Davidson Creek in the final year of operations.

#### *7.1.3.2 Execution*

The tailings processing for Candidate 1 included a thickening step to 60% solids during the cyanide destruction process followed by re-pulping to 50% solids content for tailings discharge. Candidate 10 contemplates an alternative tailings dewatering strategy where tailings will be dewatered further

(instead of being re-pulped) and discharged as a non-segregating paste in the TSF. A paste surface disposal facility at this throughput is not beyond Canadian precedent, although it is not common in British Columbia or Canada.

Tailings will be thickened above approximately 65% solids and pumped with positive displacement pumps to a discharge berm constructed in the centre of the TSF. The discharge strategy relies on pumping and execution depends on the reliability of the pumping systems. An area will be designated in the TSF for emergency discharge where slurry tailings will be sent when the paste plant or pumps are not operational.

#### *7.1.3.3 Closure*

Upon mine closure, surface facilities will be removed in stages and full reclamation of the TSF will be initiated. The closure plan is compatible with a premature closure event. General aspects of the closure plan include:

- Selective discharge of thickened (not paste) tailings from dam crests around the facility during the final years of operations to fill in low spots and facilitate surface water management and reclamation.
- Placing an oxide tailings and/or overburden cover up to 3 m thick on tailings surfaces such that transition and sulphide tailings remain saturated over a wide range of precipitation conditions.
- Covering the exposed tailings beaches with approximately 30 cm of overburden.
- Establishing wetlands and revegetating the upland beaches.
- Pumping the tailings pond supernatant to the pit for about 19 years to expedite the development of the pit lake and flooding of the majority of PAG/NAG3 rock in the ultimate pit walls.
- Dismantling and removing the tailings and reclaim delivery systems and all pipeline structures, and equipment not required beyond mine closure.
- Constructing spillways and overflow channels.
- Removing the seepage collection pumpback systems at such time that suitable water quality for direct release is achieved.
- Establishing polishing wetlands for treatment of seepage.
- Removing and re-grading all access roads, ponds, ditches, and borrow areas not required beyond mine closure.
- Long-term stabilization of all exposed erodible materials.

The remaining NAG waste rock dump areas not progressively reclaimed will be reclaimed with overburden and re-vegetated. The low grade stockpile pad will be tested for contamination and removed and disposed of as required in the open pit or TSF. The pit will be allowed to flood and, upon filling, the pit lake will discharge via a constructed channel to the TSF and hence via a closure

spillway to Davidson Creek. Seepage from the TSF will pass through constructed wetlands downstream of the TSF and hence to Davidson Creek.

Engineering reviews and inspections of the TSF will extend approximately 20 years into the closure period or until the TSF reaches a steady-state condition, with less frequent reviews and inspections thereafter.

### 7.1.4 Candidate 22 – Filtered Tailings / PAG/NAG3

Candidate 22 is a filtered tailings alternative located at the top of the Davidson Creek catchment. The filtered tailings will be stacked in a waste pile on land in a heaped valley fill arrangement in a partially saturated condition (ultimate arrangement is presented in Figure 7.1-4). The tailings waste pile is the same size and is located at the same site as Candidate 7. PAG/NAG3 waste rock will be stored in a separate engineered surface containment in a heaped arrangement. The PAG/NAG3 waste rock dump is constrained from expanding further to the east by the open pit and to the west by the ungulate winter range. A process water management pond will be located downstream of the mine waste pile and created by constructing a water-retaining dam in a single stage with a maximum height of 40 m across Davidson Creek. Process water will be stored in the pond and reclaimed for use in the mill. An 'upset' conditions slurry tailings storage area will be required in the pond for emergency conditions.

The process water pond dam safety hazard classification is SIGNIFICANT (CDA, 2014). The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the process water pond dam. The following suggested design levels were adopted from the CDA guidelines for Candidate 22 during the operational phases of the project:

- IDF – 1 in 200 year return period;
- EDGM – 1 in 1,000 year return period.

The following design flood and earthquake levels were adopted for the closure phase:

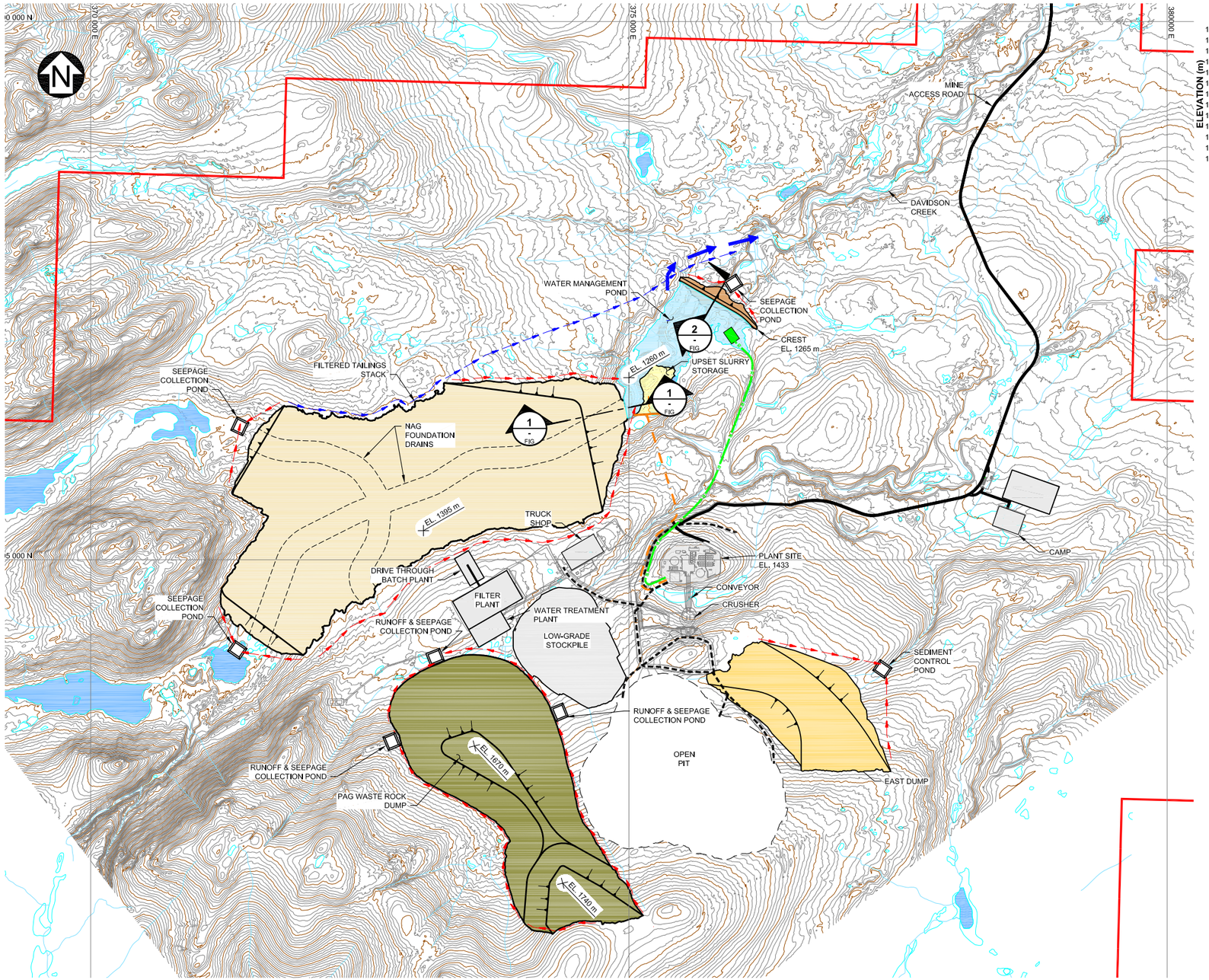
- IDF – 1/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF);
- EDGM – 1 in 2,475 year return period.

Seepage from the process water pond will be primarily controlled by the low-permeability core zone and cut-off trenches constructed in the containment dam. Seepage passing through the core zone will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main dam. Lower relative seepage rates are expected from the pond compared to other options because the pond is significantly smaller. Seepage will be recycled back to the pond or treated and discharged.

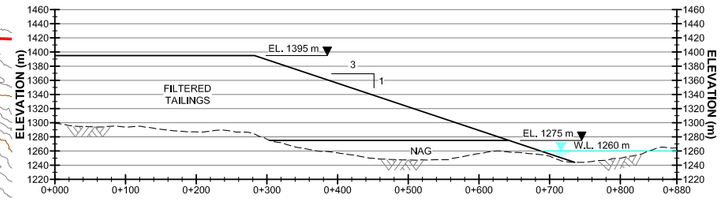
The centre of the tailings waste pile site is located 3.5 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filter plant approximately 1 km away as thickened slurry with a gravimetric solids content of 50%. Tailings will be filtered and then transported by conveyer to a truck load out building. Haul trucks will transport the filtered tailings to the stacking location where dozers will be used for placement and grading. A conveyor will be considered for placement

in later years once a large working surface has been developed. Two areas of the tailings pile will be developed: a general area where tailings will be placed in 10 m thick platforms with surface grading and compaction to reduce infiltration and maintain trafficability, and a structural area with thinner lift thicknesses and compaction to maintain stability of the stack.

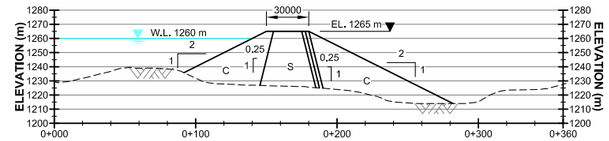
**Figure 7.1-4**
**Candidate 22 – Filtered Tailings / PAG Rock on Land**




**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




**1 - FIG SECTION**
**FILTERED TAILINGS STACK**
SCALE B




**2 - FIG SECTION**
**WATER MANAGEMENT POND**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- FILTERED TAILINGS
- PAG WASTE ROCK
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
4. PAG WASTE ROCK DUMP DESIGNED TO KEEP FOOTPRINT OUT OF UNGULATE WINTER RANGE.

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

Preparation of the tailings storage area will require clearing, grubbing, stripping of topsoil, removal of unsuitable foundation soils, and installation of a complex network of foundation drains. The filtered tailings waste pile will be constructed to elevation 1,395 m with a maximum height of approximately 145 m. The working surface of the pile at ultimate extents will be approximately 550 ha, and the rate of rise of the waste pile will be roughly 9 m per year. The filtered tailings waste pile rises approximately 40 m higher than the TSF Site C facility contemplated in Candidate 1 in the same location. This change will alter the seepage and surface water flow regime such that runoff and seepage may now report to the west of the filtered tailings pile. Two seepage collection ponds will be required on the west side of the filtered tailings pile. The waste pile slopes will be reclaimed concurrent with development; however the working surface of the pile is a large area and will require reclamation at closure.

An assessment of the stability rating for the filtered tailings waste pile was carried out using the waste dump and stockpile stability rating system as described in the interim guidelines provided by the B.C. Mine Waste Rock Pile Research Committee (BCMWRPRC, 1991). The waste pile was classified as Class III, Moderate Hazard.

The PAG waste rock dump will have a maximum height of approximately 300 m. A NAG waste rock or overburden fill platform will be constructed at the base of the dump area to raise the topography and direct drainage in to multiple seepage collection ponds constructed around the toe of the facility. The fill platform will have an engineered soil liner constructed on top of compacted overburden from the open pit. Seepage passing through the soil liner and fill platform will be collected in one of the seepage collection ponds and pumped to the water management pond via a water treatment plant and pipeline.

Unrecoverable seepage by-passing the collection and recycle systems for the process water pond, filtered tailings waste pile and PAG/NAG3 submergence impoundment has the potential to affect two watersheds: Davidson Creek and Creek 705. Any unrecovered seepage will be acidic and contain elevated metal concentrations and has the potential to impact the groundwater system and the downstream drainage area.

An assessment of the stability rating for the PAG waste rock dump was carried out using the waste dump and stockpile stability rating system as described in the interim guidelines provided by the B.C. Mine Waste Rock Pile Research Committee (BC MWRPRC 1991). The waste pile was classified as Class III, Moderate Hazard.

#### *7.1.4.1 Water Management*

The catchment area is 22.5 $km^2$ (2,250 ha) with diversion of undisturbed catchment areas upslope of the mine facilities. The water balance was predicted to be in a surplus condition throughout operations with a surplus of 3 $Mm^3$ to 6 $Mm^3$ per year. The surplus increases throughout operations as runoff from disturbed areas increases. Fresh water diversions have been included to the maximum practical extent in the design. The TSF operational pond capacity is sufficient to manage a small range of surplus water conditions on an annual basis. The surplus will require a treated operational discharge to Davidson Creek throughout operations.

Runoff and infiltration from the PAG/NAG3 waste rock dump will be captured and treated at the mill before being conveyed for storage in the process water pond. Alternatively these treated flows could be diverted to Davidson Creek if they meet discharge water quality guidelines.

Surplus water management will require on-going monitoring, calibration of model predictions, and active management of water treatment to meet design objectives and to confirm that permitted operational surface water discharge allowances meet requirements to manage the water balance on an inter-annual basis. There is limited excess storage to manage surplus water in the event that predictions do not match actual conditions or if there are issues with water treatment efficacy.

The reclaim water system will utilize a small barge-mounted pump station sized to deliver 700 $m^3$/hr of reclaim water (6 $Mm^3$ per year). The reclaim barge will be anchored in the process water pond. A volume of less than 2 $Mm^3$ of water reclaim was predicted to be required each year from the process water pond for the first ten years of operations, and will be combined with water from tailings dewatering, open pit dewatering and fresh water supply to support the milling process. Water in the process water pond after Year 10 may not be required for processing, and will be used as a temporary holding pond for the water treatment plant.

#### *7.1.4.2 Execution*

A filter plant capable of dewatering tailings at a rate of 60,000 TPD will require a building roughly 100 m by 30 m (approximately half the size of a football field). Issues with the performance of the tailings filtration plant will be expected at times due to changes in ore type, grind size, and also for unforeseen maintenance of critical components. An area will be designated in the submergence impoundment for emergency discharge where slurry tailings will be sent when the filter plant is not operational. Also, a general placement area within the filtered tailings waste pile will be required for 'upset' conditions when the filter plant produces tailings with less than optimal moisture content.

Filtered tailings material may have to be stockpiled and allowed to dry during adverse weather conditions or unforeseen truck maintenance in order to maintain production. Coordination and planning for weather conditions will be essential for development of a filtered tailings stack at this production rate (60,000 TPD) and in the weather conditions common in central British Columbia. A covered live stockpile may be required in addition to the truck load out facility. A live stockpile with a one week capacity will be approximately 100 m in diameter and 25 m in height. Movement of any stockpiled material will subsequently impact the availability of trucks to manage normal tailings production.

Transport of tailings by truck using CAT 777 haul trucks will require approximately 40 trips per hour, 24 hours a day for 365 days a year to manage a nominal production of 60,000 TPD. The operation will require a loading arrangement that can reliably load trucks at a nominal rate of 1.5 minutes per truck. Any down time has the potential to impact mill operations. This will require an active truck fleet of 10 trucks for a haul with a round trip time of 15 minutes. The total truck fleet will have to be somewhat larger to manage temporary stockpiled material, for longer haul times, and for appropriate backup equipment during periodic and unforeseen maintenance needs. Trucks may need to be equipped with heated beds to prevent moist soil from freezing to the metal in the winter.

Filtration of tailings at a rate of 60,000 TPD will exceed anything within existing precedent; however the increase in scale of filtration alone is not insurmountable. The scale at which filtered tailings has been applied in similar site conditions is more concerning. Rainfall has the potential to reduce trafficability of the surface, making placement in areas difficult or impossible in certain cases. Winter conditions will pose a challenge for placement of the filtered tailings. Precipitation falls predominantly as snow throughout five months of the year. Accumulated snow will need to be removed prior to placement of subsequent tailings material. There is potential for entrainment of snow in the waste pile that could impact the stability of the pile in the short and long-term.

Placement of filtered tailings with a conveyor system might be simpler from a bulk material handling standpoint; however, a great deal of maneuvering will be required especially in the initial lifts. There may be an opportunity to move from trucking to a conveyor system in the later years of operation.

#### *7.1.4.3 Closure*

Upon mine closure, surface facilities will be removed in stages and reclamation will be initiated. Candidate 22 is anticipated to have an indefinite active closure period with some water management facilities remaining and being maintained in perpetuity. The closure plan is compatible with a premature closure event, but it will require substantial earthworks to construct engineered covers. General aspects of the closure plan include:

- Covering PAG waste rock with approximately 2 m of overburden.
- Covering the filtered tailings waste pile with 2 m of overburden.
- Constructing a pit discharge channel.
- Establishing wetlands and re-vegetating slopes.
- Pumping the surplus water reporting to the process water pond to the pit for about 30 years to develop the pit-lake and flood of the majority of PAG/NAG3 rock in the ultimate pit walls.
- Dismantling and removing tailings dewatering and delivery structures, and equipment not required beyond mine closure.
- Pumping seepage collection ponds located to the west of the filtered tailings waste pile to the pit lake for approximately 30 years or until such time that suitable water quality is achieved.
- Removing the Davidson Creek seepage collection pumpback systems at such time that suitable water quality for direct release is achieved.
- Establishing polishing wetlands for treatment of seepage.
- Removing and re-grading all access roads, ponds, ditches, and borrow areas not required beyond mine closure.
- Long-term stabilization of all exposed erodible materials.

The remaining NAG waste pile areas not progressively reclaimed will be reclaimed with overburden and re-vegetated. The low grade stockpile pad will be tested for contamination and removed and

disposed of as required in the open pit. The pit will be allowed to flood and, upon filling, the pit lake will discharge via a constructed channel to the process water pond and hence via a closure spillway to Davidson Creek. Seepage from the pond will pass through constructed wetlands downstream and hence to Davidson Creek.

Regular engineering reviews and inspections of the site will extend for at least 30 years into the closure period or until the site reaches a steady-state condition, with less frequent reviews and inspections thereafter.

Long-term active management is expected to continue following the initial closure period to:

- Confirm that the filtered tailings waste pile remains partially saturated, limiting air entry into the void space and retarding acid generation; and
- Operate the long-term ML/ARD water treatment plant(s) for the project.

Periodic engineering reviews and inspections will be needed to confirm the performance of the water treatment systems, and to manage changing conditions. This long-term active closure period is assumed to extend into 'perpetuity' due to the expected metal leaching and acid generating nature of the PAG/ NAG3 waste rock.

## 7.2 ALTERNATIVES CHARACTERIZATION

The four candidates assessed here were evaluated for their physical stability, technical, environmental, human environment, and Project economics considerations (referred to as accounts; refer to Tables 7.2-1 through 7.2-5). EC's (2011) *Guidelines* suggest the use of four accounts: techical, environmenta, human environment, and Project economics. However, New Gold has added a fifth account, physical stability, to emphasize and evaluate the importance of this consideration to the short- and long-term safety of a facility. For each of the accounts one or more measurement criteria (indicators) have been developed to evaluate the differences among candidates, and to allow measurability and ranking of these differences. The indicators are characterized in the following section using either a quantitative metric (e.g., hectares or metres) or a qualtitative evaluation (e.g., low, moderate and high). The indicators were selected with consideration of criteria that would be differentiating between the candidate alternatives.

## 7.3 MULTIPLE ACCOUNTS LEDGER

The multiple accounts ledger identifies criteria from the alternative characterization that differentiate alternatives (based on the findings from Tables 6.2-1 through 6.2-5, above) so that candidates can be evaluated relative to one another. The multiple accounts ledger consists of two elements: sub-accounts (i.e., evaluation criteria) and indicators (i.e., measurement criteria).

**Table 7.2-1. Physical Stability Characterization Criteria Summary**

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| Location of water storage | Alternatives with water storage away from containment dams are preferred | The tailings pond is in the TSF but normal operation maintains TSF pond away from dam | The pond covers the waste rock storage facility and the water is against the dam | The pond is within the waste storage facility and the water is against the dam | The pond is not in the waste storage facility but a water management pond downstream of the TSF | Yes |
| Tailings and waste rock interstitial water | Alternatives which promote unsaturated conditions in tailings are preferred due to the effect of water content on potential flow in the event of a dam breach | The tailings and waste rock are fully saturated | The tailings are partially saturated and waste rock is fully saturated | The tailings and waste rock are fully saturated | The tailings are partially-saturated and waste rock is unsaturated | Yes |
| Normal operating pond volume | Alternatives with less water storage have less potential to mobilize a larger volume of waste materials and are preferred | Normal operating pond volume is between 11 $Mm^3$ and 20 $Mm^3$ | Normal operating pond volume is between 6 $Mm^3$ and 10 $Mm^3$ | Normal operating pond volume is between 6 $Mm^3$ and 10 $Mm^3$ | Normal operating pond volume is between 1 $Mm^3$ and 5 $Mm^3$ | Yes |
| Emergency water management - pumps (active) | Alternatives with higher capacity pumps to move water from the process water pond are preferred due to ability to move larger volumes of water in emergency conditions | Large reclaim pumps are able to move water quickly during an emergency: can reclaim 20 - 40 $Mm^3$ per year | Smaller reclaim pumps are not able to move water quickly during an emergency: capable of reclaiming between 5 - 10 $Mm^3$ per year | Reclaim pumps are capable of reclaiming between 10 - 20 $Mm^3$ per year | Smaller reclaim pumps are not able to move water quickly during an emergency: capable of reclaiming between 5 - 10 $Mm^3$ per year | Yes |
| Emergency water management - spillway (passive) | Alternatives that include spillways to manage emergency flood conditions are preferred because storage of excess water increases the potential consequences of failure | No spillway during operations; established after closure | No spillway during operations; established after closure | No spillway during operations; established after closure | Spillway established from water management pond during operations | Yes |
| Design basis / regulatory requirement | Alternatives that have additional design requirements and regulation with increased scrutiny are preferred | Developed and regulated TSF design requirements | Developed and regulated TSF design requirements for sub-aqueous PAG storage but undeveloped for filtered tailings | Developed and regulated TSF design requirements | Undeveloped requirements and regulation for filtered tailings. Developed requirements for on-land PAG storage. | Yes |
| Tailings density | Alternatives that increase density and reduce potential for mobilization of tailings are preferred | Thickened-slurry tailings discharged subaerially take a longer period to consolidate; lowest initial density, same final density as paste | Filtered tailings have lower moisture content and are more physically stable; they are actively compacted after placement; highest density | Paste tailings are discharged subaerially and take a longer period to consolidate; moderate initial density, same final density as thickened-slurry | Filtered tailings have lower moisture content and are more physically stable; they are actively compacted after placement; highest density | Yes |
| Maximum dam height | Dams with low maximum height have lower consequences in the event of a failure and are preferred | Dam height = 140 m | Dam height = 110 m | Dam height = 130 m | Dam height = 40 m | Yes |
| Operational monitoring requirements - safety | Alternatives that are less susceptible to sudden changes in conditions and require less monitoring effort are preferred | One facility of concern (TSF) with well-defined monitoring network and lower intensity monitoring | Two facilities of concern (TSF and PAG rock dam) with high intensity monitoring | One facility of concern (TSF) with easily defined monitoring network and higher intensity monitoring | Two facilities of concern (PAG dump and water management pond); pond is a small structure with less concern but high intensity monitoring required | Yes |

**Table 7.2-2. Technical Characterization Criteria Summary**

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| *Containment Design* | | | | | | |
| Style of containment | Alternatives that make use of natural topography are preferred | The design makes use of natural ground on two sides of the facility as a level valley-fill deposit | The design makes use of natural ground on two sides of the facility but is a heaped valley-fill deposit | The design makes use of natural ground on two sides of the facility as a level valley-fill deposit | The design makes use of natural ground on two sides of the facility but is a heaped valley-fill deposit. The PAG rock storage has natural ground on only one side (side hill fill) | Yes |
| Number of dams | Alternatives with fewer dams have less scheduling risk and less long term maintenance requirements and are preferred | Has four dams to contain tailings | Has one dam to contain PAG waste rock | Has three dams to contain tailings | Has no waste-retaining dams but a single-stage water dam | Yes |
| Construction volumes | Alternatives requiring less dam construction material are preferred | Dam will require from 60 - 80 $Mm^3$of construction material | Dam will require from 20 – 40 $Mm^3$ of construction material | Dam will require from 60 - 80 $Mm^3$ of construction material | Dam will require from 1 – 20 $Mm^3$ of construction material | Yes |
| Tailings initial settled density | Alternatives with higher initial tailings density will require reduced storage volume requirements and are preferred | Tailings are thickened but have lower initial settled density (1.2 - 1.6 $t/m^3$) compared to filtered tailings | Tailings are filtered and have higher initial settled density (1.6 - 1.8 $m^3/t$) | Tailings are thickened but have lower initial settled density (1.2 - 1.6 $t/m^3$) compared to filtered tailings | Tailings are filtered and have higher initial settled density (1.6 - 1.8 $m^3/t$) | Yes |
| Drainage provisions | Alternatives with more complex drainage provisions are less preferred | Drainage provisions are simple with easily installed embankment drains | Drainage provisions are complex for foundation drains beneath the TSF; simple, easily installed embankment drains | More complex embankment drains are required no underdrains are required | Drainage provisions are complex for foundation drains beneath the TSF and PAG waste rock facilities | Yes |
| Seepage management - physical | Alternatives with less foundation preparation and simpler seepage collection facilities are preferred | Seepage management includes cut-off trenches with single seepage collection point downgradient of dams | Seepage management includes cut-off trenches with multiple seepage collection points | Seepage management includes cut-off trenches with multiple seepage collection points | Seepage management includes cut-off trenches with multiple seepage collection points; liner and closure cover for PAG rock facility | Yes |
| Seepage management - quality | Alternatives that prevent degradation of water quality are preferred | PAG waste rock and tailings are submerged and saturated preventing water quality degradation | PAG waste rock is submerged and saturated but management of PAG tailings runoff and seepage required to prevent water quality degradation | PAG waste rock is submerged and tailings are saturated, reducing water quality degradation | Management of PAG waste rock and tailings runoff and seepage required to prevent water quality degradation | Yes |

*(continued)*

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Construction Requirements*** | | | | | | |
| Foundation preparation for tailings storage area (excludes dam) | Alternatives with smaller footprint area and/or less involved requirements for surface preparation are preferred | Larger footprint but less involved foundation preparation (clearing, grubbing and stripping of TSF footprint) | More involved foundation preparation requirements (clearing, grubbing and stripping, foundation preparation and drainage installation for TSF footprint) | Larger footprint but less involved foundation preparation (clearing, grubbing and stripping of TSF footprint) | Smaller footprint but more involved foundation preparation requirements (clearing, grubbing and stripping, foundation preparation and drainage installation for TSF) | Yes |
| Tailings infrastructure | Alternatives with fewer facilities that need to be constructed and commissioned for tailings distribution are preferred | Infrastructure required for slurry production and thickening | Infrastructure required for slurry production, thickening, filtration and a load-out facility | Infrastructure required for slurry production and increased thickening | Infrastructure required for slurry production, thickening, filtration and a load-out facility | Yes |
| Foundation preparation for PAG waste rock facility | Alternatives without PAG waste rock stored on land that require additional surface preparation and/or infiltration prevention measures and are preferred | PAG waste rock co-disposed with tailings; foundation preparation requires clearing, grubbing and stripping | Underwater storage of PAG; foundation preparation for PAG waste rock facility same as TSF and requires clearing, grubbing and stripping | PAG waste rock co-disposed with tailings; foundation preparation requires clearing, grubbing and stripping | Foundation preparation for PAG waste rock facility requires clearing, grubbing, stripping, foundation preparation, liner and runoff and seepage collection installation | Yes |
| Initial dam construction | Alternatives with less complex initial dam construction are preferred | More complex initial dam construction: multiple stage with moderate construction volumes | Complex initial dam construction: multiple stage with large construction volumes | Complex initial dam construction: multiple stage with large construction volumes | Less complex initial dam construction: single stage water dam with low construction volumes | Yes |
| Sustaining construction (excludes waste delivery) | Alternatives with less complex sustaining construction requirements are preferred | Dam raise required every (1) year | Dam raise required every five (5) years | Dam raise required every two (2) years | No sustaining dam construction; completed during initial construction | Yes |
| ***Water Management*** | | | | | | |
| Catchment area | Alternatives with smaller catchment areas would develop smaller flood volumes and are preferred | Catchment area upstream of the mine facilities approximately 45 $km^2$ | Catchment area upstream of the mine facilities approximately 30 $km^2$ | Catchment area upstream of the mine facilities approximately 45 $km^2$ | Catchment area upstream of the mine facilities approximately 23 $km^2$ | Yes |
| Flood routing | Alternatives with flood routing that would limit impacts of erosion and sedimentation are preferred | Flood is routed for storage in the pond; there is no downstream discharge for the inflow design flood (IDF) | Flood is routed into active (TSF) construction area; no downstream discharge for inflow design flood (IDF) | Flood is routed for storage in the pond; there is no downstream discharge for the inflow design flood (IDF) | Flood is routed into active (TSF) construction area; discharge would be directed downstream through spillway | Yes |
| Water balance - surplus/deficit/balance | Alternatives which can maintain a balanced condition throughout operations and closure are preferred | Water balance has slight surplus late in mine life that can be managed by additional freshwater diversions | Water balance has surplus (3 $Mm^3$ to 6 $Mm^3$ /a) managed through diversions and treated discharge during operation | Water balance has surplus (2 – 6 $Mm^3$/a) managed through diversions initially and treated discharge later on during operation | Water balance has e surplus (3 $Mm^3$ to 6 $Mm^3$ /a) managed through diversions and treated discharge during operation | Yes |

*(continued)*

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Water Management*** *(cont'd)* | | | | | | |
| Water recycle requirement | Alternatives that require less water recycle are preferred | Relatively large volume of annual water recycle required (10 - 20 $Mm^3$ /year) | Small volume of annual water recycle required (< 5 $Mm^3$) | Moderate volume of annual water recycle required (5 - 10 $Mm^3$) | Small volume of annual water recycle required (< 5 $Mm^3$) | Yes |
| Water treatment | Alternatives that require capture and treatment of surface water are less preferred | Capture and treatment for a single small area required. No discharge of treated mine water required during operations. | Capture and treatment for multiple areas required. Discharge of mine water during operations. | Capture and treatment for a single small area required. Discharge of treated mine water required during operations. | Capture and treatment for multiple areas required. Operational discharge of mine water | Yes |
| Surplus water management | Alternatives that deal with surplus conditions with simpler water management are preferred | Surplus water can be managed via diversion ditches and / or pipeline conveyance | Surplus water would need to be collected, treated and discharged (1 - 5 $Mm^3$ / year) | Surplus water would need to be collected, treated and discharged (< 1 $Mm^3$ / year) | Surplus water would need to be collected, treated and discharged (1 - 5 $Mm^3$ / year) | Yes |
| Operational monitoring requirements - internal site water management | Alternatives that are less susceptible to sudden changes in conditions and require greater monitoring effort are preferred | Less susceptible to sudden changes in condition requiring standard water quality monitoring to confirm expectations | Potentially more susceptible to sudden changes in conditions; the positioning of mine facilities also complicates monitoring requirements | Potentially more susceptible to sudden changes in conditions; the positioning of mine facilities also complicates monitoring requirements | Extensive internal site water quality monitoring in multiple locations, with expected variances requiring response and correction | Yes |
| ***Execution*** | | | | | | |
| Technology precedent - processing | Alternatives utilizing tailings production technology proven at project throughput rates are preferred | Thickened slurry tailings production technology is proven at the Project throughput | Filtered tailings production technology is not proven at the Project throughput | Paste tailings production technology is not proven at the Project throughput | Filtered tailings production technology is not proven at the Project throughput | Yes |

*(continued)*

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Execution*** *(cont'd)* | | | | | | |
| Technology precedent - storage | Alternatives utilizing tailings production technology at project throughput rates shown to be effective in similar site conditions are preferred | The storage technology (valley fill with staged, centre-line dam construction) is proven at the Project throughput | The most reasonable example of a mining project utilizing filtered tailings in climate conditions similar to the Project is Greens Creek located 30 km southwest of Juneau, Alaska. The throughput at Greens Creek is 1,500 TPD; however, only approximately 50% of the tailings is filtered and the remainder is used as paste backfill for underground workings; thus, the storage technology is not proven at the Project throughput; proven at less than 6000 t/day in climatic conditions similar to the Project | Candidate contemplates an alternative tailings dewatering strategy where tailings will be dewatered further (instead of being re-pulped) and discharged as a non-segregating paste in the TSF. A paste surface disposal facility at this throughput is not beyond Canadian precedent, although it is not common in BC or Canada. | The most reasonable example of a mining project utilizing filtered tailings in climate conditions similar to the Project is Greens Creek located 30 km southwest of Juneau, Alaska. The throughput at Greens Creek is 1,500 TPD; however, only approximately 50% of the tailings is filtered and the remainder is used as paste backfill for underground workings; thus, the storage technology is not proven at the Project throughput; proven at less than 6000 t/day in climatic conditions similar to the Project | Yes |
| Tailings delivery complexity | Alternatives that have less complex tailings delivery systems are preferred | Simple tailings delivery using gravity-fed pipeline | Requires complex system of conveyor / stacker (likely more than one) or truck haul delivery | Requires pumps to deliver tailings to TSF | Requires complex system of conveyor / stacker (likely more than one) or truck haul delivery | Yes |
| Tailings placement complexity | Alternatives with smaller active fill surfaces are preferred due to impact of mechanical spreading and or compaction, precipitation, snow and ice removal | Simple placement over smaller area, not affected, or to a small degree by weather conditions | Most complex tailings placement requiring spreading, compaction and management of precipitation (snow removal) | More complex placement with pumping from central dike, affected to a small degree by weather conditions | Most complex tailings placement requiring spreading, compaction and management of precipitation (snow removal) | Yes |
| PAG waste rock delivery and placement | Alternatives with less complex PAG waste rock delivery and placement are preferred due to lower placement costs | Complex as PAG waste rock has long haul and placed in thin lifts concurrent with other tailings placement | Less complex as PAG waste rock can be placed in thick lifts despite the long haul distance | Most complex as PAG waste rock has long haul and there is increased co-disposal difficulty associated with concurrent placement with paste tailings | Least complex as PAG waste rock can be placed in thick lifts and has short haul distance | Yes |

*(continued)*

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Execution*** *(cont'd)* | | | | | | |
| Operational flexibility | Alternatives with secondary discharge areas and/or ease of adjustment to placement method are preferred | Most flexible because there are secondary discharge points within the primary facility that minimize production delays to less than a day | Less flexible despite provision of an upset facility for out of specification tailings, production delays up to a month are possible | Flexible as there are secondary discharge points within the TSF that would minimize production delays to less than a week | Least flexible despite provision of an upset facility for out of specification tailings, production delays more than a month are possible | Yes |
| ***Closure*** | | | | | | |
| Closure concept - physical | Alternatives with less water contained and/or water positioned away from dams within the facility at closure are preferred | The pond is within the waste storage facility but there is less water contained and water stored away from the dam at closure | The pond covers waste rock in the PAG disposal area and water is against the dam | Water produced from the paste tailings accumulates against the dam | The pond is not in the waste storage facility | Yes |
| Closure concept - geochemical | Alternatives that passively manage geochemical concerns in closure are preferred | Preferred because all PAG materials are submerged and saturated | PAG waste rock is submerged however surface management of PAG tailings will be required | PAG materials saturated. . Some surface management of PAG tailings may be required | Least preferred because of active management of all PAG materials required. | Yes |
| Closure concept - active closure period | Alternatives that require a shorter term active closure period are preferred | Shorter active closure period with pumping the tailings pond supernatant to the pit for about 18 years | Longer active closure period because pumping the tailings pond supernatant to the pit for about 29 years | Shorter active closure period because pumping the tailings pond supernatant to the pit for about 19 years | Longer active closure period with pumping seepage collection ponds to the pit lake for approximately 30 years | Yes |
| Closure concept - long-term maintenance and monitoring | Alternatives that require lower long-term maintenance and monitoring are preferred | Less long-term maintenance and monitoring because there are no facilities **o**f concern and normal confirmatory closure monitoring and maintenance expected | More long-term maintenance and monitoring as there is one facility of concern requiring site wide water quality monitoring with variances potentially requiring correction | More long-term maintenance and monitoring as there is one facility of concern requiring site wide water quality monitoring with variances potentially requiring correction | Most long-term maintenance and monitoring as there are two facilities of concern, requiring extensive internal site wide water quality monitoring, expected variances requiring correction. Potential for long-term water treatment. | Yes |
| Concurrent closure and reclamation | Alternatives where project facilities can be incrementally reclaimed during operations are preferred | Some areas can be concurrently reclaimed: TSF embankments and upstream part of TSF | Limited areas can be concurrently reclaimed: PAG rock dam embankments and lower slopes of TSF | Some areas can be progressively reclaimed; e.g., TSF embankments | Limited area progressively reclaimed: lower slopes of PAG rock dump and TSF | Yes |
| Premature closure | Alternatives that are more amenable to premature closure are preferred | Requires smallest amount of earthworks for implementation of closure plan - smaller surface area on TSF because of supernatant pond(s) | Requires minimal earthworks for implementation of closure plan because of large surface area on TSF | Requires some earthworks to fill in low spots to facilitate water management and reclamation – of large surface area on TSF | Requires substantial earthworks for implementation of closure plan: largest surface area - TSF and PAG rock dump | Yes |

**Table 7.2-3. Environmental Characterization Criteria Summary**

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Climate and Air Quality*** | | | | | | |
| Noise and vibration | Alternatives with lower potential for noise and vibration are preferred due to fewer disturbances to wildlife and harvesting experience. | Open pit operations and co-disposal of waste rock provide a source of noise and vibration. Considered to have lower potential for noise and vibration than filtered tailings as tailings are pumped and not trucked | Open pit operations and disposal of waste rock in submerged storage area provide a source of noise and vibration. Considered to have moderate potential for noise and vibration since filtered tailings are trucked, spread and compacted | Open pit operations and co-disposal of waste rock provide a source of noise and vibration. Considered to have lower potential for noise and vibration than filtered tailings as tailings are pumped and not trucked | Open pit operations and additional disposal of PAG waste rock on land provide a source of noise and vibration. Considered to have high potential for noise and vibration since filtered tailings are trucked, spread and compacted. Large PAG waste rock facility | Yes |
| Sensitivity to climate change | Alternatives with lower risk of loss of water cover and initiation of ML/ARD from exposed tailings and PAG waste rock are preferred. Alternatives that retain the inflow design flood (IDF) during operations and the Probable Maximum Flood passes through the spillway during closure are preferred | Low sensitivity to climate change. Low risk for loss of water cover on the tailings/PAG waste rock during drought conditions. Retains the IDF during operation and passes the probable maximum flood (PMF) on closure. | Low to moderate sensitivity to climate change. Low potential for the water cover to be lost over the PAG waste rock during drought conditions. Moderate risk for loss of vegetative cover and tailings erosion during drought conditions. Retains the IDF during operation and passes the probable maximum flood (PMF) on closure. | Low to moderate sensitivity to climate change. Moderate risk for loss of vegetative cover and tailings erosion during drought conditions. Retains the IDF during operation and assess the probable maximum flood (PMF) on closure. | Moderate to high sensitivity to climate change. Moderate risk for loss of vegetative cover on PAG waste rock dump and TSF during drought conditions. Retains the 1:200 year return period (Inflow Design Flood) during operation and passes the 1/3 between the 1 in 1,000 year return period and probable maximum flood (PMF) during operation and closure.. | Yes |
| Dust emissions | Alternatives that have low potential for dust are preferred due to lower associated risks to human health, vegetation and wildlife habitat | Low potential for dust generation as tailings remain saturated | Moderate potential for dust from filtered tailings | Low to moderate potential for dust generation | Moderate to high potential for dust from filtered tailings and PAG waste rock stored on land | Yes |
| ***Surface water flow*** | | | | | | |
| Loss of catchment area | Alternatives with the smallest catchment and least potential to reduce flows are preferred | 45 km$^2$ diverted catchment area | 30 km$^2$ diverted catchment area | 45 km$^2$ diverted catchment area | 23 km$^2$ diverted catchment area | Yes |
| Make-up water requirement | Alternatives that require less make-up water from Tatelkuz Lake for processing are preferred | Initially requires more water for start-up pond but similar annual make-up water requirement from Tatelkuz Lake as other options (~ 1 Mm$^3$) | Annual make-up requirement from Tatelkuz Lake of approximately 1 Mm$^3$ | Annual make-up requirement from Tatelkuz Lake of approximately 1 Mm$^3$ | Annual make-up requirement from Tatelkuz Lake of approximately 1 Mm$^3$ | No - not significantly differentiating |
| ***Surface water quality*** | | | | | | |
| Storage of PAG material | Alternatives that store PAG waste rock and tailings sub-aqueously are preferred as there is lower risk of ML/ARD | Stores PAG waste rock and tailings sub-aqueously; low risk of ML/ARD | Stores PAG waste rock but not tailings sub-aqueously ; potential risk of ML/ARD. | Store PAG waste rock and tailings sub-aqueously low risk of ML/ARD | PAG waste rock and tailings not stored sub-aqueously; ML/ARD expected | Yes |
| Seepage quantity | Alternatives with smaller ponds situated away from dams are preferred | Has large pond but water is separated from main dam by large tailings beach | Has large pond with water against dam | Has large pond with water against dam | Has small pond with water against dam | Yes |
| Dam embankment area | Alternatives with smaller dam embankment areas are preferred as they will have less infiltration and runoff that may affect surface water quality (although can be collected) | Dam embankment area = 132 ha | Dam embankment area = 69 ha | Dam embankment area = 92 ha | Dam embankment area= 7 ha | Yes |

*(continued)*

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Surface water quality*** *(cont'd)* | | | | | | |
| Operational discharge of treated water | Alternatives that do not require discharge of treated water during operations are preferred | Does not require operational discharge of treated water | Discharge required and treatment of the discharge may need to be intensive to meet receiving water quality objectives given limited dilution. | Discharge required and operational discharge of treated water | Discharge required and intensive treatment requiring more than one plant for different strength effluents may be needed to meet receiving water quality objectives given limited dilution. | Yes |
| ***Groundwater*** | | | | | | |
| Groundwater quality | Alternatives with less risk to groundwater quality are preferred | PAG rock and tailings stored under water, reducing ML/ARD potential in seepage | PAG rock is stored underwater reducing ML/ARD potential in seepage; however, filtered tailing stored on land has moderate ML/ARD risk and potential to affect water quality in pond, resulting in moderate risk to groundwater quality. | PAG rock is deposited with tailings and remains saturated reducing ML/ARD potential. Low ML/ARD risk and potential to affect water quality in pond, resulting in low risk to groundwater quality. | PAG rock and filtered tailings stored on land have greatest potential for ML/ARD resulting in poor quality seepage resulting in high risk to groundwater quality. | Yes |
| Groundwater quantity | Alternatives that do not reduce groundwater flow to downstream creeks are preferred. | Large pond potentially increases flow through and beneath dam; however, large dam with engineered groundwater cut-off reduces groundwater contribution to creek flow. | Large pond and close to dam potentially increases flow through and beneath dam; however, large dam with engineered groundwater cut-off reduces groundwater contribution to creek flow. | Pond close to dam potentially increases flow through and beneath dam; however, large dam with engineered groundwater cut-off reduces groundwater contribution to creek flow. | Significantly smaller pond and dam unlikely to affect groundwater contribution to creek flow. | Yes |
| ***Terrestrial ecosystems*** | | | | | | |
| Loss and risk to wetlands | Alternatives that directly impact less wetland surface area or have fewer risks to wetlands are preferred as they have a lower probability of affecting habitat and ecological function. | Loss of wetlands: 210 ha. Risk to wetlands considered minimal because of under water storage of all PAG materials and better water quality | Loss of wetlands: 207 ha<br>Risk of alteration to wetlands considered low because of under water storage of PAG rock | Loss of wetlands 210 ha. Low risk of alteration to downstream wetlands because of co-disposal of tailings and waste rock | Loss of wetlands: 137 ha. Moderate risk of alteration to downstream wetlands because of storage of PAG material on land | Yes |
| ***Fish, fish habitat and aquatic resources*** | | | | | | |
| Risks to non-CRA fisheries and aquatic resources | Alternatives that present less risk to aquatic resources from changes in water quantity and quality are preferred | Minimal changes in downstream water quality above background conditions predicted in modeling studies. Water quantity to be augmented with lake water during operations | Potentially minor changes in downstream water quality due to uncaptured, poor quality seepage (originating from filtered tailings) from pond. Water quantity to be augmented with lake water during operations | Minimal to potentially minor changes in downstream water quality due to uncaptured, poor quality seepage (originating from paste tailings) from pond. Water quantity to be augmented with lake water during operations | Potentially moderate changes in downstream water quality due to uncaptured, poor quality seepage from PAG waste rock and from filtered tailings. Water quantity to be augmented with lake water during operations | Yes |
| Risks to CRA fish species | Alternatives that present reduced risk to fish that are a part of, or contribute to, a commercial, recreational or Aboriginal fishery due to changes in water quantity and quality are preferred | Supplementing in-stream flow needs with releases from the Freshwater Reservoir will mitigate risks. Changes in water quality not anticipated to effect CRA fishery. | Supplementing in-stream flow needs with releases from the Freshwater Reservoir will mitigate risks. Changes in water quality not anticipated to effect CRA fishery. | Supplementing in-stream flow needs with releases from the Freshwater Reservoir will mitigate risks. Changes in water quality not anticipated to effect CRA fishery. | Supplementing in-stream flow needs with releases from the Freshwater Reservoir will mitigate risks Changes in water quality not anticipated to effect CRA fishery. | No - not significantly differentiating |
| Fish species | Alternatives that do not affect fish within the Project footprint that are a part of, or contribute to, a commercial, recreational or Aboriginal fishery are preferred | Rainbow Trout present as CRA species | Rainbow Trout present as CRA species | Rainbow Trout present as CRA species | Rainbow Trout present as CRA species | No - not significantly differentiating |

*(continued)*

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Fish, fish habitat and aquatic resources*** *(cont'd)* | | | | | | |
| Fish habitat | Alternatives with less potential for 'serious harm' and/or less area of permanently altered or destroyed habitat (PAD) for CRA fish species within the Project footprint are preferred | Loss of 14.2 km of known Rainbow Trout habitat and 12.4 km of unconfirmed Rainbow Trout habitat | Loss of 13.8 km of known Rainbow Trout habitat and 12.5 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Loss of 12.9 km of known Rainbow Trout habitat and 11.1 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Loss of 7.5 km of known Rainbow Trout habitat and 8.4 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Yes |
| Presence of rare and endangered aquatic species | Alternatives that impact rare or endangered species (as considered by the British Columbia Conservation Data Centre, the *Species at Risk Act*, and the Committee on the Status of Endangered Wildlife in Canada) are detrimental to biodiversity and may have broader ecosystem impacts. | No rare or endangered aquatic species were identified within or in close proximity. Freshwater mollusc found in Lake 01682LNRS unlikely to be impacted because of distance from TSF. | Freshwater mollusc (BC blue-listed Acroloxus coloradensis) identified in Lake 01682LNRS more likely to be impacted because of proximity of TSF. | No rare or endangered aquatic species were identified within or in close proximity. Freshwater mollusc found in Lake 01682LNRS unlikely to be impacted because of distance from TSF. | Freshwater mollusc (BC blue-listed Acroloxus coloradensis) identified in Lake 01682LNRS more likely to be impacted because of proximity of TSF. | No - not significantly differentiating |
| ***Terrain and Soil*** | | | | | | |
| Total footprint area (including TSF and MRSF) | Alternatives with smaller footprints are preferred as they have lower potential effects to terrestrial and aquatic environments. | 1,515 ha | 1,505 ha | 1,310 ha | 1,038 ha | No. The effects on this indicator are better considered under more specific habitat loss indicators |
| Soils | Alternatives that affect smaller areas of high productivity soils are preferred | 48 ha of high productivity soil (3% of total footprint) | 60 ha of high productivity soil (4% of total footprint) | 35 ha of high productivity soil (3% of total footprint) | 73 ha of high productivity soil (7% of total footprint) | Yes |
| ***Wildlife and wildlife habitat*** | | | | | | |
| Loss of high-quality habitat for species of conservation concern | Alternatives that have less potential impact for high quality habitat (terrestrial birds, myotis bat and western toad) are preferred | Loss of high-quality habitat = 1,279 ha (terrestrial birds = 74 ha; myotis bat = 785 ha and western toad = 420 ha) | Loss of high-quality habitat = 1,301 ha (terrestrial birds = 73 ha; myotis bat = 827 ha and western toad = 401 ha) | Loss of high-quality habitat = 1,124 ha terrestrial birds = 73 ha; myotis bat = 648 ha and western toad = 403 ha | Loss of high-quality habitat = 678 ha (terrestrial birds = 17 ha; myotis bat = 583 ha and western toad = 79 ha) | Yes |
| Loss of high-quality habitat for caribou | Alternatives that have less impact on high quality caribou habitat are preferred | Loss of high-quality caribou habitat = 402 ha | Loss of high-quality caribou habitat = 416 ha | Loss of high-quality caribou habitat = 317 ha | Loss of high-quality caribou habitat = 212 ha | Yes |
| Loss of high-quality habitat for moose | Alternatives that have less impact on high quality moose habitat are preferred | Loss of high-quality moose habitat = 272 ha | Loss of high-quality moose habitat = 257 ha | Loss of high-quality moose habitat = 259 ha | Loss of high-quality moose habitat = 95 ha | Yes |
| Toxicological risk to migratory birds, amphibians and bats | Alternatives that present less toxicological risk to migratory birds, amphibians and bats are preferred | Minimal to low toxicological risk. Better water quality because PAG rock co-disposed subaqueously with tailings. Size of pond could temporarily attract migratory waterbirds but unlikely during operations. | Low to moderate potential for toxicological risk. Large size of pond could attract waterbirds, amphibians and bats. Better water quality because of sub-aqueous PAG rock storage but partially-saturated filtered tailings could affect water quality. Seepage from TSF may affect migratory birds, amphibians and bats if metals accumulate in wetland vegetation. | Low potential for toxicological risk. Pond unlikely attract waterbirds, amphibians and bats. Better quality water because of lower ML/ARD potential. May affect migratory birds, amphibians and bats if metals accumulate in wetland vegetation. | Moderate potential for toxicological risk. On land PAG and tailings disposal may affect water quality of downstream waterways used by waterfowl, amphibians and bats. Seepage from TSF may affect migratory birds, amphibians and bats if metals accumulate in wetland vegetation. Seepage collection pond from PAG rock expected to have ML/ARD affected water. | Yes |

*(continued)*

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Wildlife and wildlife habitat*** *(cont'd)* | | | | | | |
| Toxicological risk to terrestrial wildlife species | Alternatives that present less toxicological risk to wildlife species are preferred | Minimal toxicological risk associated with dusting from TSF beaches and from pond water quality and associated seepage to downstream wetlands / creeks | Low to moderate toxicological risk associated with dusting from filtered tailings stack and from pond water quality | Low toxicological risk associated with dusting from paste tailings and from pond water quality | Moderate toxicological risk associated with dusting from filtered tailings stack, PAG rock dump and poor water quality in seepage collection pond downstream of PAG rock dump | Yes |

**Table 7.2-4. Human Environment Criteria**

| Characterization Criteria<br>Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation (LDN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Alternative has potential to affect access to LDN harvest areas (trapline). | Alternative has potential to affect access to LDN harvest areas (trapline). | Alternative has potential to affect access to LDN harvest areas (trapline). | Alternative has potential to affect access to LDN harvest areas (trapline). | No - not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Alternative overlaps with habitat of species harvested by LDN. Moose habitat total area = 272 ha. Caribou habitat total area = 402 ha. Loss of 14.2 km of known Rainbow Trout habitat and 12.4 km of unconfirmed Rainbow Trout habitat. | Alternative overlaps with habitat of species harvested by LDN. Moose habitat total area = 257 ha. Caribou habitat total area = 416 ha. Loss of 13.8 km of known Rainbow Trout habitat and 12.5 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by LDN. Moose habitat total area = 259 ha. Caribou habitat total area = 317 ha. Loss of 12.9 km of known Rainbow Trout habitat and 11.1 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by LDN. Moose habitat total area = 95 ha. Caribou habitat total area = 212 ha. Loss of 7.5 km of known Rainbow Trout habitat and 8.4 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Yes |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Alternative has minimal toxicological risk associated with dusting from TSF beaches and from pond water quality and associated seepage to downstream wetlands / creeks that may affect the quality of resources harvested by LDN. | Alternative has low to moderate toxicological risk associated with dusting from filtered tailings stack and from PAG pond water quality that has potential to affect the quality of resources harvested by LDN. | Alternative has low toxicological risk associated with dusting from filtered tailings stack and from pond water quality that has potential to affect the quality of resources harvested by LDN. | Alternative has moderate toxicological risk associated with dusting from filtered tailings stack, PAG rock dump and poor water quality in seepage collection pond downstream of PAG rock dump that has potential to affect the quality of resources harvested by LDN. | Yes |
| Quality of Aboriginal harvesters' experience (based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Alternative has the potential to affect the quality of experience of LDN harvesters due to low noise generation from equipment and operations | Alternative has the potential to affect the quality of experience of LDN harvesters due moderate levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of LDN harvesters due to low levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of LDN harvesters, moderate levels of noise from equipment, truck and operations | Yes |
| ***Current Use of Lands and Resources for Traditional Purposes - Nadleh Whut'en First Nation (NWFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | No, not differentiating |

*(continued)*

| Characterization Criteria | Rationale | Candidate 1 - Slurry tailings / submerged PAG | Candidate 7 - Filtered tailings / submerged PAG | Candidate 10 - Paste tailings / submerged PAG | Candidate 22 - Filtered tailings / PAG on land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Nazko First Nation (NFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | No, not differentiating |
| ***Current Use of Lands and Resources for Traditional Purposes – Métis*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | No, not differentiating |
| ***Current Use of Lands and Resources for Traditional Purposes - Saik'uz First Nation (SFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | No – not differentiating |

*(continued)*

| Characterization Criteria | Rationale | Candidate 1 - Slurry tailings / submerged PAG | Candidate 7 - Filtered tailings / submerged PAG | Candidate 10 - Paste tailings / submerged PAG | Candidate 22 - Filtered tailings / PAG on land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Saik'uz First Nation (SFN)*** *(cont'd)* | | | | | | |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect quality of resources harvested in Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect quality of resources harvested in Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect quality of resources harvested in Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect quality of resources harvested in Tatelkuz Lake. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake, however TSF options will not impact visual or noise quality at Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake, however TSF options will not impact visual or noise quality at Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake, however TSF options will not impact visual or noise quality at Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake, however TSF options will not impact visual or noise quality at Tatelkuz Lake. | No, not differentiating |
| ***Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation (STN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on the September STN TLUS (2015), the alternative has the potential to affect access to STN harvest areas (hunting) and cultural sites. Exact locations of the hunting area have not been provided. | Based on the September STN TLUS (2015), the alternative has the potential to affect access to STN harvest areas (hunting) and cultural sites. Exact locations of the hunting area have not been provided.. | Based on the September STN TLUS (2015), the alternative has the potential to affect access to STN harvest areas (hunting) and cultural sites. Exact locations of the hunting area have not been provided. | Based on the September STN TLUS (2015), the alternative has the potential to affect access to STN harvest areas (hunting) and cultural sites. Exact locations of the hunting area have not been provided. | No - not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Alternative overlaps with habitat of species harvested by STN. Moose habitat total area = 272 ha. Caribou habitat total area = 402 ha. Loss of 14.2 km of known Rainbow Trout habitat and 12.4 km of unconfirmed Rainbow Trout habitat. | Alternative overlaps with habitat of species harvested by STN. Moose habitat total area = 257 ha. Caribou habitat total area = 416 ha. Loss of 13.8 km of known Rainbow Trout habitat and 12.5 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by STN. Moose habitat total area = 259 ha. Caribou habitat total area = 317 ha. Loss of 12.9 km of known Rainbow Trout habitat and 11.1 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by STN. Moose habitat total area = 95 ha. Caribou habitat total area = 212 ha. Loss of 7.5 km of known Rainbow Trout habitat and 8.4 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Yes |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Alternative has minimal toxicological risk associated with dusting from TSF beaches and from pond water quality and associated seepage to downstream wetlands / creeks that may affect the quality of resources harvested by STN. | Alternative has low to moderate toxicological risk associated with dusting from filtered tailings stack and from PAG pond water quality that has potential to affect the quality of resources harvested by STN. | Alternative has low toxicological risk associated with dusting from filtered tailings stack and from pond water quality that has potential to affect the quality of resources harvested by STN. | Alternative has moderate toxicological risk associated with dusting from filtered tailings stack, PAG rock dump and poor water quality in seepage collection pond downstream of PAG rock dump that has potential to affect the quality of resources harvested by STN. | Yes |

*(continued)*

| Characterization Criteria | Rationale | Candidate 1 - Slurry tailings / submerged PAG | Candidate 7 - Filtered tailings / submerged PAG | Candidate 10 - Paste tailings / submerged PAG | Candidate 22 - Filtered tailings / PAG on land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation (STN)*** | | | | | | |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Alternative has the potential to affect the quality of experience of STN harvesters due to potential low levels of noise generation from equipment and operations | Alternative has the potential to affect the quality of experience of STN harvesters due to moderate levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of STN harvesters due to moderate potential for low levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of STN harvesters due to high potential for moderate levels of noise from equipment, truck and operations | Yes |
| ***Current Use of Lands and Resources for Traditional Purposes - Stellat'en First Nation (StFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | No, not differentiating |
| ***Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation (UFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Alternative has potential to affect access to UFN harvest areas. Alternative may affect UFN access to a campsite (UFN TLUS); exact location not provided. | Alternative has potential to affect access to UFN harvest areas. Alternative may affect UFN access to a campsite (UFN TLUS); exact location not provided. | Alternative has potential to affect access to UFN harvest areas. Alternative may affect UFN access to a campsite (UFN TLUS); exact location not provided. | Alternative has potential to affect access to UFN harvest areas. Alternative may affect UFN access to a campsite (UFN TLUS); exact location not provided. | No - not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Alternative overlaps with habitat of species harvested by UFN. Moose habitat total area = 272 ha. Caribou habitat total area = 402 ha. Loss of 14.2 km of known Rainbow Trout habitat and 12.4 km of unconfirmed Rainbow Trout habitat. | Alternative overlaps with habitat of species harvested by UFN. Moose habitat total area = 257 ha. Caribou habitat total area = 416 ha. Loss of 13.8 km of known Rainbow Trout habitat and 12.5 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by UFN. Moose habitat total area = 259 ha. Caribou habitat total area = 317 ha. Loss of 12.9 km of known Rainbow Trout habitat and 11.1 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by UFN. Moose habitat total area = 95 ha. Caribou habitat total area = 212 ha. Loss of 7.5 km of known Rainbow Trout habitat and 8.4 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Yes |

*(continued)*

| Characterization Criteria | Rationale | Candidate 1 - Slurry tailings / submerged PAG | Candidate 7 - Filtered tailings / submerged PAG | Candidate 10 - Paste tailings / submerged PAG | Candidate 22 - Filtered tailings / PAG on land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation (UFN;*** *cont'd)* | | | | | | |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Alternative has minimal toxicological risk associated with dusting from TSF beaches and from pond water quality and associated seepage to downstream wetlands / creeks that may affect the quality of resources harvested by UFN. | Alternative has low to moderate toxicological risk associated with dusting from filtered tailings stack and from PAG pond water quality that has potential to affect the quality of resources harvested by UFN. | Alternative has low toxicological risk associated with dusting from filtered tailings stack and from pond water quality that has potential to affect the quality of resources harvested by UFN. | Alternative has moderate toxicological risk associated with dusting from filtered tailings stack, PAG rock dump and poor water quality in seepage collection pond downstream of PAG rock dump that has potential to affect the quality of resources harvested by UFN. | Yes |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Alternative has the potential to affect the quality of experience of UFN harvesters due to potential low noise generation from equipment and operations | Alternative has the potential to affect the quality of experience of UFN harvesters due to moderate levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of UFN harvesters due to low levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of UFN harvesters due moderate levels of noise from equipment, truck and operations | Yes |
| ***Current Use of Lands and Resources for Traditional Purposes - Tsilhqot'in National Government (TNG)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | No, not differentiating |
| ***Non-traditional land-use*** | | | | | | |
| Agriculture and range tenures | Alternatives that do not overlap agriculture or range tenures are preferred as they will not affect access to and use of tenure | 268 ha (0.8% of Tenure RAN075154) | 214 ha (0.7% of Tenure RAN075154) | 248 ha (0.8% of Tenure RAN075154) | 0 ha | Yes |
| Guide outfitting licenses | Alternatives that do not overlap guide outfitting licenses are preferred as they may not affect access to and use of guiding area | 789 ha (0.2% of Tenure 484246); 726 ha (1.3% of Tenure 1206416) | 767 ha (0.2% of Tenure 484246); 737 ha (1.4% of Tenure 1206416) | 665 ha (0.2% of Tenure 484246); 746ha (1.2% of Tenure 1206416) | 366 ha (0.1% of Tenure 484246); 722 ha (1.3% of Tenure 1206416) | No - not differentiating |
| Registered traplines | Alternatives that overlap trapline tenures may affect access to and use of tenure | 1,138 ha (3.0% of Tenure TR0512T027); 377 ha (0.4% of Tenure TR0601T003) | 1,238 ha (3.3% of Tenure TR0512T027); 267 ha (0.3% of Tenure TR0601T003) | 960 ha (2.5% of Tenure TR0512T027); 351 ha (0.3% of Tenure TR0601T003) | 1,038 ha (2.7% of Tenure TR0512T027) | Yes |

*(continued)*

| Characterization Criteria | Rationale | Candidate 1 - Slurry tailings / submerged PAG | Candidate 7 - Filtered tailings / submerged PAG | Candidate 10 - Paste tailings / submerged PAG | Candidate 22 - Filtered tailings / PAG on land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Public recreation*** | | | | | | |
| Overlap of areas with recreational sensitivity and significance | Alternatives that are not located in areas with high recreational values that may affect public use are preferred | 1,172 ha (Medium Sensitivity/Medium Significance) and 0 ha in Medium Significance / High Sensitivity<br>total: 1,172 ha | 978 ha in (Medium Sensitivity/Medium Significance)and 43 ha in Medium Significance / High Sensitivity<br>total: 1,021 ha | 1,021 ha (Medium Sensitivity/Medium Significance and 0 ha in Medium Significance / High Sensitivity<br>total: 1,021 ha | 376 ha in (Medium Sensitivity/Medium Significance and 112 ha in Medium Significance / High Sensitivity<br>total: 488 ha | Yes |
| ***Heritage*** | | | | | | |
| Known archaeological sites | Alternatives that do not overlap known archaeological sites are preferred | Overlaps with one archaeological site (FhSf-4) | Overlaps with one archaeological site (FhSf-4) | Overlaps with one archaeological site (FhSf-4) | No archaeological sites within 1,000 m | Yes |
| ***Human health*** | | | | | | |
| Potential health risks | Alternatives with less human health risks (e.g., air quality from dust deposition, water quality from ML/ARD and to country foods from both dust and poor quality water) are preferred. | Minimal to low potential human health risks. Minimal potential for dust inhalation, effects of dust deposition on country foods and drinking water quality as tailings and waste rock remain saturated, reducing dusting and ML/ARD risk. | Low to moderate potential human health risks. Low risk from dust inhalation and to country foods provided tailings are reclaimed progressively. PAG rock stored underwater reduces ML/ARD risk but filtered tailings have some ML/ARD risk that may affect downstream drinking water quality. | Low potential human health risks. Low risk from dust inhalation and to country foods because of low dusting potential because of paste tailings moisture content, non-segregating and crust forming properties. PAG rock is co-disposed with tailings reducing ML/ARD risk but small ML/ARD risk of paste tailings affecting downstream drinking water quality | Moderate potential for human health risks. Moderate potential for dust inhalation from filtered tailings and waste rock (mine camp is downwind of). Any unrecovered ML/ARD from PAG waste increases risk of downstream water quality effects and to downstream fisheries | Yes |
| ***Employment*** | | | | | | |
| Employment opportunities | Alternatives that have more employment opportunities for local communities are preferred | Estimated to employ between 550 and 600 people | Estimated to employ between 600 and 650 people based on additional staff for dam construction and filter tailings placement | Estimated to employ between 550 and 600 people | Estimated to employ between 600 and 650 people based on additional staff for filter tailings placement | Yes |

**Table 7.2-5. Proponent Cost Criteria**

| Characterization Criteria Indicators | Rationale | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Proponent Costs*** | | | | | | |
| Initial capital cost | Options with lower costs are preferred. | Lowest capital cost. Less than $100 M | Highest capital cost due to filters and tailings conveyance / deposition equipment: $175 M - $200 M | Lower capital cost: $100 M- $124 M | Higher capital cost due to filters and tailings conveyance / deposition equipment: $150 M - $174 M | Yes |
| Sustaining capital and operating costs | Options with lower costs are preferred. | Lower sustaining capital and operating costs: $175 M - $349 M | Very high sustaining capital and operating costs: > $875 M | Lower sustaining capital and operating costs: $175 M - $349 M | Very high sustaining capital and operating costs: > $875 M | Yes |
| Closure costs | Options with lower costs are preferred. | Lowest closure cost: $25 M - $49 M | Higher closure cost: $100 M - $125 M | Lower closure cost: $50 M - $74M | Highest closure cost: >$125 M | Yes |
| Post-closure costs | Options with minimal to no active management are preferred | Minimal to no active management/ maintenance anticipated. Periodic inspections | Active management with water treatment over a period of approximately ten years, variances requiring correction expected. | Minor active management with periodic inspections | Long-term water treatment expected with regular maintenance of seepage ditches etc. | Yes |

### 7.3.1 Evaluation Criteria (Sub-Accounts)

The evaluation criteria must be differentiating (i.e., an aspect that distinctly differentiates one alternative from another) and non-redundant so that no more than one sub-account measures the same evaluation criteria. The evaluation criteria should also be 'impact driven'; relevant in the context of the alternative being evaluated; understandable and have 'judgemental independence' such that one sub-account cannot depend on another (Environment Canada 2011).

The selected evaluation criteria are provided in Table 7.3-1

**Table 7.3-1. Evaluation Criteria and Rationale for Selection**

| Account | Evaluation Criteria (Sub-Account) | Rationale |
|---|---|---|
| Physical stability | Physical stability | Alternatives that promote physical stability through robust design and water management are preferred. |
| Technical | Construction Requirements | Alternatives with less complex construction requirements are preferred |
| | Water Management | Alternatives with simpler water management requirements are preferred. |
| | Execution | Alternatives with simpler execution strategies and requirements are preferred. |
| | Closure | Alternatives that facilitate earlier and safer closure are preferred. |
| Environmental | Climate and Air Quality | Alternatives that have low potential for dust generation are preferred due the potential for dust to affect other environmental and human environment areas of importance. |
| | Surface water quantity | Alternatives with lower potential effects to surface water quantity are preferred due the potential for altered flows to affect other environmental and human environment areas of importance. |
| | Surface water quality | Alternatives with lower potential effects to surface water quality are preferred due the potential for degradation in surface water quality to affect other environmental and human environment areas of importance. |
| | Groundwater | Alternatives with potentially lower risks to groundwater quality and quantity are preferred. |
| | Fish, Fish Habitat and Aquatic Species | Alternatives with lower impacts to fish or fish habitat, endangered aquatic species, and pose a risk to fish and non-fish species are preferred due to their high biodiversity values. |
| | Terrestrial Ecosystems | Alternatives that have lower risks and impacts to wetlands and other terrestrial aquatic ecosystems are preferred due to their high biodiversity values. |
| | Wildlife and Wildlife Habitat | Alternatives with lower risks and impacts to species of conservation concern, present increased risk to migratory birds and potential toxicological risk to wildlife species are less preferred due to their high biodiversity values. |

*(continued)*

| Account | Evaluation Criteria (Sub-Account) | Rationale |
|---|---|---|
| Human Environment | Current use of Lands and Resources for Traditional Purposes – Lhoosk'uz Dene Nation | Alternatives with lower potential impacts to CULTRP for Lhoosk'uz Dene Nation are preferred. |
| | Current use of Lands and Resources for Traditional Purposes – Skin Tyee Nation | Alternatives with lower potential impacts to CULTRP for Skin Tyee Nation are preferred. |
| | Current use of Lands and Resources for Traditional Purposes – Ulkatcho First Nation | Alternatives with lower potential impacts to CULTRP for Ulkatcho First Nation are preferred. |
| | Non-traditional Land Use | Alternatives with lower impacts to non-traditional land use (i.e., the economic interests of commercial tenure holders) are preferred. |
| | Public Recreation | Alternatives with lower impacts to public recreation are preferred. |
| | Heritage | Archaeological sites are protected under the *Heritage Conservation Act* (1996a) and non-protected heritage sites may hold cultural and social value. Alternatives that do not impact heritage resources are preferred. |
| | Human Health | Alternatives that have lower risk human health risks are preferred. |
| | Employment | Alternatives with higher employment requirements are preferred. |
| Project Economics | Proponent costs | Alternatives with lower lifecycle costs are preferred. |

### 7.3.2 Measurement Criteria (Indicators)

Measurement criteria allow the sub-accounts and accounts to be measured. A six-point scale is used because it provides sufficient range to differentiate without being overly detailed, and it is an even number scale which eliminates the tendency to select the "middle-of-the road" value. Qualitative (i.e., value-based) scales were developed (e.g., very high, high, low, etc.) when precise measurability was not possible.

Value scales were developed to be:

- Reliable such that reviewers can rate an alternative according to the value scale and assign the same score;
- Directly relevant to the indicator being scored; and,
- Justifiable so that a reviewer can conclude that the value scale is reasonable and representative.

Table 7.3-2 list the "indicator" parameter / unit and whether a qualitative value has been assigned for the multiple accounts ledger. The measurement criteria and scores for each candidate under

physical stability, technical, environmental, human environment and project economic accounts are provided in Appendix E in Tables 5-3 through 5-7.

**Table 7.3-2. Multiple Accounts Ledger**

| Account | Sub-Account (Evaluation Criteria) | Indicator (Measurement Criteria) | Indicator Parameter | Unit |
|---|---|---|---|---|
| Physical stability | Physical stability | Location of water storage | Qualitative Value | - |
| | | Tailings and waste rock interstitial water | Qualitative Value | - |
| | | Normal operating pond volume | Volume | $Mm^3$ |
| | | Emergency water pond management – active | Reclaim pump capacity | $Mm^3/y$ |
| | | Emergency water pond management – passive | Qualitative Value | - |
| | | Design basis / regulatory requirement | Qualitative Value | - |
| | | Tailings density | Qualitative Value | - |
| | | Maximum dam height | Height | m |
| | | Operational monitoring requirements - safety | Qualitative Value | - |
| Technical | Containment design | Style of containment | Qualitative Value | - |
| | | Number of dams | Number | # |
| | | Construction volumes | Volume | $Mm^3$ |
| | | Tailings initial settled density | Density | $t/m^3$ |
| | | Drainage provisions | Qualitative Value | - |
| | | Seepage management - physical | Qualitative Value | - |
| | | Seepage management – quality | Qualitative Value | - |
| | Construction requirements | Foundation Preparation for Tailings Storage Area (excludes dam) | Qualitative Value | - |
| | | Tailings infrastructure | Qualitative Value | - |
| | | Foundation preparation for PAG waste rock facility | Qualitative Value | - |
| | | Initial dam construction | Qualitative Value | - |
| | | Sustaining construction (excludes waste delivery) | Dam raise frequency | years |
| | Water management | Catchment area | Area | $km^2$ |
| | | Flood routing | Qualitative Value | - |
| | | Water balance – surplus / deficit / balance | Qualitative Value | - |
| | | Water recycle requirement | Volume | $Mm^3/y$ |
| | | Water treatment | Qualitative Value | - |
| | | Surplus water management | Volume | $Mm^3/y$ |
| | | Operational monitoring requirements – internal site water management | Qualitative Value | - |
| | Execution | Technology precedent – processing | Proven to Project throughput ratio | ratio |
| | | Technology precedent – storage | Proven to Project throughput ratio | ratio |
| | | Tailings delivery complexity | Qualitative Value | - |

*(continued)*

| Account | Sub-Account (Evaluation Criteria) | Indicator (Measurement Criteria) | Indicator Parameter | Unit |
|---|---|---|---|---|
| | | Tailings placement complexity | Qualitative Value | - |
| | | PAG waste rock delivery and placement | Qualitative Value | - |
| | | Operational flexibility | Qualitative Value | - |
| | Closure | Closure concept – physical | Qualitative Value | - |
| | | Closure concept – geochemical | Qualitative Value | - |
| | | Closure concept – active closure period | Years | # |
| | | Closure concept – long-term maintenance and monitoring | Qualitative Value | - |
| | | Concurrent closure and reclamation | Qualitative Value | - |
| | | Premature closure | Qualitative Value | - |
| Environmental | Climate and air quality | Sensitivity to climate change | Qualitative value | - |
| | | Noise and vibration | Qualitative value | - |
| | | Dust emissions | Qualitative Value | - |
| | Surface water quantity | Loss of catchment area | Area | $km^2$ |
| | Surface water quality | Storage of PAG materials | Qualitative Value | - |
| | | Dam embankment area | Volume | $Mm^3$ |
| | | Seepage quantity | Qualitative value | - |
| | | Operational discharge of treated water | Qualitative value | - |
| | Groundwater | Groundwater quality | Qualitative value | - |
| | | Groundwater quantity (base flow to downstream creeks) | Area | $km^2$ |
| | Terrain and soils | High productivity soils | Area | ha |
| | Fish, Fish Habitat and Aquatic Species | Fish habitat | Stream length | km |
| | | Risks to non-CRA fish aquatic resources | Qualitative value | - |
| | Vegetation and ecosystems | Loss of and risk to wetlands | Area | ha |
| | Wildlife and wildlife habitat | Loss of high-quality habitat for species of conservation concern | Area | ha |
| | | Loss of high-quality habitat for caribou | Area | ha |
| | | Loss of high-quality habitat for moose | Area | ha |
| | | Toxicological risk to migratory birds and amphibians | Qualitative value | - |
| | | Toxicological risks to terrestrial wildlife species | Qualitative value | - |

*(continued)*

| Account | Sub-Account (Evaluation Criteria) | Indicator (Measurement Criteria) | Indicator Parameter | Unit |
|---|---|---|---|---|
| Human Environment | Current use of lands and resources for traditional purposes – Lhoosk'uz Dene Nation | Availability (abundance and distribution) of resources harvested by Aboriginal people | Area and length | ha and km |
| | | Quality of resources harvested by Aboriginal people | Qualitative Value | - |
| | | Quality of Aboriginal harvesters' experience | Qualitative Value | - |
| | Current use of lands and resources for traditional purposes – Skin Tyee First Nation | Availability (abundance and distribution) of resources harvested by Aboriginal people | Area and length | ha and km |
| | | Quality of resources harvested by Aboriginal people | Qualitative Value | - |
| | | Quality of Aboriginal harvesters' experience | Qualitative Value | - |
| | Current use of lands and resources for traditional purposes – Ulkatcho First Nation | Availability (abundance and distribution) of resources harvested by Aboriginal people | Area and length | ha and km |
| | | Quality of resources harvested by Aboriginal people | Qualitative Value | - |
| | | Quality of Aboriginal harvesters' experience | Qualitative Value | - |
| | Non-traditional land use | Agricultural and range tenures | Project overlap of tenure area | % |
| | | Registered traplines | Project overlap of tenure area | % |
| | Public recreation | Overlap with areas of recreational sensitivity and significance | Project overlap of recreational areas | ha |
| | Heritage | Known archaeological sites | Distance / overlap with known sites | m / # |
| | Human Health | Potential health risks | Qualitative Value | - |
| | Employment | Employment opportunities | People employed | # |
| Project Economics | Proponent cost | Initial capital costs | Cost | $ |
| | | Sustaining capital and operating costs | Cost | $ |
| | | Closure costs | Cost | $ |
| | | Post-closure costs | Qualitative value | - |

## 7.4 VALUE-BASED DECISION PROCESS

### 7.4.1 Indicator Weightings

The indicator weightings presented in Table 7.4-1 were assigned based on professional judgement, legislated requirements (e.g., SARA, COSEWIC), consultation feedback, understood importance to Aboriginal people, and the relative risk to TSF stability, receiving environment, etc. to a given indicator. Full justification for these weightings is provided in Appendix E. All values were evaluated on a six-point scale, with 6 being the most significantly valued and 1 being the least. Weightings are relevant only when there is more than one indicator since they contrast the relative importance of each indicator within the sub-account. Note that a comparison of indicator weightings is only relevant within a given sub-account; relative indicator weightings cannot be compared between sub-accounts. Although physical stability is not traditionally an account under the *Guidelines*, it has been separated from the *technical* account and assigned the highest weighting (along with the *environmental* account) to emphasize the *Panel Report's* emphasis on the physical safety / stability of waste impoundments.

**Table 7.4-1. Multiple Accounts Analysis: Indicator Weighting**

| Account | Sub-Account | Indicator | Weighting Value[1] |
|---|---|---|---|
| Physical Stability | Physical Stability | | |
| | | Location of water storage | 6 |
| | | Tailings and waste rock interstitial water | 5 |
| | | Normal operating pond volume | 6 |
| | | Emergency water management - pumps (active) | 2 |
| | | Emergency water management - spillway (passive) | 4 |
| | | Design basis / regulatory requirement | 3 |
| | | Tailings density | 5 |
| | | Maximum dam height | 4 |
| | | Operational monitoring requirements - safety | 5 |
| Technical | Containment Design | | |
| | | Style of containment | 6 |
| | | Number of dams | 5 |
| | | Construction volumes | 3 |
| | | Tailings initial settled density | 1 |
| | | Drainage provisions | 4 |
| | | Seepage management - physical | 3 |
| | | Seepage management - quality | 5 |
| | Construction Requirements | | |
| | | Foundation preparation for tailings storage area (excludes dam) | 6 |
| | | Tailings infrastructure | 4 |

*(continued)*

| Account | Sub-Account | Indicator | Weighting Value[1] |
|---|---|---|---|
| Technical *(cont'd)* | Construction Requirements | | |
| | | Foundation preparation for PAG / NAG3 waste rock facility | 6 |
| | | Initial dam construction | 6 |
| | | Sustaining construction (excludes waste delivery) | 4 |
| | Water Management | | |
| | | Catchment area | 3 |
| | | Flood routing | 4 |
| | | Water balance - surplus/deficit/balance | 6 |
| | | Water recycle requirement | 2 |
| | | Water treatment | 4 |
| | | Surplus water management | 5 |
| | | Operational monitoring requirements - internal site water management | 4 |
| | Execution | | |
| | | Technology precedent - processing | 2 |
| | | Technology precedent - storage | 4 |
| | | Tailings delivery complexity | 6 |
| | | Tailings placement complexity | 5 |
| | | PAG / NAG3 waste rock delivery and placement | 4 |
| | | Operational flexibility | 5 |
| | Closure | | |
| | | Closure concept - physical | 6 |
| | | Closure concept - geochemical | 5 |
| | | Closure concept - active closure period | 2 |
| | | Closure concept - long-term maintenance and monitoring | 5 |
| | | Concurrent closure and reclamation | 1 |
| | | Premature closure | 4 |
| Environmental | Climate and Air Quality | | |
| | | Sensitivity to climate change | 3 |
| | | Dust emissions | 5 |
| | | Noise and Vibrations | 2 |
| | Surface Water Quantity | | |
| | | Loss of catchment area[1] | n/a |
| | Surface Water Quality | | |
| | | Storage of PAG /ML material | 6 |
| | | Seepage quantity | 3 |
| | | Dam embankment area | 2 |
| | | Operational discharge of treated water | 5 |

*(continued)*

| Account | Sub-Account | Indicator | Weighting Value[1] |
|---|---|---|---|
| Environmental *(cont'd)* | Groundwater | | |
| | | Groundwater quality | 5 |
| | | Groundwater quantity | 3 |
| | Terrain and Soils | | |
| | | High productivity soils[1] | n/a |
| | Fish, fish habitat, and aquatic resources | | |
| | | Loss of fish habitat | 6 |
| | | Risk to non-CRA fish and aquatic resources | 1 |
| | Terrestrial Ecosystems | | |
| | | Loss and risk to wetlands | n/a |
| | Wildlife | | |
| | | Loss of high-quality habitat for species of conservation concern | 3 |
| | | Loss of high quality habitat for caribou | 6 |
| | | Loss of high quality habitat for moose | 2 |
| | | Toxicological risk to migratory birds and amphibians and bats | 6 |
| | | Toxicological risk to terrestrial wildlife species | 4 |
| Human Environment | CULRTP – Lhoosk'uz Dene Nation | | |
| | | Availability (abundance and distribution) of resources | 3 |
| | | Quality of resources harvested by Aboriginal people | 6 |
| | | Quality of Aboriginal harvesters' experience | 4 |
| | CULRTP – Skin Tyee Nation | | |
| | | Availability (abundance and distribution) of resources | 3 |
| | | Quality of resources harvested by Aboriginal people | 6 |
| | | Quality of Aboriginal harvesters' experience | 4 |
| | CULRTP – Ulkatcho First Nation | | |
| | | Availability (abundance and distribution) of resources | 3 |
| | | Quality of resources harvested by Aboriginal people | 6 |
| | | Quality of Aboriginal harvesters' experience | 4 |
| | Non-traditional Land Use | | |
| | | Registered trap lines | 3 |
| | | Agricultural and range tenures | 2 |
| | Public Recreation | | |
| | | Overlap with areas of recreational sensitivity and significance | n/a |
| | Heritage | | |
| | | Known archaeological sites[1] | n/a |

*(continued)*

| Account | Sub-Account | Indicator | Weighting Value[1] |
|---|---|---|---|
| Human Environment *(cont'd)* | Human Health | | |
| | | Potential health risks[1] | n/a |
| | Employment | | |
| | | Employment opportunities | n/a |
| Project Economics | Proponent Costs | | |
| | | Initial capital costs | 1 |
| | | Sustaining capital and operating costs | 1 |
| | | Closure costs | 1 |
| | | Post-closure Costs | 1 |

[1]_ *Weightings are not applicable for sub-accounts with only one indicator.*

### 7.4.2 Sub-account Weighting

The sub-account weightings presented in Table 7.4-2 were assigned based on professional judgement, legislated requirement, consultation feedback, understood importance to Aboriginal people, and the relative risk to TSF stability, receiving environment, etc. to a given indicator. All values were evaluated on a six-point scale, with 6 being the most significantly valued and 1 being the least. Weightings are relevant only when there is more than one sub-account in an account since they contrast the relative importance of each indicator within the account. Note that a comparison of sub-account weightings is only relevant within a given account; relative sub-account weightings cannot be compared among individual accounts.

**Table 7.4-2. Multiple Accounts Analysis: Sub-Account Weighting**

| Account | Sub-Account | Weighting Value[1] |
|---|---|---|
| Physical Stability | | |
| | Physical Stability[1] | n/a |
| Technical | | |
| | Containment Design | 6 |
| | Construction Requirements | 4 |
| | Water Management | 6 |
| | Execution | 6 |
| | Closure | 6 |
| Environmental | | |
| | Climate and Air Quality | 3 |
| | Surface Water Quantity | 4 |
| | Surface Water Quality | 6 |
| | Groundwater | 3 |
| | Terrain and Soils | 1 |

*(continued)*

| Account | Sub-Account | Weighting Value[1] |
|---|---|---|
| Environmental *(cont'd)* | | |
| | Fish, fish habitat, and aquatic resources | 6 |
| | Terrestrial Ecosystems | 3 |
| | Wildlife | 5 |
| Human Environment | | |
| | CULRTP – Lhoosk'uz Dene Nation | 6 |
| | CULRTP – Skin Tyee Nation | 6 |
| | CULRTP – Ulkatcho First Nation | 6 |
| | Non-traditional Land Use | 2 |
| | Public Recreation | 2 |
| | Heritage | 4 |
| | Human Health | 6 |
| | Employment | 3 |
| Project Economics | | |
| | Proponent Costs[1] | n/a |

[1] *Weighting not-applicable for only one sub-account*

### 7.4.3 Account Weighting

The recommended base-case account weightings were derived from the *Guidelines*, and are presented in Table 7.4-3. Although physical stability is not traditionally an account under the Guidelines, it has been separated from the *technical* account and assigned the highest weighting (along with the *environmental* account) to emphasize the *Panel Report's* emphasis on the physical safety / stability of waste impoundments.

**Table 7.4-3. Account Weighting for Base-case Value Scenarios**

| Account | Weighting Base Case |
|---|---|
| Physical Stability | 6 |
| Technical | 3 |
| Environment | 6 |
| Human Environment | 3 |
| Project Economic | 1.5 |

## 7.5 QUANTITATIVE ANALYSIS

The detailed tables with the results of the MAA are presented in Appendix E (Table 6.4-1 through 6.4-5 for the five accounts). The tables provide the indicators for each sub-account along with a scalar value and metric on which to score the candidates.

The overall results are presented in Table 7.5-1. The scoring represents the sum of the five Accounts with Base Case weightings as per Table 7.4-3. Candidate 1 scored highest overall with 3.9, indicating

that it is the preferred alternative for the base case analysis. Sensitivity analysis of this result is presented in Section 6.6.

**Table 7.5-1. Multiple Accounts Analysis Results**

| | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|
| Base Case | 3.9 | 3.0 | 3.4 | 3.3 |

The complete MAA calculation tables are included in Appendix A.1 of Appendix E.

Candidate 1 was the selected option (BAT) with the overall highest score of 3.9.

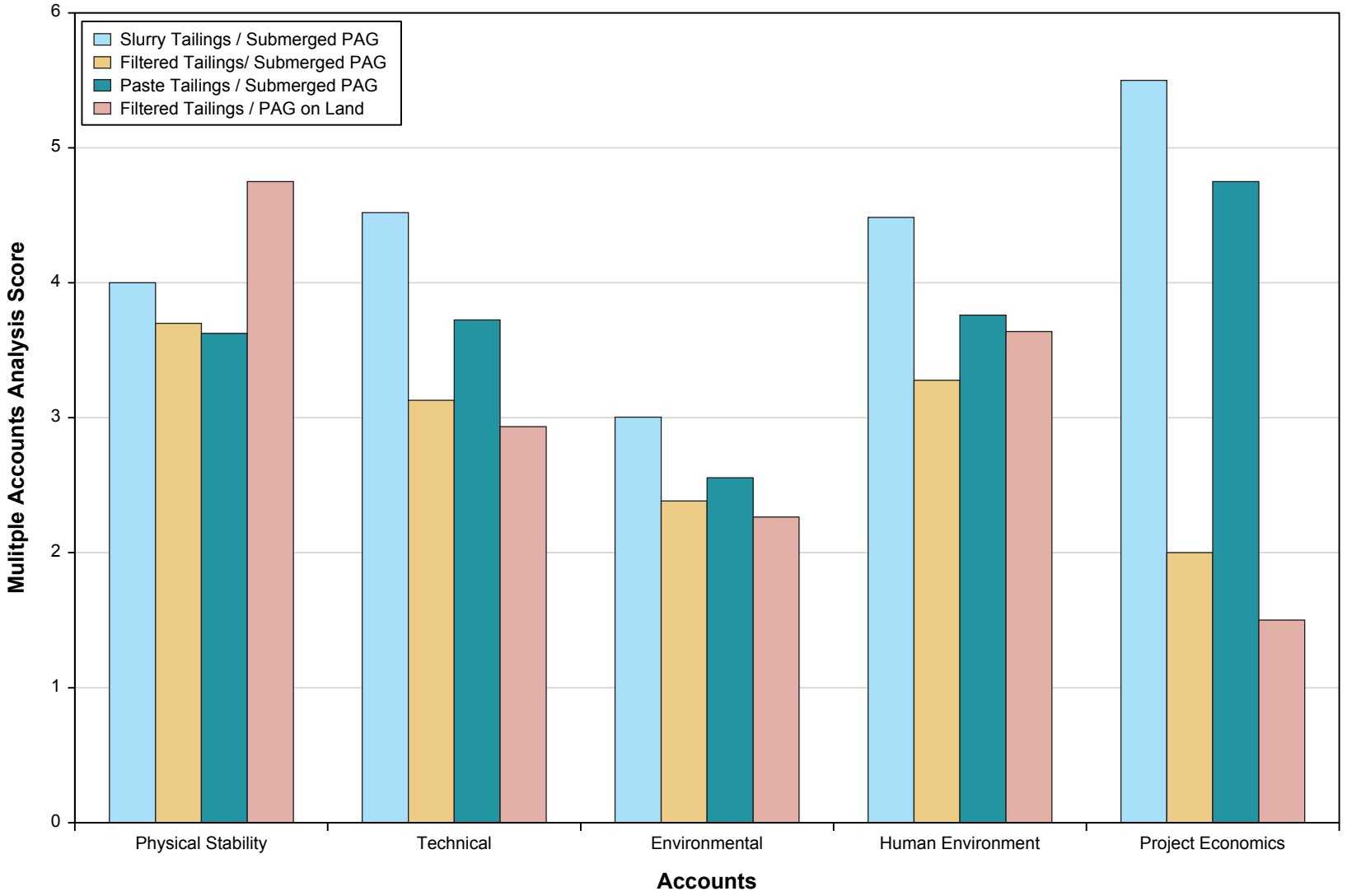
The scoring of the individual accounts is shown graphically below (Figure 7.5-1; sensitivity analyses 8 – 12) and illustrates that Candidate 1 scored highest for all accounts except *Physical Stability*. As expected, Candidate 22 scored highest with respect to *Physical Stability* because it meets many of the BAT principles suggested in the *Panel Report* (e.g., water not stored within the active waste storage facility and dry, compacted tailings promote strength). Candidate 1 scored the second highest for Physical Stability.

However, Candidate 22 does not score high in the other accounts because of the technical challenges of operating a filtered TSF at the Project throughput and the geochemical risks associated with unsaturated storage of PAG materials. The scores on the vertical axis of Figure 7.5-1 are relative to each account and not comparable across accounts.

Candidate 1 scored highest for the *Technical* account because this candidate allows for the best management of seepage through development of a long tailings beach. Candidate 1 also entails fewer foundation construction requirements and infrastructure for tailings production compared to the other alternatives. Water management is simplest with a small and manageable water surplus later in the mine life. There will be no requirement for discharge of contact surface water during operations. Slurry deposition allows the greatest flexibility in the event of plant upset conditions as the tailings can easily be rerouted to other depositional areas. The submergence of PAG/NAG3 materials is very important in ameliorating geochemical conditions so that ML/ARD is minimized; long-term monitoring and maintenance is reduced with only one facility of concern.

Candidate 1 scored highest for the *Environment* account because the effects from poor water quality (ML/ARD) are minimized by submergence. Deposition by slurry maintains a wetted beach that minimizes dust generation. The seepage quantity is less than the other candidates as water is kept away from the dam by a large beach. The better water quality and lower dust emissions means toxicological risk to wildlife is minimized. Candidate 1 also scored highest for the human environmental account because less dust and better water quality minimize the potential health effects from harvested resources.

**Figure 7.5-1**
**Account Scores for Technology Candidates**



The *Project Economics* are more favourable for Candidates 1 because they do not require the cost of constructing and operating a filter plant and equipment for tailings placement, as well as higher anticipated closure costs of the filtered tailings candidates. The closure costs are significantly less for Candidates 1 because it does not require long-term active management associated with water treatment and maintenance of areas affected by acidic conditions.

## 7.6 SENSITIVITY ANALYSIS

The sensitivity analysis re-assigns the weightings of the accounts and sub-accounts to provide alternative value systems to those recommended in the *Guidelines* for the base case.

Twelve sensitivity analyses were performed for this assessment (Table 7.6-1):

1. All accounts were given an equal weighting (i.e., a value of 1);
2. All accounts and sub-accounts were assigned equal weightings (i.e., a value of 1);
3. *Project Economics* were weighted towards their relative contribution to the NPV;
4. *Project Economics* were removed from the analysis;
5. *Physical Stability* was incorporated into the *Technical* account consistent with the *Guidelines*;
6. Only *Current Use of Lands and Resources for Traditional Purposes* was considered in the analysis;
7. Only differentiating indicators considered;
8. Only *Physical Stability* Account considered (Figure 7.5-1);
9. Only *Technical* Account considered (Figure 7.5-1);
10. Only *Environment* Account considered (Figure 7.5-1);
11. Only *Human Environment* Account considered (Figure 7.5-1); and
12. Only *Project Economics* Account considered (Figure 7.5-1).

The sensitivity analyses indicate that the overall rankings are relatively insensitive to other value systems as Candidate 1 scores highest in all other sensitivity runs, with the exception of sensitivity run 8: only *Physical Stability* account considered.

**Table 7.6-1. Results of Sensitivity Analyses**

| Sensitivity Run | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|
| 1 - all accounts given equal weighting | 3.6 | 2.3 | 3.1 | 2.2 |
| 2 – all accounts and sub-accounts given equal weighting | 4.2 | 2.9 | 3.7 | 3.1 |
| 3 – Project economics weighted towards contribution to net present value (NPV) | 4.0 | 3.0 | 3.4 | 3.3 |
| 4 –Project economics removed from the analysis | 3.8 | 3.1 | 3.3 | 3.4 |
| 5 - Physical Stability incorporated into Technical account | 3.9 | 2.7 | 3.3 | 2.7 |
| 6 – Only Current Use of Lands and Resources for Traditional Purposes considered | 5.1 | 3.2 | 4.0 | 3.2 |
| 7 – Only differentiating indicators considered | 3.1 | 2.4 | 2.7 | 2.5 |
| 8 – only Physical Stability account considered | 4.0 | 3.6 | 3.6 | 4.8 |
| 9 – only Technical account considered | 4.5 | 3.1 | 3.8 | 2.9 |
| 10 – only Environmental account considered | 3.0 | 2.4 | 2.6 | 2.3 |
| 11 – only Human Environment account considered | 4.5 | 3.3 | 3.8 | 3.6 |
| 12 – only Project Economics account considered | 5.5 | 2.0 | 4.8 | 1.5 |

# 8. STEP 5 – FAILURE MODES EFFECTS ASSESSMENT

## 8.1 INTRODUCTION

A Failure Modes and Effects Assessment (FMEA) was completed to identify and characterize risks from accidents, failures of an engineered system or malfunctions and to identify BAP (Knight Pièsold Ltd. 2015; Appendix F). The FMEA evaluated risks specific to the TSF concept identified to be the BAT for the Project, Candidate 1. The FMEA evaluated risk management practices outlined in the Application/EIS (New Gold 2015), and other practices expected to be applied during the Project's permitting phase. The FMEA also identified areas where additional mitigations and contingencies, based on BAP for tailings management, could be implemented to minimize identified risks.

Risk is defined as the product of the likelihood of an event occurring and the consequences of the event. Definitions for likelihood and consequence are the same as for the HLRA, and are provided in Tables 6.1-1 and 6.1-2 respectively.

The risk classification used for FMEA is provided in Table 8-1.

**Table 8-1. Risk Classification for Failure Modes Effects Assessment**

| Score (Likelihood x Consequence) | Descriptor |
|---|---|
| 1 to 3 | Very Low |
| 4 to 6 | Low |
| 7 to 12 | Medium |
| 13 to 20 | High |
| 21 to 25 | Very High |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project,* Failure Modes and Effects Assessment Report. VA101-457/15-2

The FMEA focused on the main components of the TSF during the Project's Construction, Operations, and Closure/Decommissioning (including post-closure) phases:

- Coffer dams;
- Diversion Ditches;
- Sediment Control Ponds;
- TSF Site C Dams;
- TSF Site D Dam;
- TSF (General); and
- Environmental Control Dam (ECD).

## 8.2 RISK ANALYSIS

The TSF design incorporates design measures and operational practices that lead to an overall low risk profile. A list of key defensive measures incorporated in the TSF design for each specific hazard is shown in Appendix F. The following sections provide a summary of the key measures included in the project design that reduce the potential risk and enhance safety of the facility; the full description of the Project facilities is available in the *Mine Waste and Water Management Design Report* (Knight Pièsold 2014c).

The TSF design incorporates many key defensive measures that were considered in the FMEA and included in the Application/EIS (New Gold 2015) which lead to an overall low risk profile, including:

- Designed to store and submerge all PAG / NAG3 waste rock to prevent acid generation and minimize metal leaching;
- Tailings beach developed through slurry deposition provides separation of supernatant pond from embankment;
- Designed to store the Inflow Design Flood (IDF) assuming all diversions fail;
- Tailings dams designed to withstand the Maximum Credible Earthquake (MCE);
- Staged dam construction to reduce potential for overloading of foundation soils; and
- Instrumentation installed in dams to monitor operational conditions in the dam and foundations.

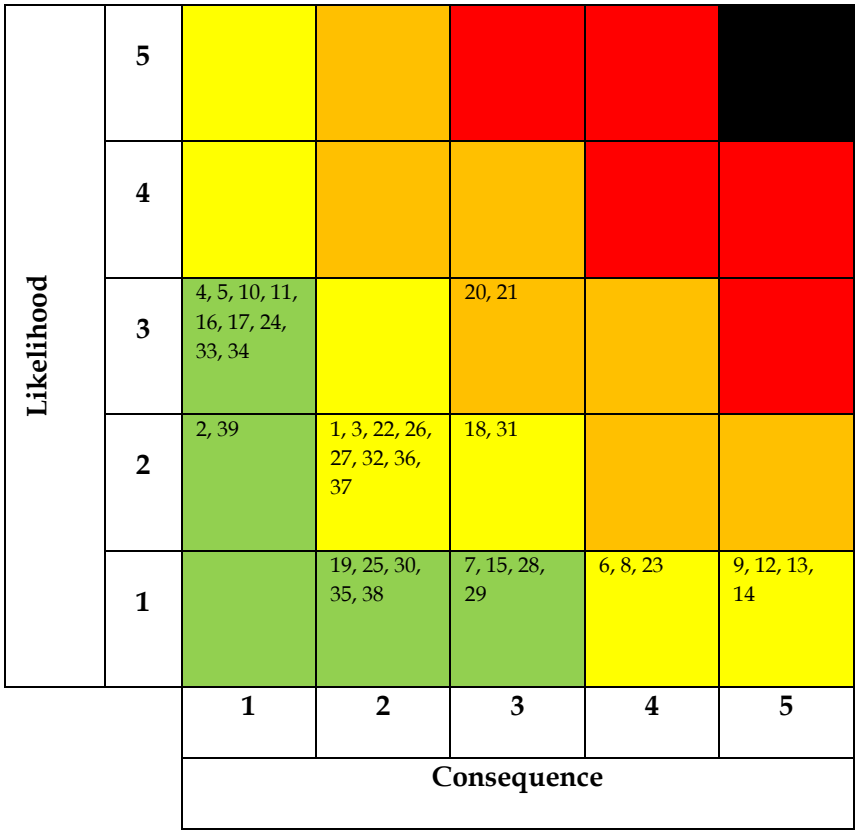
## 8.3 RISK ASSESSMENT

### 8.3.1 Preliminary Risk Classification

The FMEA identified 39 hazards related to the TSF through the mine phases. Preliminary classification of each risk is shown on Figure 8.3-1 and a summary of the risk description and risk rating is included in Table 8.3-1. The classifications were completed based on the design measures and operational practices included in the TSF design. The classifications included:

- 2 medium risk ratings
- 17 low risk ratings, and
- 20 very low risk ratings.

**Figure 8.3-1. Preliminary Risk Classifications**




*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project, Failure Modes and Effects Assessment Report. VA101-457/15-2*

**Table 8.3-1. Risk Description and Preliminary Rating Summary**

| Risk ID | Phase* | Risk Description | Rating |
|---|---|---|---|
| 1 | C | Extreme precipitation or runoff event: Overtop of cofferdam resulting in loss of dam fill material and sediment loading to receiving streams | Low |
| 2 | C | Failure of pumping system for cofferdam: cofferdam overflows resulting in discharge of suspended solids and sediment loading to receiving streams | Very Low |
| 3 | C | Cofferdam failure due to any mechanism leading to loss of containment with loss of dam contents (water and sediment) and dam materials to receiving streams | Low |
| 4 | C/O | Erosion of construction diversion ditches: high suspended solids and sediment loading to receiving streams | Very Low |
| 5 | C/O | Excessive erosion or high flows from construction areas including borrow sites during runoff events: high suspended solids and sediment loading from SCP's to receiving streams | Very Low |

| Risk ID | Phase* | Risk Description | Rating |
|---|---|---|---|
| 6 | C | Too rapid rate of initial construction and filling of TSF dam: high pore pressures, foundation movement causing instability and TSF dam failure | Low |
| 7 | O/CL | TSF dam foundation failure: foundation movement resulting in collapse of Site C tailings dam | Very Low |
| 8 | C | Too rapid rate of initial construction and filling of TSF dam: high pore pressures, foundation movement causing instability and TSF dam failure | Low |
| 9 | O/CL | TSF dam foundation failure: foundation movement resulting in collapse of Site D tailings dam | Low |
| 10 | O/CL | Ponding on tailings dam crest or downstream shell: erosion of dam fill leading to localized scour of slopes (flows to ECD) | Very Low |
| 11 | O/CL | Inclusion of ice or snow in tailings dam fill: settlement of dam resulting in deformation but not loss of containment | Very Low |
| 12 | O/CL | Extreme precipitation or runoff event: overtop of Site D Main Dam resulting in failure of dam | Low |
| 13 | O/CL | Failure of TSF Site D Main Dam filter zone resulting in excessive internal erosion, leading to piping and collapse of dam | Low |
| 14 | O/CL | Embankment deformation resulting in overtopping and discharge of supernatant pond | Low |
| 15 | O/CL | Embankment deformation resulting in slumping of tailings | Very Low |
| 16 | O/CL | PAG or NAG3 waste rock used in Site D tailings dam downstream shell: contamination of runoff and seepage to ECD | Very Low |
| 17 | O/CL | Unexpected metal or nitrogen leaching from NAG waste rock and/or overburden used in TSF Site D dam shell construction: contamination of surface runoff and seepage to ECD | Very Low |
| 18 | O/CL | Failure of TSF Site D cut-off trench resulting in increased seepage | Low |
| 19 | O/CL | Landslide or avalanche into TSF Site D resulting in supernatant pond wave and/or additional material in TSF | Very Low |
| 20 | O | Failure to follow staged construction plan to meet filling requirements or storage of excess water leading to design freeboard violation | Medium |

| Risk ID | Phase* | Risk Description | Rating |
|---|---|---|---|
| 21 | O | Inadequate tailings pond capacity or excessive water resulting in need to discharge tailings pond supernatant to receiving streams | Medium |
| 22 | O | Incorrect water balance modelling resulting in unexpected surplus or deficit of water | Low |
| 23 | O/CL | Extreme seismic activity: large earthquake resulting in embankment deformation and/or tailings liquefaction | Low |
| 24 | O | High sediment loading to ECD reducing pond capacity | Very Low |
| 25 | O | Failure of recycle water pump or pipeline from ECD to tailings pond resulting in excessive water in ECD | Very Low |
| 26 | O | Seepage or runoff exceeds pumping capacity of ECD resulting in discharge from ECD to receiving streams | Low |
| 27 | C/O | Unforeseen capital costs for TSF construction | Low |
| 28 | O/CL | Unforeseen seepage or run-off resulting in overtopping of ECD | Very Low |
| 29 | O/CL | Failure of ECD due to piping | Very Low |
| 30 | O/CL | Blockage of the spillway in ECD by debris | Very Low |
| 31 | O/CL | Unexpected metal or nitrogen leaching from NAG waste rock and/or overburden used in ECD dam construction: contamination of water reservoir and discharge to receiving streams | Low |
| 32 | O/CL | Excessive metals or increase in unrecoverable seepage to receiving streams during operations and closure | Low |
| 33 | O | Failure of tailings distribution line on tailings dam resulting in discharge of tailings outside of impoundment footprint | Very Low |
| 34 | CL | Blockage of TSF spillways by debris | Very Low |
| 35 | CL | Inadequate capacity of spillways to convey flows | Very Low |
| 36 | CL | Excessive metals in tailings pond supernatant and seepage discharge to receiving streams during closure | Low |
| 37 | CL | Incorrect water balance modelling resulting in unexpected surplus or deficit of water | Low |
| 38 | CL | Extreme drought: inadequate water cover resulting in acid generation from the tailings or PAG waste rock contaminating seepage and tailings pond supernatant discharge to receiving streams | Very Low |

| Risk ID | Phase* | Risk Description | Rating |
|---|---|---|---|
| 39 | CL | Settlement of tailings leading to formation of depression on the tailings surface and inability to meet closure objectives including location of closure water pond | Very Low |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project,* Failure Modes and Effects Assessment Report. VA101-457/15-2
** Project phases: C=Construction; O=Operations; CL=Closure & Decommissioning*

### 8.3.2 Improvements to Current Practice

The key measures included in the Project design that reduce the potential risk and enhance safety of the facility are described in the preceding sections, as well as Appendix F. These measures are deemed best practices; however, it is prudent to consider if there are additional design measures or operational practices that will further reduce the potential risk of the facility and enhance safety.

The risk items shown in Table 8.3-1 with 'low' and 'medium' risk ratings are generally affected by water management, with potential consequences of failure improved or worsened by water management strategies. The *Panel Report* provided suggestions for improvement of tailings physical stability through measures that:

- Eliminate surface water from the impoundment
- Promote unsaturated conditions in the tailings with drainage provisions, and
- Increase tailings deposit strength.

These suggestions highlight that effective management and control of water enhances the physical stability of a tailings impoundment and may reduce overall project risk. This is consistent with the March 19, 2015 letter to New Gold from EAO, which provided a request that proponents consider:

- Options for managing water balance to enhance safety and reduce risk (likelihood and consequence) of a tailings dam failure during all phases of mine life, and
- For the project design option selected, consider the potential risks and implications of that option, and have a technically and economically feasible plan to address the potential risks and implications.

The opportunity to enhance safety and reduce project risk through improvement in water management practices was evaluated during the risk assessment process. Several opportunities for improved water management became apparent during this review. These opportunities include consideration of the physical location of water storage, active management of undisturbed runoff contributing to the water balance, emergency removal of water from the pond, and dam safety in extreme conditions.

The storage capacity in TSF Site C is underutilized in the present design and there is an opportunity to use this capacity to minimize storage requirements in TSF Site D. The volume of water stored within the TSF Site C pond is show to fluctuate between 3 to 4 $Mm^3$ and between 8 to 11 $Mm^3$ for TSF Site D, increasing after Year 11, with the total pond volume (including both ponds) varying

throughout the year between roughly 11 and 14 $Mm^3$. The filling plan for TSF Site C leaves approximately 14 $Mm^3$ of storage capacity available for water storage below the spillway invert EL. 1346 m. The vast majority of water could be stored within TSF Site C during operations.

A surplus condition was predicted to develop beginning in Year 11 due to increasing runoff from the expanding disturbed areas of the mine facilities. The stochastic results indicated that for extreme wet conditions ($95^{th}$ percentile) the facility will operate in a surplus condition of roughly 1 $Mm^3$ per year, increasing after Year 11. The tailings facility in either of these conditions and without surplus water management intervention will require larger operating pond allowances. TSF Site D will require additional normal operating freeboard to manage the additional water volumes or the surplus condition could be managed with additional fresh water diversions.

The design recognized that the need to increase the dam freeboard or construct fresh water diversions were contingencies that could be implemented reactively later in response to observed conditions. There is an opportunity to include these fresh water diversions as part of the overall water management plan, and actively manage inflows to the tailings facility based on observed conditions on an inter-annual basis to maintain the pond volumes in the preferred operating range. This will provide a proactive water management strategy, rather than reactive.

The evaluation further recognized that as a zero operational discharge (or closed circuit) facility there is no available means to remove mine impacted water from the water balance. The classification as a closed circuit facility cannot be a reason to encroach on storm freeboard allowances and potentially adversely affect the safety of the facility. The ability to remove water from the tailings facility in a freeboard violation scenario was considered an improvement to the water management plan.

The tailings facility was designed to manage a very large design storm event by including storm storage freeboard above the normal operating pond allowance. Additional freeboard is available above the storm storage for wave run-up. There is a period of exposure to risk during operations before construction of the closure spillway where the tailings facility relies on climate predictions and storm storage to prevent a release of mine water to the environment. The downside of designing a tailings facility to contain a large flood to protect the environment from release of mine water is that the storage of large volumes of water has the potential to exacerbate the consequences of failure. An uncontrolled release of the impoundment can be limited to a small controlled release by including interim emergency overflow channels in the staged development of the facility. The overflow channels will operate in the additional freeboard for wave run-up and therefore will not impact the storm storage characteristics of the facility.

Given these considerations, the opportunity to reduce risk through additional design elements, operational practices, and contingencies was then evaluated when reviewing project hazards through the rating process. Four additional defensive measures (2 mitigation measures and 2 contingency measures) in particular were identified that provide significant benefit in risk reduction:

- The mitigations measures are:

  - Installation of optional diversions upstream of TSF Site D (northern diversion) and upstream of the mine facilities south of the TSF (southern diversion) to convey any excess non-contact water around rather than into the tailings facility, and
  - Transfer and storage of the majority of tailings pond supernatant in TSF Site C to minimize water in TSF Site D and maximize the beach width.
- The contingency measures are:
  - Establishment of interim emergency overflow channels around the Site D Main Dam during operations to ensure that the incremental increase in runoff from the PMF during operations is safely transmitted around the dam in a controlled manner, and
  - Emergency water storage in the open pit in the event that excessive water is encountered in the TSF that causes a violation of freeboard requirements and water levels need to be lowered. Use of the emergency pit storage will lead to a suspension of operations.

These four additional defensive measures reduce risk by enhancing physical stability through effective management and control of water. These measures are described in more detail in the following section as well as in Appendix F.

## 8.4 STEP 6 – RISK MANAGEMENT MEASURES AND POTENTIAL ENVIRONMENTAL EFFECTS

Risk management measures identified focus on improvements to water management practices and contingencies as water is often a key factor in tailings dam failures. These measures were developed by Knight Piésold Ltd. (Appendix F) and include additional design elements, operational practices, and contingencies that reduce risk. The risk management measures have the potential to change the Project's environmental effects (e.g., from alterations in water release); potential effects are discussed in the following sections.

### 8.4.1 Northern and Southern Diversions

#### *8.4.1.1 Introduction*

Water balance modeling shows that TSF inputs will equal outputs under average precipitation conditions throughout the first 10 years of operations. A surplus condition was predicted from Year 11 through to the end of mining (Knight Pièsold Ltd. 2014). Diverting runoff upstream of the Site D TSF in the later years of operation was identified as a means of reducing the volume of water reporting to the TSF in later years of mine life and providing additional control of the TSF water balance. The diversion systems would not divert all runoff during extreme events but would allow diversion during average conditions to maintain the TSF water balance.

The Northern Diversion will convey runoff northwest of the TSF Site D to the Freshwater Reservoir and Davidson Creek via collection ditches, a 3.5 m high concrete intake structure and pipeline (Figure 8.4-1). The Southern Diversion will convey runoff from the area southwest of the Open Pit and West Dump to the Freshwater Reservoir using similar infrastructure (Figure 8.4-2). Although not needed until Year 10 for average conditions, the diversions will be constructed during the early years of project development to control the volume of water reporting to the TSF during operations and allow greater control over water accumulation in the TSF during wetter than average years. The two diversions will allow active management of the operating pond volume within preferred operating limits. Runoff from extreme events can be offset by subsequent diversion during normal conditions to maintain the operating pond in a balanced condition.

The design basis for the Northern and Southern diversions are included in Appendix F.

#### *8.4.1.2 Design Methodology*

The proposed southern diversion system has been sized to convey runoff for the area southwest of the open pit and west dump, as shown on Figure 9.1-2. Water will pass over the intake structure spillway during extreme runoff events, for short durations, however the volume of water reporting to the TSF Site D is anticipated to be minimal when compared to the supernatant pond volume and will have little impact on the water balance. Overflow to the TSF during extreme runoff events can be offset by subsequent diversion during average conditions to maintain water within the preferred operating limits. The design peak flows for each of the diversion system components have been calibrated for their respective catchment area using project site long term unit runoff and regional peak flow estimates (Knight Pièsold 2013a) .

Design Peak flows for the southern and northern diversions are presented in Table 8.4-1 and 8.4-2 respectively.

**Table 8.4-1. Design Peak Flows – Southern Diversion**

| Item | Design Event | Catchment Area ($km^2$) | Design Flow ($m^3/s$) |
|---|---|---|---|
| Water Conveyance Pipeline | Max. Mean Monthly | 5.4 | 0.1 |
| Gated Sluice Pipe (Bypass) | Max. Mean Monthly | 5.4 | 0.1 |
| Overflow Spillway | 200 Year | 5.4 | 4.1 |
| Collection Ditch | 10 Year | 3.9 | 1.3 |

**Table 8.4-2. Design Peak Flows – Northern Diversion**

| Item | Design Event | Catchment Area ($km^2$) | Design Flow ($m^3/s$) |
|---|---|---|---|
| Water Conveyance Pipeline | Max. Mean Monthly | 9.7 | 0.2 |
| Gated Sluice Pipe (Bypass) | Max. Mean Monthly | 9.7 | 0.2 |
| Overflow Spillway | 200 Year | 9.7 | 6.5 |
| Northern Collection Ditch | 10 Year | 1.0 | 0.5 |
| Southern Collection Ditch | 10 Year | 1.4 | 0.6 |

*8.4.1.3 Results*

Southern Diversion

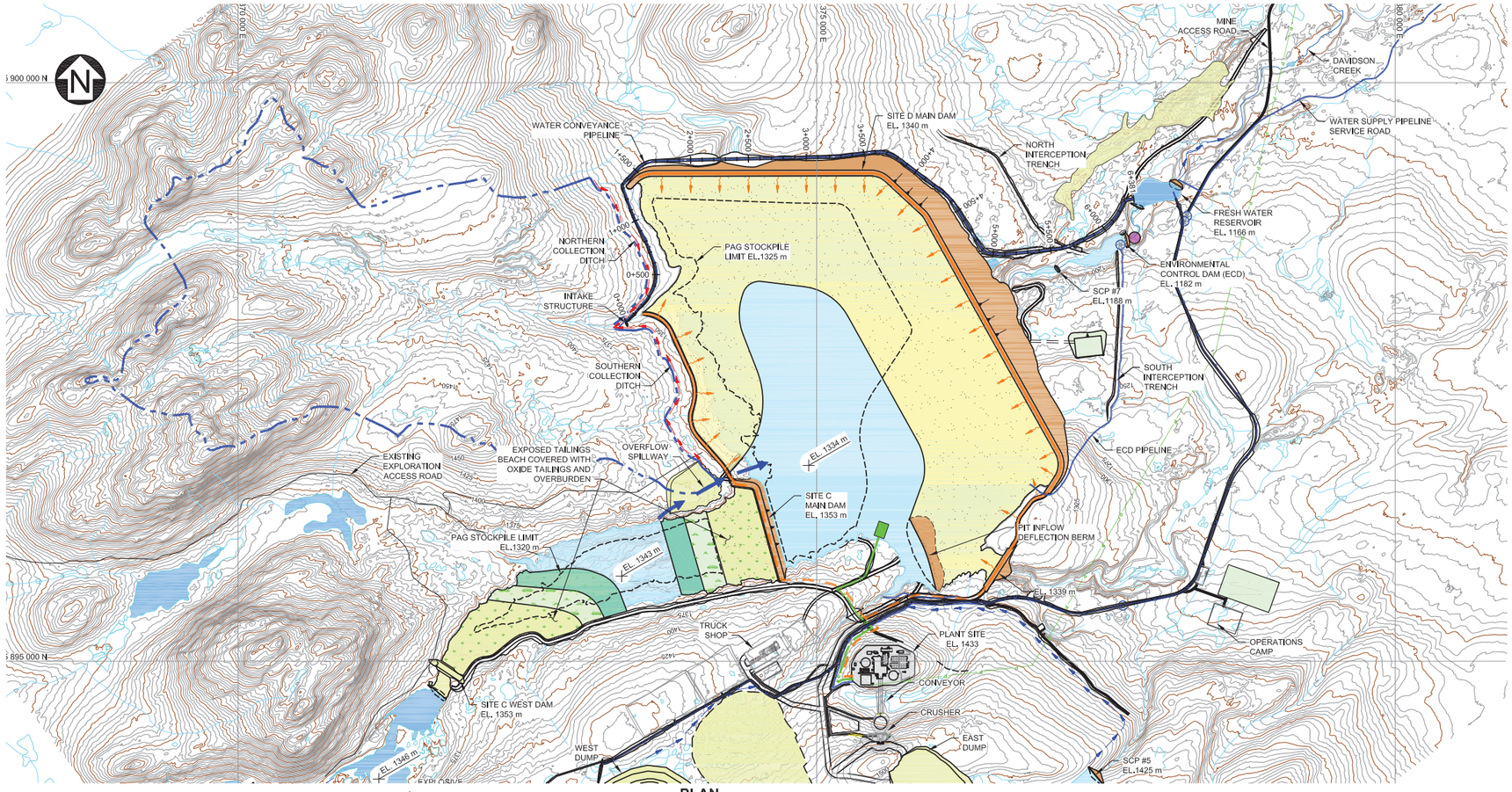
The southern diversion structure consists of a 3.5 m high concrete structure to provide submergence to the water conveyance pipeline. The 10-inch diameter HDPE water conveyance pipeline is sized to convey the estimated maximum mean monthly flow of 0.1 $m^3/s$. The southern diversion structure will include a gated sluice pipe to clean out sediment accumulation. Flow from the water conveyance pipe will enter the Freshwater Reservoir, via an energy dissipation structure, prior to release to Davidson Creek.

The southern diversion structure spillway design conveys the full 200 year design peak flow of 4.1 $m^3/s$; assuming the water conveyance pipeline and gated sluice pipe are inoperable. The spillway will consist of a 3 m wide broad crested weir capable of passing the design storm while maintaining 0.5 m of freeboard between the maximum water level and the crest of the structure.

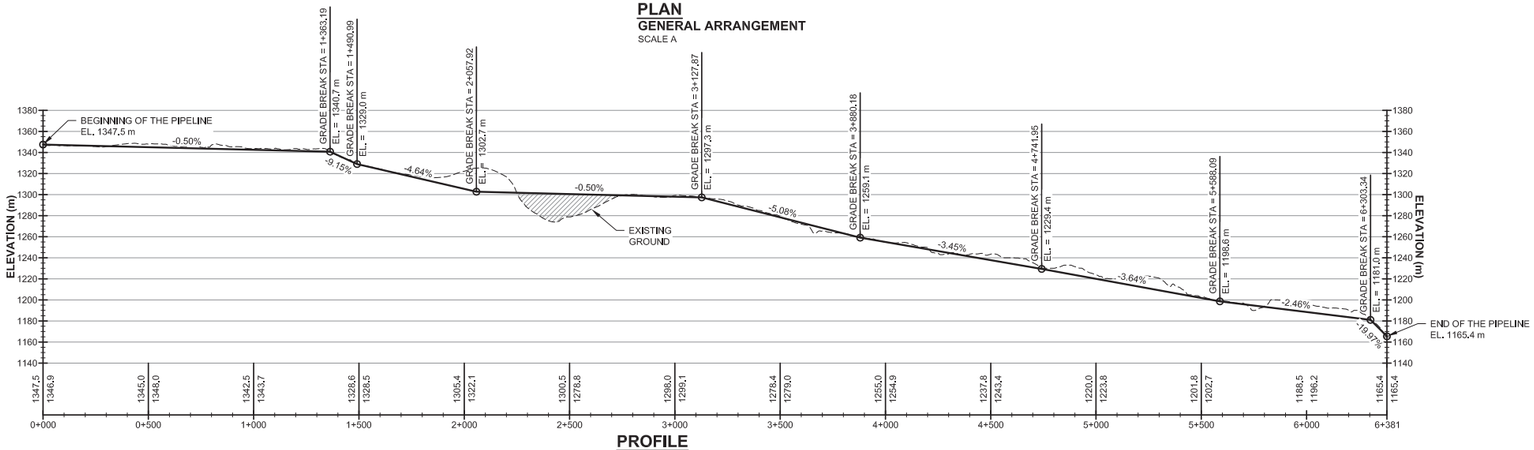
The southern collection ditch has been designed with sufficient capacity to convey the runoff and withstand erosive forces from the 10 year design peak flow of 1.3 $m^3/s$. Ditches will typically be at least 1 m-deep and trapezoidal shaped with a 1 m-base width and 2H:1V slopes. Erosion resistant material will be placed over a non-woven geotextile, which will help prevent erosion of fine underlying soils.

**Figure 8.4-1**

**Northern Diversion General Arrangement and Water Conveyance Pipeline Profile**




**PLAN**
**GENERAL ARRANGEMENT**
SCALE A




**PROFILE**
**WATER CONVEYANCE PIPELINE**
HORIZONTAL SCALE A
VERTICAL SCALE B

**NOTES:**

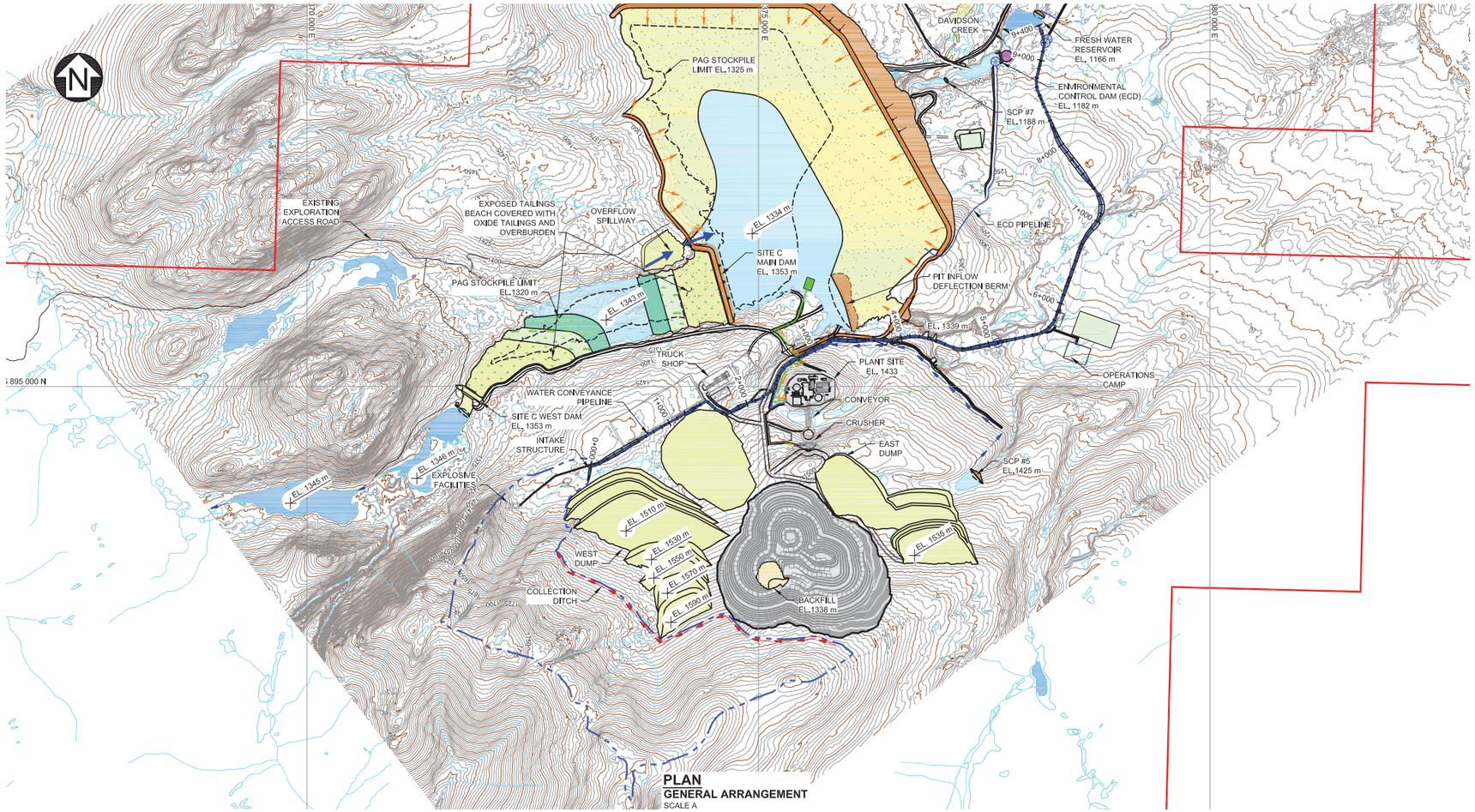
1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. SCP STANDS FOR SEDIMENT CONTROL POND.

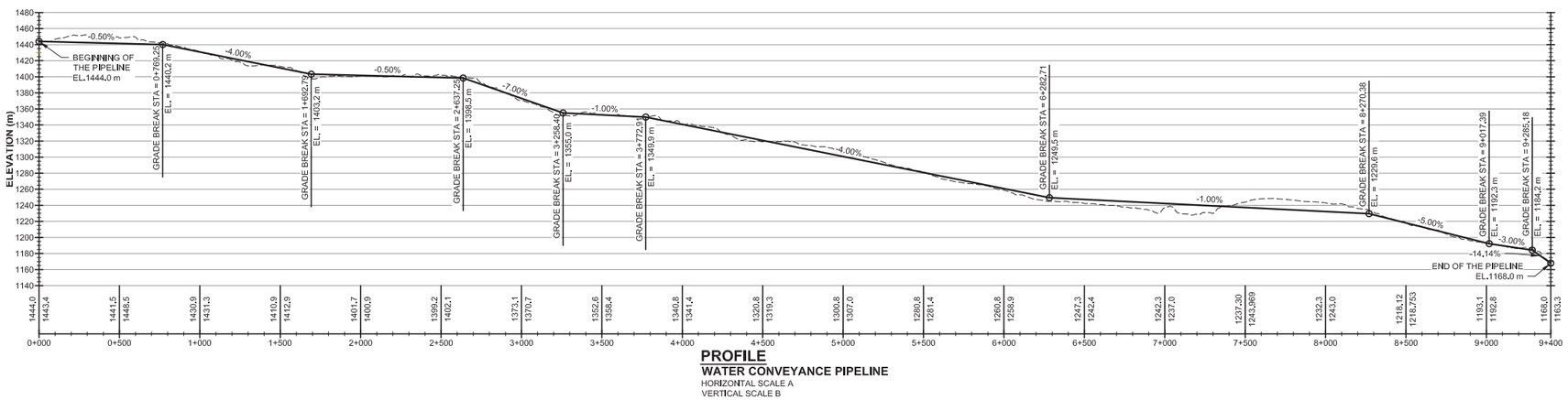
SCALE C: 0,5 0,25 0 0,5 1,0 1,5 2,0 2,5 m
SCALE B: 2,5 1,25 0 2,5 5 7,5 10 12,5 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

**Figure 8.4-2**

**Southern Diversion General Arrangement and Water Conveyance Pipeline Profile**




**NOTES:**

1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. SCP STANDS FOR SEDIMENT CONTROL POND.

SCALE C: 60 30 0 100 200 300 m
SCALE B: 300 150 0 500 1000 1500 m
SCALE A: 500 250 0 500 1000 1500 2000 2500 m

*Source: Knight Piesold Consulting (2015).*

Northern Diversion

The northern diversion structure consists of a 3.5 m high concrete structure to provide submergence to the water conveyance pipeline. The 16-inch diameter HDPE water conveyance pipeline is sized to convey the estimated maximum mean monthly flow of 0.2 $m^3/s$. The northern diversion structure will include a gated sluice pipe to clean out sediment accumulation. Flow from the water conveyance pipe will enter the Freshwater Reservoir, via an energy dissipation structure, prior to release to Davidson Creek.

The northern diversion structure spillway design conveys the full 200 year design peak flow of 6.5 $m^3/s$; assuming the water conveyance pipeline and gated sluice pipe are inoperable. The spillway will consist of a 5 m wide broad crested weir capable of passing the design storm while maintaining 0.5 m of freeboard between the maximum water level and the crest of the structure.

The northern collection ditches have been designed with sufficient capacity to convey the runoff and withstand erosive forces from the 10 year design peak flow of 0.5 and 0.6 $m^3/s$, respectively. Ditches will typically be at least 1 m-deep and trapezoidal shaped with a 1 m-base width and 2H:1V slopes. Erosion resistant material will be placed over a non-woven geotextile, which will help prevent erosion of fine underlying soils.

*8.4.1.4 Environmental Effects*

The construction, operation and closure of the Northern and Southern diversion ditches may potentially affect Project VCs through changes to the terrestrial footprint of the Project, changes to water flow and volume downstream of the Project in Davidson Creek, and changes to water and air quality as a result of sediment (suspended solids) and dust respectively created during construction.

The diversions comprise ditches, a concrete intake structure, and pipelines, which are all contained within the EA footprint assessed in the Project's Application/EIS (New Gold 2015) and no incremental changes are predicted to terrestrial VCs.

Sediment in ditch discharges will be mitigated by constructing the ditches in the winter or during a dry period when all water would be diverted to Site D pond. Additional Best Management Practices (BMP's) will be used as required including selected placement of rip rap, geotextile liners and early revegetation of disturbed areas.

These diversion collection ditches are designed with sufficient capacity to convey runoff and withstand erosive forces from the 10-year design peak instantaneous flow. Releases from the Freshwater Reservoir in high flow events would not increase flows above baseline conditions in Davidson Creek. Any diverted flows would augment instream flow needs in Davidson Creek, and could be offset by decreased pumping from Tatelkuz Lake to Davidson Creek.

Dust generation from ditch construction activities will be mitigated using standard dust suppression techniques outlined in the Application/EIS and will include as required, watering access roads, excavations and spoil piles, use of dust suppression chemicals and early revegetation of disturbed areas.

No significant residual effects were assessed for any Project VCs during the Project's Application/EIS for the Mine Site. Due to the proposed Northern and Southern diversion systems

being contained entirely within the EA Project footprint, no predicted flow volumes above baseline conditions in Davidson Creek, and the application of standard sediment control and dust suppression outlined in the Application/EIS, no changes to the environmental effects predicted in the Project Application/EIS are expected as a result of the Northern and Southern diversions.

### 8.4.2 Relocation of Water Storage to Site C through Operation of the Site D TSF

#### *8.4.2.1 Introduction*

The relocation of water storage to Site C from Site D reduces overall risk to the TSF by several means. Water storage relocated from the impoundment undergoing active construction to the inactive impoundment reduces one variable of impoundment filling. It simplifies mine waste disposal planning within the active impoundment and increases flexibility to actively manage the location where the tailings beach meets the co-disposed PAG/NAG3 waste rock platform thereby improving the ability to meet closure plan objectives. The reduction in the supernatant pond will increase subaerial beach length, which is an indicator of improved dam safety. The storage of water outside of the active impoundment decreases the likelihood and consequences of containment loss in the event of embankment deformation.

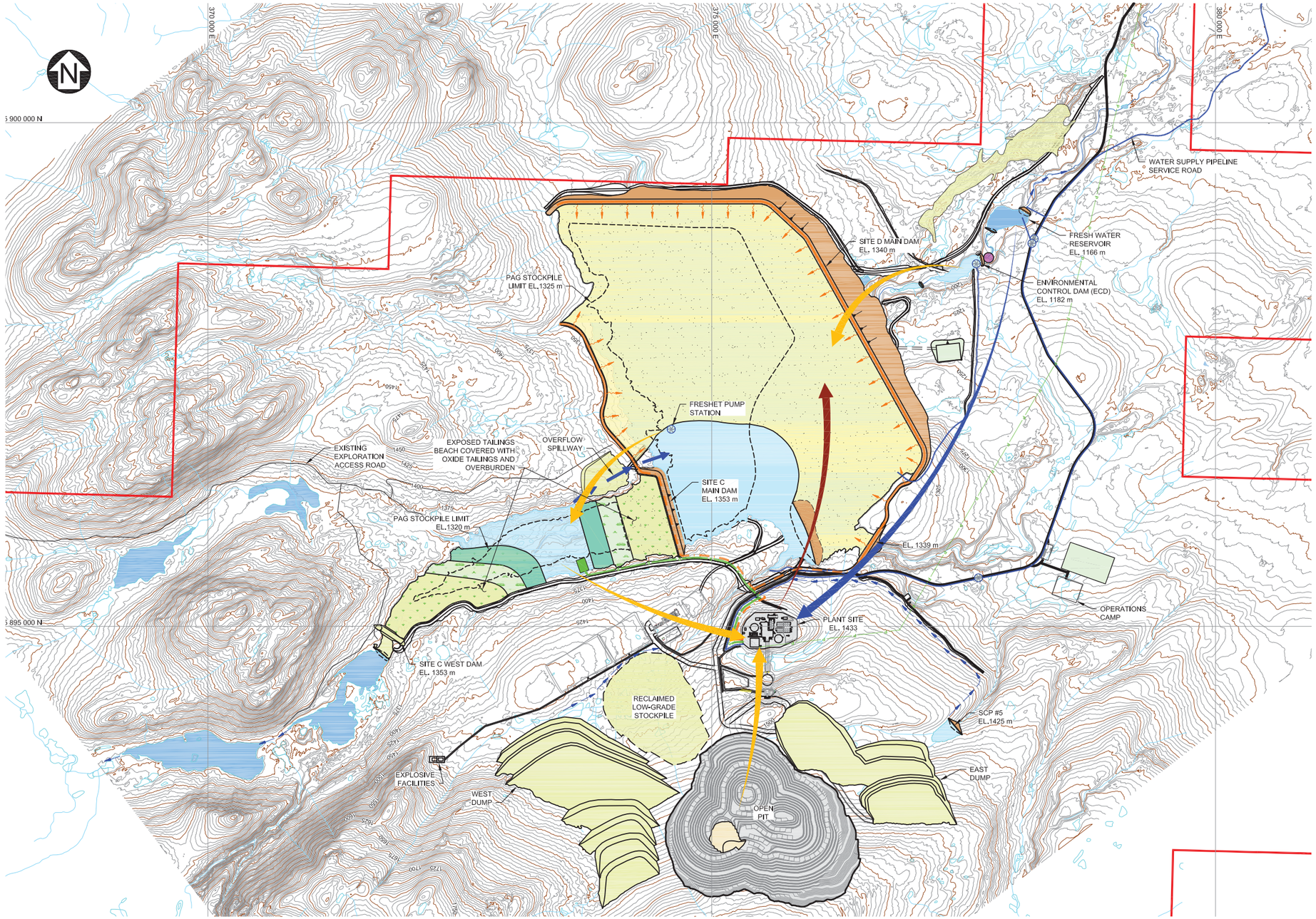
Relocation of water to Site C during operations will result in most of the supernatant pond volume being stored on and reclaimed from the Site C TSF (Figure 8.4-3). The Site C pond volume will fluctuate between 8 $Mm^3$ and 10 $Mm^3$ with an increase to 13 $Mm^3$ at the end of mine Year 14 (maximum storage capacity of 14 $Mm^3$). The TSF Site D pond volume will fluctuate between 1 $Mm^3$ and 5 $Mm^3$ for the majority of the mine operations. A surplus was predicted to develop after Year 11 without diversion after Year 11. This surplus is manageable with the optional diversions discussed in the preceding section.

This compares to 3 to 4 $Mm^3$ for TSF Site C and 8 to 11 $Mm^3$ for TSF Site D, increasing after Year 11 as described in the Application/EIS (New Gold 2015). The overall water balance condition is unchanged and the total pond volume varies throughout the year between roughly 11 and 14 $Mm^3$; however, the location of water storage is adjusted.

The tailings pond supernatant present at the end of mining will be used to accelerate Open Pit filling and limit the onset of ML/ARD from the pit walls (Knight Pièsold 2014c).

**Figure 8.4-3**

**Proposed Water Management Plan (End of Year 17)**




**LEGEND:**

- UPLAND BEACH
- BOG / WETLAND AREA
- EMERGENT VEGETATION WETLAND
- UPLAND SLOPE
- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- PAG WASTE ROCK
- TOPSOIL
- RECLAIM SYSTEM
- PUMPSTATION
- SEEPAGE SUMP AND PUMPBACK SYSTEM
- MINE ACCESS ROAD
- PIPELINE SERVICE ROAD
- DIVERSION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TRANSMISSION LINE
- SPILLWAY
- TAILINGS PIPELINE
- TAILINGS DEPOSITION
- FRESH WATER
- TAILINGS SLURRY
- SITE WATER

**NOTES:**

1. CONTOUR INTERVAL IS 5 METRES.
2. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. SCP STANDS FOR SEDIMENT CONTROL POND.

SCALE A 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

#### *8.4.2.2 Water Management Objectives*

The key water management objective for the Project is to provide sufficient mill water reclaim requirements and maintain PAG/NAG3 materials in the TSF in a subaqueous state, while mitigating environmental impacts to downstream receiving waters.

Water within the project area will be recycled and used to the maximum practical extent by collecting and managing site runoff from both undisturbed and disturbed areas. Site runoff water will be collected and stored within the TSF and used to inundate the PAG/NAG3 waste rock and tailings solids to prevent ARD and minimize ML.

#### *8.4.2.3 Current Reclaim Water System Strategy*

The reclaim water system, as described in the Mine Waste and Water Management Design Report (Knight Pièsold 2014c), will initially utilize a barge-mounted pump station sized to deliver 3,200 $m^3$/hr of process water from TSF Site C to the reclaim water tank at the Mill. The reclaim barge will be located in TSF Site C during Years 1 and 2 of operations, and then moved to TSF Site D late in Year 2 for the remainder of mine operations and closure.

A reclaim structure, consisting of a concrete intake with stoplogs and trash racks, will be constructed in TSF Site C in Year 2 to reclaim water during the relocation of the barge. The reclaim structure may be used during the remaining years of operations to regulate the water level within TSF Site C and/or to support the barge-mounted pump station with reclaim to the mill. The reclaim structure pump system will incorporate the same pumps and motors as the barge-mounted system for consistency of spare parts and ease of maintenance.

#### *8.4.2.4 Proposed Change to Water Management Strategy*

It is proposed to relocate the majority of water storage currently planned for Site D to Site C throughout operations. The water management strategy for Years 1 and 2 would utilize a barge-mounted pump station in TSF Site C, as described above. However, the barge-mounted pump station would remain in TSF Site C throughout the life of mine and reclaim water would be transferred from TSF Site D to TSF Site C, utilizing the Freshet Pump Station. The volume of water maintained within the TSF Site D facility would be only the amount required to maintain PAG/NAG3 materials in a saturated state with an allowance for annual operational fluctuation.

#### *8.4.2.5 Changes to the Water Balance*

The majority of the supernatant pond volume will be stored in TSF Site C. The TSF Site C pond is located upstream of the TSF Site C Main Dam, and is connected to TSF Site D by a closure spillway for passive management of the maximum Site C operating pond level.

The pump rates from TSF Site D to TSF Site C required to achieve the pond volumes presented on Figure 8.1-4 are:

- 1,000 $m^3$/hr (mine years 1 and 2);

- 1,900 $m^3$/hr (mine years 3 through 17) during the winter season (October through March); and
- 2,050 $m^3$/hr (mine years 3 through 17) during the summer season (April through September).

The TSF Site C pond volume will fluctuate approximately between 9 $Mm^3$ and 10 $Mm^3$ of water for the majority of the mine life, with an increase to 13 $Mm^3$ at the end of mine Year 14. TSF Site C can store up to 14 $Mm^3$ of water based on a spillway invert elevation of 1346 m. The TSF Site D pond volume will fluctuate approximately between 3 $Mm^3$ and 5 $Mm^3$ of water for the majority of the mine life.

The amount of surplus increases after Year 11 over time due to increasing runoff from the expanding disturbed areas of the mine facilities, and also from decreases in waste rock production and corresponding decreases of water storage in waste rock voids for the mine rock stored within TSF Site D. This was identified as a desirable condition during the Feasibility Study (KP, 2014a) with this surplus water used to accelerate open pit filling and limit the onset of acid rock drainage conditions in the pit walls. It was also identified as a surplus condition that was manageable with additional fresh water diversions. Two optional diversions of undisturbed areas were identified during the FMEA and are now included in the Project design. These diverted areas will be combined with the revised water management strategy in subsequent water balance modelling to support permitting.

#### *8.4.2.6 Environmental Effects*

Relocation of water storage on the TSF during Project Operations may affect Project VCs through changes in water quality due to alteration in seepage quality through the TSF, and changes in air quality as a result of increased dusting. Relocation of water storage on the TSF will not alter the Project footprint and therefore will not have any incremental effects on terrestrial VCs.

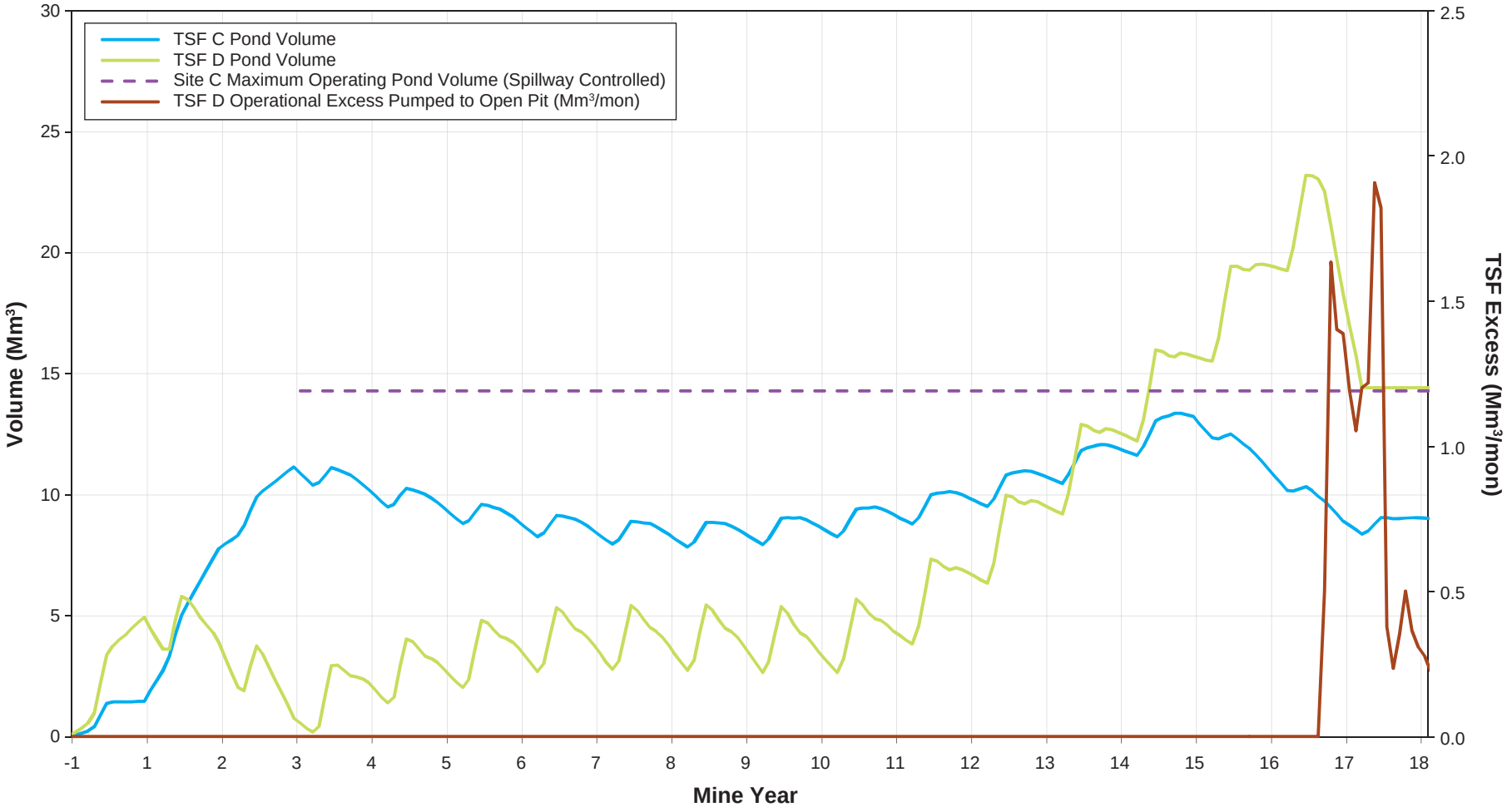
A key water management objective for the Project is to maintain subaqueous storage of PAG/NAG3 waste rock. Submergence of PAG/NAG3 waste rock in Site D will be maintained by managing the elevation and location of the PAG waste rock platform and the water level in the TSF. The volume of water stored within the TSF Site D would only be the amount required to maintain PAG/NAG3 waste rock in a saturated state, with allowance for annual operational fluctuation. Relocation of water from Site D to Site C reduces the operational pond size on Site D and results in a larger beach area. The tailings beach would be maintained in a near saturated, fresh state by rotating the tailings discharge spigots. A smaller pond, more distant from the dam, would reduce seepage rates through the dam and potentially improve downstream water quality.

Storage on Site C will not increase seepage to the west because the groundwater gradient (i.e., the elevation difference between the TSF Site C pond and the water level west of the Site C West Dam) will remain towards Site C (hydraulic barrier) as described in the Application/EIS (New Gold 2015).

The larger tailings beach area on Site D resulting from a smaller pond will potentially increase dust generation. Dust generation will be monitored and mitigated by maintenance of frequent changes in spigot locations to maintain near wetted beach conditions, and other dust suppression methods (e.g. spraying water on tailings beach using sprinklers) if required.

**Figure 8.4-4**

**Proposed Water Management Changes**
**TSF Pond Volumes and Excess Volumes**




*Notes: Spillway is constructed in year 3.*

*Source: Knight Piesold Consulting (2015).*

No significant residual effects were assessed for any Project VCs during the Project's Application/EIS (New Gold 2015) for the Mine Site. The relocation of water storage to Site C through operation of the Site D will not change the Project's footprint, will have positive to no changes on the seepage quality and quantity through the TSF, and will not increase dust emissions through mitigation and monitoring procedures. Therefore, no to slight positive changes to the environmental effects predicted in the Project Application/EIS (New Gold 2015) are expected as a result of the change in water storage location from TSF Site C to Site D during Operations.

### 8.4.3 Interim Overflow Channel during Operations

#### *8.4.3.1 Introduction*

The purpose of the interim overflow channel is to ensure the TSF Dam D is protected during a very unlikely extreme precipitation and runoff event. The TSF design evaluated in the Project's Application/EIS (New Gold 2015) incorporated a spillway at closure, whereas this design change adds a contingency interim overflow channel during operations. The channel will be constructed in natural ground on the right abutment of Site D embankment and comprise a ditch (2 m wide by 4 m deep) and energy-dissipating plunge pool, connecting to the South Interception Trench (Figure 8.4-5) and the Environmental Control Dam and ultimately to Davidson Creek.

#### *8.4.3.2 Design Basis*

The Interim Emergency Overflow Channel for the TSF Site D was designed to pass the peak flow from the PMF flood event without consideration of attenuation provided by tailings facilities ponds or storage that will be maintained below the invert of the channel. It was assumed that the diversion ditches were damaged and not functioning at the time of the flood as this represented the worst case condition. The PMF flood event volume of approximately 11.7 $Mm^3$ was calculated based on the following:

- Probable maximum precipitation (PMP) of 195 mm
- Snowmelt equivalent of 171 mm, calculated based on:
  - The average maximum temperature and wind speed recorded in the months of April and May, and
  - Assuming the catchment area of 4150 ha is at least 50 percent covered by trees.

Table 8.4-3 summarizes the design basis for the proposed Interim Emergency Overflow Channel.

**Table 8.4-3. Interim Emergency Overflow Channel Design Criteria Summary**

| Item | Design Criteria |
|---|---|
| Tailings Storage Facility Capacity | Water level is at the Interim Emergency Overflow Channel invert at the time of the storm. |
| Design Flood | Probable Maximum Flood (PMF); probable maximum precipitation (PMP) and snowmelt |
| Flood Management – Catchment Areas | Area upstream of the TSF Site D, assuming all diversion systems are non-functional during the Design Flood |
| Design Freeboard | Minimum 1 m above maximum water level for wave run-up |

The design flow for the Interim Emergency Overflow Channel was calculated by routing the PMF hydrograph through TSF Site D Stage 3 (End of Year 4) and Stage 15 (End of Year 17) arrangements to determine the range of design flows. The routing evaluation, using HydroCAD, determined the peak inflow to be approximately 355 $m^3/s$. Modelling indicated that a 2 meter (m) wide and 4 m deep channel, with 0.5 horizontal to 1 vertical side slopes, would result in a peak outflow of approximately 21 and 6 $m^3/s$ for the Stage 3 and Stage 15, respectively. The peak water elevations, above the Interim Emergency Overflow Channel invert, were estimated to be approximately 2.8 and 1.4 m for the Stage 3 and Stage 15, respectively; maintaining the minimum freeboard of 1.0 m for wave run-up.

The Interim Emergency Overflow Channel will be located on the right (south) abutment of each stage of the TSF Site D embankment. The channel will be excavated in bedrock to provide erosion protection. The Interim Emergency Overflow Channel will convey the design flood past the right abutment and downstream of the TSF Site D embankment to a plunge pool for energy dissipation prior to release to Davidson Creek via the South Interception Trench and Environmental Control Dam. The plunge pool design will be completed during detailed design based on precise channel alignments, slopes, and flow characteristics.

#### *8.4.3.3 Environmental Effects*

The interim overflow channel is a contingency measure. The probability of this contingency measure being used during Project operations is very low, because the TSF is designed to hold the IDF (i.e., 2/3 between 1/1000 year and PMF during operations). This is the storm storage freeboard allowance below the invert of the spillway and above the maximum operating water level of the facility. In other words, for the spillway to be used the facility would have to contain the maximum operating pond and capture the IDF, and only then would subsequent flows be released via the spillway to the ECD. The IDF is crudely approximated as the 1/5000 event, and the probability of such an event occurring during the 17 year life is roughly 0.3% under the worst case conditions described above. The IDF would not lead to spilling, and therefore the probability is somewhat less than this rough percentage. Thus, this contingency measure would not have an impact on the conclusions of the Project's Application/EIS (New Gold 2015).

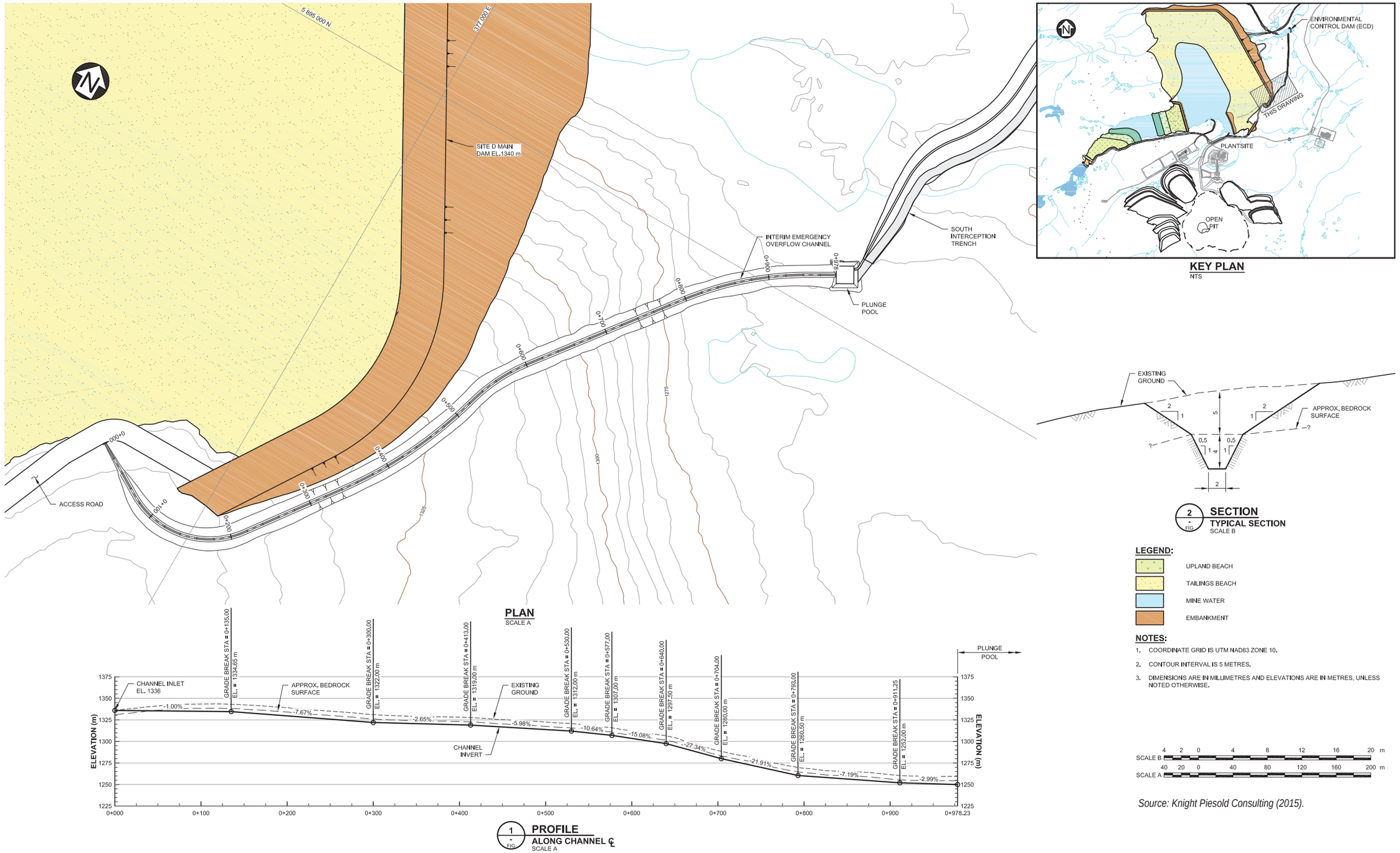
### 8.4.4 Open Pit Emergency Water Storage

#### *8.4.4.1 Technical Description*

The TSF was planned as a no surface water discharge (or closed circuit) during operations facility. There is no available means to remove mine impacted water from the water balance. The classification as a closed circuit facility should not be a reason to encroach on storm freeboard allowances and potentially adversely affect the safety of the facility. The ability to remove water from the tailings facility in a freeboard violation scenario was considered an improvement to the water management plan.

**Figure 8.4-5**
**Interim Emergency Overflow Structure**

ERM




*Source: Knight Piesold Consulting (2015).*

The transfer of water from the TSF to the Open Pit for storage could be accomplished by one of the following alternatives:

- **Alternative 1. Early Installation of the TSF Closure Dewatering Pipeline** - The closure plan for the Blackwater Project includes pumping the tailings supernatant pond to the Open Pit to expedite its filling and submergence of the majority of ML and PAG rock in the exposed Open Pit walls. The planned pumping system to complete pit filling in closure would utilize the reclaim barge and/or structure and reclaim pipeline(s), with an extension of the reclaim pipeline from the Mill to the Open Pit. The closure pit filling system would maintain the operative reclaim capacity of 3,200 $m^3$/hr.
- **Alternative 2. Utilizing the Pit Dewatering System –** The current Open Pit dewatering system consists of a series of wells and skid-mounted diesel drive pumps conveying flows through a 16" p pipeline, designed to pump approximately 700 m3/hr of water from the Open Pit to the Mill. It is assumed that in an emergency situation, in which the water level in the TSF exceeded maximum capacity, all operations, including processing and pit dewatering would be suspended; it is therefore reasonable to assume the TSF could be dewatered using the reclaim system in combination with the pit dewatering system pipeline. This alternative would maintain the pit dewatering capacity of 700 m3/hr and tie the Open Pit dewatering pipeline into a blind flange for the reclaim water system pipeline at the Mill.

Table 8.4-4 summarizes the estimated rate of drawdown for each of the facilities, for each alterative, and were based on approximate pond areas of 100 and 500 hectares for TSF Site C and TSF Site D, respectively.

The alternative implemented will reflect where the majority of water is stored within the TSF. Alternative 1 was considered to be the most robust option for the current design. If the water management strategy is modified to manage the majority of the water in TSF Site C, with TSF Site D only containing enough water to submerge the PAG/NAG3 waste rock, it may be suitable to defer the closure pipeline installation until closure and use the pit dewatering system during operations.

This contingency would be effective after about year 4 of operations when the pit is no longer free draining.

**Table 8.4-4. Approximate Drawdown Rates**

| Pumping System | Pumping Capacity ($m^3$/hr) | TSF C (mm/day) | TSF D (mm/day) |
|---|---|---|---|
| Alternative 1 | 3,200 | 77 | 15 |
| Alternative 2 | 700 | 17 | 3 |

*8.4.4.2 Environmental Effects*

The Open Pit emergency water storage is a contingency measure. Water stored in the pit would not be released to the downstream environment but rather returned to the TSF or used in the mill when normal operating conditions were re-established. Thus, this contingency measure would not have an impact on the conclusions of the Project's Application/EIS (New Gold 2015).

## 8.5 RE-EVALUATION OF RISK CLASSIFICATION

The opportunity to enhance safety and reduce project risk through improvement in water management practices was evaluated during the risk assessment process. Several opportunities for improved water management were implemented as a result of the FMEA, described above. These opportunities include relocation of the physical location of water storage, active management of undisturbed runoff contributing to the water balance, allowance for emergency removal of water from the pond, and dam safety protection in extreme flooding conditions.

The above noted measures reduce project risk by enhancing physical stability through effective management and control of water. Several of the preliminary risk rankings were improved by adopting these additional design measures, operational practices, and contingencies. A summary of the final risk classifications after application of the additional mitigation and contingency measures is shown in Table 8.5-1.

**Table 8.5-1. Summary of Risk Rating Improvements**

| Risk ID | Risk Description | Preliminary Risk Rating | Additional Mitigation | Final Risk Rating |
|---|---|---|---|---|
| 1 | Extreme precipitation or runoff event: Overtop of coffer dam resulting in loss of dam fill material and sediment loading to receiving streams | Low | Maintain low spot during construction of dam as preferential emergency swale | Very Low |
| 3 | Coffer dam failure due to any mechanism leading to loss of containment with loss of dam contents (water and sediment) and dam materials to receiving streams | Low | Maintain low spot during construction of dam as preferential emergency swale | Very Low |
| 9 | TSF dam foundation failure: foundation movement resulting in collapse of Site D tailings dam | Low | Relocate water storage to Site C throughout operations and only manage minimal water within Site D | Very Low |
| 12 | Extreme precipitation or runoff event: overtop of Site D Main Dam resulting in failure of dam | Low | Establish interim emergency overflow channel for TSF after each major construction lift. | Very Low |
| 13 | Failure of TSF Site D Main Dam filter zone resulting in excessive piping and collapse of dam | Low | Relocate water storage to Site C throughout operations and only manage minimal water within Site D | Very Low |
| 14 | Embankment deformation resulting in overtopping and discharge of supernatant pond | Low | Relocate water storage to Site C throughout operations and only manage minimal water within Site D | Very Low |

| Risk ID | Risk Description | Preliminary Risk Rating | Additional Mitigation | Final Risk Rating |
|---|---|---|---|---|
| 15 | Embankment deformation resulting in slumping of tailings | Very Low | Relocate water storage to Site C throughout operations and manage minimal water volume within Site D.<br>Monitor and maintain extensive subaerial tailings beach during operations separating the supernatant pond from the tailings dam | Very Low |
| 20 | Failure to follow staged construction plan to meet filling requirements or storage of excess water leading to design freeboard violation | Medium | Establish extension of reclaim water system to open pit for emergency drawdown of the TSF pond. Establish interim emergency overflow structures for TSF after each major construction lift | Very Low |
| 21 | Inadequate tailings pond capacity or excessive water resulting in need to discharge tailings pond supernatant to receiving streams | Medium | Establish extension of reclaim water system to open pit for emergency drawdown of the TSF pond. | Very Low |
| 22 | Incorrect water balance modelling resulting in unexpected surplus or deficit of water | Low | Install diversion systems in areas upslope of TSF Site D (northern diversion) and upslope of mine facilities (southern diversion) for optional diversion of these catchment areas | Very Low |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project,* Failure Modes and Effects Assessment Report. VA101-457/15-2

The FMEA demonstrated that the majority of risks to the Project are mitigated through the key defensive measures in place in the current design and key defensive measures to be applied during permitting. The FMEA created a catalogue of potential hazards to the proposed TSF and documents the best available practices to mitigate the risk of each hazard and is a 'living document' that will be periodically updated during the mine phases. Additional mitigations and contingencies will be developed further during permitting, design and early construction to establish an implementation strategy and plans that provide further reduction of risk to the Project's current low risk TSF profile.

## 8.6 FINAL RISK CLASSIFICATION

A total of 39 hazards were identified and catalogued in Table 1 of Appendix A. The preliminary classification of each risk was shown on Figure 2.5. The preliminary classifications were completed based on the design measures and operational practices included in the TSF design, and included:

- 2 medium risk ratings
- 17 low risk ratings, and
- 20 very low risk ratings.

The improvements to the risk classifications were evaluated based on the additional mitigations and contingencies that were adopted as a result of the FMEA. Final classification of each risk is shown on Figure 8.6-1. The final classifications include:

- 10 low risk ratings, and
- 29 very low risk ratings.

**Figure 8.6-1. Final Risk Classifications**

| Likelihood | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | | | | | |
| | 4 | | | | | |
| | 3 | 4, 5, 10, 11, 16, 17, 24, 33, 34 | | | | |
| | 2 | 1, 2, 39 | 26, 27, 32, 36, 37 | 18, 31 | | |
| | 1 | 20, 21, 22 | 3, 14, 15, 19, 25, 30, 35, 38 | 7, 9, 12, 13, 38, 29 | 6, 8, 23 | |
| | | 1 | 2 | 3 | 4 | 5 |
| | | Consequence | | | | |

*Source: Knight Piésold Ltd. 2015. Blackwater Gold Project, Failure Modes and Effects Assessment Report. VA101-457/15-2*

## 8.7 RESIDUAL RISKS TO WATER MANAGEMENT

### 8.7.1 Temporary Shutdowns

Temporary shutdowns have the potential to occur due to unforeseen financial conditions (e.g., severe drop in gold price) or extreme climate conditions (e.g., major forest fires, flooding). Facilities will be secured and maintained in a condition such that they can be rapidly restarted. The following measures will be evaluated and as appropriate, initiated to secure and maintain the TSF facilities:

- Tanks that have a risk of sanding with ore or tailings slurry within the mill and tailings delivery system will be drained with their contents treated by the $SO_2$/air treatment system and discharged to the TSF via the tailings pipeline.
- The Northern and Southern Diversions will be used to divert fresh water to the fresh water reservoir and hence to Davidson Creek in order to maintain a low inventory of water in the TSF.
- Water from Tatelkuz Lake will continue to be pumped and discharged to Davidson Creek to augment the flows from the diversions and maintain flows required for downstream aquatic resources as per the site water management plan.
- Opportunities for temporary diversion of other water sources meeting discharge standards will be investigated (e.g., East Dump drainage and ECD).
- Drainage from the temporary ore and low grade ore stockpiles will continue to be treated by the lime treatment system and discharged to the TSF.
- Water will be recycled and discharged via the tailings distribution system or sprayed (e.g., by sprinklers) when required to maintain the beaches in a wetted condition to significantly restrict oxygen diffusion and dusting.
- The TSF pond level will be monitored to confirm there is no encroachment on freeboard allowances and that the PAG/NAG3 waste rock remains saturated. If necessary PAG/NAG3 waste rock piles above the water level will be bulldozed into the pond.
- If necessary, surplus water from the tailings supernatant pond will be pumped into the open pit (after about year 4 when the pit is no longer free draining) to prevent encroachment on freeboard allowances.
- If a tailings dam lift was being constructed at the time of the shutdown, the need to continue constructing the lift during the expected shutdown will be evaluated and the lift completed if required.
- Natural degradation (e.g. photolysis) will reduce cyanide and metal concentrations in the TSF supernatant. If required, the supernatant could be recycled through the $SO_2$/air treatment system to lower concentrations further.
- If a prolonged temporary shutdown were deemed possible, the two water treatment plants (mill $SO_2$/air and stockpile lime addition) will be evaluated for their suitability for treatment and discharge of mine site water to prevent surplus water accumulation. A wetland treatment system could also be constructed below the TSF Dam D to polish any effluent from the treatment systems.
- Regular site and geotechnical inspections of the water management systems and TSF will continue.

### 8.7.2 Premature Closure

Premature closure is the permanent closure of the mine before completion of the mine plan as described in the Application/EIS (New Gold 2015). The closure plan described for the final facility

will be modified as required for the waste facilities in place at that time. The following measures will be applied in addition to those discussed for temporary closure and where still relevant, the Closure Plan in the Application/EIS:

- The tailings dams are planned to be constructed at closure slopes, and will be evaluated to confirm the dams as constructed meet long-term closure stability requirements. Modifications will be made if required prior to final contouring and reclamation.
- A wedge of overburden will be placed (by truck or wide-track dozer) or slurried onto the tailings beaches to cover the PAG tailings and shape the final closure pond to the desired size and location. A minimum 30 cm cover on the PAG/NAG3 waste rock will be placed as described in the Application/EIS.
- The water level will be allowed to rise such that the capillary fringe maintains PAG tailings in a near saturated state restricting air entry.
- The interim emergency overflow channel will be modified as necessary to establish a final closure spillway. A secondary spillway will also be constructed.
- Treatment wetlands will be constructed in the ECD and water reservoir basins to improve seepage quality as described in the Application/EIS.
- Any unprocessed stockpiled coarse ore or low-grade ore will be deposited into the TSF or the open pit and will be flooded.

## 8.8 EFFECT OF RISK MANAGEMENT MEASURES ON MULTIPLE ACCOUNTS ANALYSIS

The MAA was rescored for the *physical stability* account based on the BAP risk management measures described in the previous section. The indicators that changed were *location of water storage* and *emergency water management – spillway* as the mitigation measures include decrease of water volume storage in TSF Site D and an emergency spillway during operation. For the *location of water storage* indicator, the score increased from 3 to 4 to reflect the larger beach and smaller pond in the TSF Site D as a result of pumping much of the water in this pond to the TSF Site C during operation. For the *emergency water management – spillway* indicator, the score increased from 4 to 6 because of spillway (emergency overflow channels) availability throughout operations.

The re-ranking result shows an improvement in the overall *physical stability* score for Candidate 1 from 4.0 in the base case to 4.3 in the re-ranking (Table 8.8-1). This indicates that significant improvement in the physical stability of the TSF is achieved as a result of these measures.

**Table 8.8-1. Re-scoring of Physical Stability Account based on Risk Mitigation Measures**

| Indicator | Candidate 1 - Original | Candidate 1 – Re-ranked with BAP in place | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|
| Location of water storage | 3 | **4** | 1 | 1 | 5 |
| Tailings and waste rock interstitial water | 3 | 3 | 4 | 3 | 5 |

| Indicator | Candidate 1 - Original | Candidate 1 – Re-ranked with BAP in place | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|
| Normal operating pond volume | 4 | 4 | 5 | 5 | 6 |
| Emergency water management - pumps (active) | 5 | 5 | 3 | 4 | 3 |
| Emergency water management - spillway (passive) | 4 | **6** | 4 | 4 | 6 |
| Design basis / regulatory requirement | 6 | 6 | 6 | 6 | 3 |
| Tailings density | 3 | 3 | 5 | 3 | 5 |
| Maximum dam height | 3 | 3 | 3 | 3 | 5 |
| Operational monitoring requirements - safety | 6 | 6 | 3 | 5 | 3 |
| Sub-account merit score | 158.0 | 172.0 | 148.0 | 145.0 | 190.0 |
| Sub-account merit rating | 4.0 | 4.3 | 3.7 | 3.6 | 4.8 |

# 9. STEP 7 - ASSESSMENT OF ABORIGINAL RIGHTS AND INTERESTS

The tailings and waste rock storage facility has the potential to infringe on Aboriginal rights and interests to the extent that it interferes with Aboriginal groups' distinctive practices, customs, and traditions relating to lands and resources in the area. Interference with the exercise of Aboriginal rights could result from impeded access, reduced resource availability, reduced resource quality, and other factors (such as excessive noise, increased presence of non-Aboriginal land users, etc.).

The traditional territories of four First Nations overlap with the candidate tailings and waste rock storage sites (Figure 1.4-11), including Lhoosk'uz Dene Nation (LDN), Ulkatcho First Nation (UFN), Skin Tyee Nation (STN), and Tsilhqot'in National Government (TNG). Métis' Aboriginal rights are not tied to traditional sites and territories, given their traditionally extensive mobility. Métis Nation British Columbia (MNBC) has asserted harvesting rights around the proposed Project.

The tailings and waste rock storage facility is located within the historic LDN Baptiste keyoh (family-owned area used for traditional activities). The provincially-registered trapline associated with this keyoh (TR0512T027) has not been commercially active for 20 years, but Aboriginal rights may continue to be practiced in the area. The facility is also located in the proximity of the LDN Mashu keyoh. The provincially-registered trapline associated with this keyoh (TR0512T014) continues to be active. LDN members traditionally harvested caribou on Mt. Davidson and continue to hunt caribou on the south side and summit of Mt. Davidson to a limited extent. Moose harvesting has become more prominent for LDN members following declines in caribou numbers. LDN has expressed concerns about potential impacts on fishing in Davidson Creek and other water bodies. LDN elders noted they pick traditional plants at lower elevations around lakes such as Kuyakuz Lake and Tatelkuz Lake. LDN has not entered into treaty negotiations with the Crown to date, nor launched legal proceedings with respect to Aboriginal title.

UFN members traditionally hunted and trapped a variety of species within their territory, including caribou, grizzly and black bears, beaver, rabbits, mountain goats, groundhogs, grouse, and waterfowl. Members continue to hunt in areas overlapping with the tailings and waste rock storage facility (on Mt. Davidson), in addition to other locations. No UFN fishing practices were identified in the area of the tailings and waste rock facility. UFN traditional plant harvesting activities tend to be concentrated around lakes. UFN has expressed concerns about potential effects of the Project on caribou, in particular, and has also expressed concerns about potential impacts on other ungulates, fish, and harvestable plants. UFN has not entered into treaty negotiations with the Crown to date, nor launched legal proceedings with respect to Aboriginal title.

STN traditionally used its territory to hunt, trap, fish, and gather plants. STN members continue to practice Aboriginal rights related to hunting (primarily for moose and elk), fishing, and plant gathering (both for food and medicinal purposes). Some members continue to trap, although this activity has diminished considerably. Consultation efforts to date and review of publically-available information have not identified specific sites where STN continues to practice Aboriginal rights that

overlap with the tailings and waste rock storage facility. STN has not entered into treaty negotiations with the Crown to date, nor launched legal proceedings with respect to Aboriginal title.

Consultation efforts with TNG have not identified Aboriginal rights and interests that overlap with the tailings and waste rock facility. The proposed Project falls within the Engagement Zone A of the Tsilhqot'in Framework Agreement. The agreement was established by the Province of BC, Tsilhqot'in Nation and TNG to streamline the referral process on natural resource applications within the TN traditional territories of TNG member communities. Activities in Engagement Zone A are defined as having no or low impacts on TNG members' Aboriginal rights. The Project does not overlap with proven TN title lands (which form a smaller portion of TN traditional territory). Consequently, the facility is not anticipated to affect TNG's Aboriginal rights.

MNBC expressed concerns regarding current traditional harvesting activities (hunting, fishing, and plant harvesting) occurring in the proposed Project area that could be negatively affected by the Project. Consultation efforts with MNBC to date and review of publically-available information has not identified Métis harvesting in the area that may be considered distinctive and integral to a pre-control Métis community, or that such practices continue in a contemporary Métis community.

The tailings and waste rock facility will be located in an area off limits to the public, thereby preventing Aboriginal groups from exercising Aboriginal rights and interests in the vicinity of the facility through the life of the mine. Among the alternatives, Candidate 1 is the preferred option with respect to potential impacts on Aboriginal rights, as it will result in the least impact to resources relied upon by Aboriginal groups for the exercise of Aboriginal rights.

Candidate 1 will remove 10 to 15 km of known Rainbow Trout habitat but no spawning habitat. The proponent will mitigate this effect through three on-site and two off-site fish habitat enhancement projects. Surface water and sediment quality will meet applicable provincial and federal standards, or established site specific criteria so as not to affect fish. Consequently, effects on the exercise of the Aboriginal right to fish due to reductions in fish abundance is anticipated to be negligible.

Candidate 1 will result in the loss of between 300 ha and 450 ha of high quality caribou habitat and between 150 and 300 ha of high quality moose habitat. Neither reduction is expected to significantly affect regional caribou or moose populations. Additionally, Candidate 1 will result in minimal to low toxicological risks to wildlife. Consequently, effects on the exercise of the Aboriginal right to hunt due to reductions in caribou and moose abundance is anticipated to be low and reversible following reclamation.

Site clearing for the tailings and waste rock storage facility will remove plants potentially harvested by Aboriginal groups. The facility is located at an elevation that is not conducive to high yields of berries, despite the presence of the plants, because of lower temperatures. During closure the mine site and other linear components will be re-vegetated using native species, including those harvested for traditional purposes. Consequently, effects on the exercise of the Aboriginal right to harvest plants due to vegetation clearing is anticipated to be low and reversible following reclamation.

In summary, the tailings and waste rock facility is anticipated to infringe LDN's and UFN's – and potentially STN's and MNBC's - Aboriginal rights to hunt caribou and moose on the lower north slope of Mount Davidson, to fish in the upper reaches of Davidson Creek and stream 661, and to gather plants in the facility footprint due to access constraints to some traditional use sites throughout the life of the mine. The exercise of these Aboriginal rights will able to be resumed following reclamation. Effects on Aboriginal rights due to changes in the abundance or quality of resources are anticipated to be negligible to low, and will be reversible following reclamation. No effects on Aboriginal title (proven or asserted) are anticipated. However, should LDN, UFN, or STN establish Aboriginal title over lands containing the facility at a future date, the facility has the potential to affect the title-bearing Aboriginal group's right to occupy, manage, govern, enjoy economic benefits from, and otherwise use, the lands occupied by the facility.

# 10. CONCLUSIONS

New Gold has developed and undertaken a comprehensive and structured assessment of tailings and PAG/NAG3 waste rock management alternatives for the Blackwater Project in response to the BC EAO March 19, 2015 and CEA Agency June 03, 2015 requests. The approach taken considered location, technology and water management practices in selecting best available technology (BAT) and best available practices (BAP) for tailings and waste rock management. Four distinct steps were used to determine BAT for the Project: identification of a broad range of initial candidates that combined technologies and locations, a preliminary screening, a high-level risk assessment, and a multiple accounts analysis (MAA). A failure modes effects assessment (FMEA) was then used to identify BAP to further reduce risk for the selected BAT candidate.

BAT for the Project was determined by the four steps to be submerged co-disposal of thickened slurry tailings and PAG/NAG3 waste rock in a single impoundment in Davidson Creek (Candidate 1). That alternative scored the highest in the MAA for technical, environmental, human environment and Project economics criteria primarily due to the extensive precedent and flexibility of the waste storage technology at the Project's throughput and climate, the high geochemical stability of the wastes, and simpler water management requirements. The high geochemical stability and contained contact surface water during mine operations minimizes the facility's effects on the natural and human environment primarily due to lower toxicological risks to wildlife and humans. No filtration plant or trucking/conveying of tailings would be required, simplifying operations with a lower life cycle cost of the facility.

The selected candidate scored second highest with respect to physical stability. The filtered tailings and PAG/NAG3 on-land alternative scored the highest in physical stability but was the lowest or second lowest in the other four MAA accounts largely due to the high risk of failure of the long-term acid rock drainage collection and treatment system for the on-land waste rock dump.

To improve the physical stability of the chosen candidate further and to determine Project BAP, a FMEA was conducted that catalogued many of the practices currently in the Application/EIS and identified two additional operational design elements and two contingency measures:

- Design elements:
  - Diversion of non-contact water upstream of the TSF Site D (northern diversion) and upstream of the mine facilities south of the TSF (southern diversion);
  - Relocation of tailings pond supernatant storage to the upper TSF Site C through operation of the TSF Site D;
- Contingency measures:
  - Establishment of interim overflow structures in the TSF Site D during operations;
  - Provision for emergency tailings pond supernatant storage in the open pit.

Those design elements and contingency measures result in more robust water management, and thus improve physical stability. Further, the elements and measures do not materially change the environmental effects assessed in the Project's Application/EIS, nor do they cause incremental changes to Project impacts to Aboriginal rights and title.

New Gold is confident that the thorough and comprehensive assessment described in this report determined BAT and BAP appropriate for the Project: the Blackwater TSF can be constructed, operated and closed in both a physically and geochemically safe manner. New Gold is committed to implementing the design elements and practices described in this report and looks forward to discussing them during the Application/EA review and defining them further during the permitting stage of the Project.

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# *Appendix A*

*Consultation Tracking Table*

## Appendix A - Consultation Tracking Table for the Tailings Alternative Assessment, Blackwater Gold Project

| ID # | Type | Organization | Issue/Topic | Comment | Proponent Response |
|---|---|---|---|---|---|
| 1. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | MEM | High Level Risk Assessment - Candidate Ratings | New Gold is requested to provide additional background on how they determined the high level risk assessment candidate ratings provided on Slide #43 prior to moving forward to the next phase of assessment. The intent would be to evaluate whether the rationale is defensible. | The candidates remaining after pre-screening were assigned a composite numerical ranking representing the anticipated risks to development, with respect to the other alternatives. Candidates were analysed based on specific hazards applying to each candidate with respect to safety, environment and technical execution. The numerical rating was based on the likelihood of occurrence and the resulting consequence of each identified hazard.<br><br>• For Safety, the primary hazard considered for each candidate was based on the potential for loss of containment of mine waste and/or mine water. This hazard applies to all options for tailings and waste rock management. This hazard is often described as a dam breach for a water containing facility; however a similar hazard also exists for a filtered tailings waste pile.<br>• For Environment, the primary hazard is loss of effluent due to failure of collection and/or treatment systems during operations and closure. A loss of effluent is considered a loss of mine contact water above ground; this could encompass unplanned spilling from a water storage dam spillway, unplanned discharge from a water treatment facility or pipeline or overtopping of a water storage dam due to a storm event of a magnitude greater than allowed for in design storage.<br>• For Technical execution, the primary hazard is the application of unproven or complex technology resulting in an inability to meet design criteria. This includes the inability to produce, transport and/or place tailings in a manner that meets design specifications.<br><br>Discussion of the hazards and criteria used in the High Level Risk Assessment are provided in Section 3 and Appendix B. |
| 2. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | MEM | Candidate #10: ultra-thickened/paste tailings option | New Gold is requested to provide consideration in carrying Candidate #10 (ultra-thickened/paste tailings option) forward to the next phase. This question was brought up by EAO during the teleconference call. It is understood that New Gold selected the best option out of each of the categories 1) slurry, 2) filtered, and 3) physical stability, however, it is unclear why this approach was taken. It is understood that Candidate #10 had the second lowest risk score, and it could be arguable that the paste option differs than other "slurry" options presented. | Paste tailings are produced by ultra-thickening resulting in a material that is fully saturated and must be discharged via pipeline similar to thickened slurry tailings. Paste tailings will not segregate upon deposition and will continue to release water after placement. Water would be present against the containment dam as a beach cannot be developed. Therefore paste tailings do not provide advantages over slurry or filtered tailings. Paste tailings (candidate 10) have been included as a candidate in the assessment (Sections 4 to 6 and Appendix B). |

| ID # | Type | Organization | Issue/Topic | Comment | Proponent Response |
|---|---|---|---|---|---|
| 3. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | MEM | High Level Risk Assessment - Likelihood Ratings | New Gold is requested to consider the language presented in the "Likelihood ratings" table in Slide #41. This was brought up during the teleconference call. The qualitative descriptors are reasonable, but the associated frequencies seem questionable, at least when one considers the "safety" component (dam breach or overtopping). Dam breaches are not typically viewed in the context of more than one event per year or month. This seems to compress the ratings into two categories – either "very rare" or "unlikely". I am wondering whether it is worthwhile expanding beyond 100 years. Would this assist in differentiating the likelihood of the various alternatives more than currently? If not, even the language as presented may be questioned by external parties/FN such as the use of an "unlikely" descriptor with an associated frequency as low as 1:10 years for a dam breach. I realize this table is intended to accommodate other smaller hazards such as pipeline breaks etc. but I am worried that this will result in other parties questioning the analyses as a whole. I do realize that the rankings are relative and that this will likely not change the results of the evaluation. I also understand from KP that removal of the safety component in its entirety would not impact the rankings; however, I think this is worth having a second look in terms of presentation. | The Likelihood Ratings incorporate frequencies from more than annually to less than one event every 1,000 years. This is considered appropriate in the context of dam safety risk as well as other significant hazards identified in the High Level Risk Assessment. The definitions for likelihood are provided in Appendix B... |
| 4. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | Pre-Screening Assessment - Fatal Flaw Analysis | We see there has been evolution in the criteria. I can trace some to discussions we have had, but some seem have changed for other reasons. For example, avoiding direct impact to white bark pine was a design criteria noted in the presentation for the July 20 meeting with Carrier Sekani First Nations, but not in the most recent presentation; sterilizing mineral resources, making the project uneconomic, minimizing seepage to the environment, were in earlier documents but seem to no longer be considered. We are not saying we agree or disagree with those changes; just the rationale for them is not transparent. Can New Gold provide an explanation/reason for the evolution of these criteria over the past few weeks? | As explained during the July 20th presentation, KP adjusted the pre-screening criteria to ensure as wide a consideration of candidates as possible in the High Level Risk Assessment. KP was informed from the previous discussion to not include economic aspects in the identification and pre-screening of candidates. Therefore some of the pre-screening criteria used in the original MAA in the EA were relaxed or removed and some added to reflect guidance given by the Working Group provided during the presentation (Section 5.3 of Appendix B). |
| 5. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | Pre-Screening Assessment - Fatal Flaw Analysis | In terms of the August 13 presentation, the short description on the importance of the criteria identified as fatal flaws – i.e. faults above all others – was very brief and not necessarily painting the picture that it was a fault that could not be overcome. In the report, we will need to see a strong rationale why these are in the category of "unacceptable" versus being a potential negative effect that could be outweighed by other benefits. | The pre-screening criteria are based on environmental constraints to evaluate the group of candidates identified over an area of approximately 30 x 35 km. The criteria were developed as questions such that if a candidate responded affirmative to the question (e.g. does it encroach on federal or provincial designated land) it was excluded from further consideration (Section 5.3 in Appendix B) |
| 6. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos | EAO | Candidate development | The candidate development includes some of the same criteria as in the fatal flaw analysis (e.g. minimal upstream catchment; sufficient capacity of storage of mine waste). It is not clear why, if the criteria was applied in site selection, it also needs to be applied in the fatal flaw analysis (although the water management question in the | Minimal upstream catchment was not considered in pre-screening. Sufficient capacity for storage of mine waste is a fundamental requirement and was used in a preliminary manner to identify the potential candidates. That criterion was applied in a more fulsome manner during pre-screening. Only Candidates 11 and 20 failed |

| ID # | Type | Organization | Issue/Topic | Comment | Proponent Response |
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| | (July 2 and 24, 2015) | | | fatal flaw does seem like it might be broader than in the candidate development). | the capacity criterion. |
| 7. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | Candidate development | It isn't clear from the presentation what distinguishes options 5-9 – all of which are filtered tailings in the same location. I assume that will be detailed in the report? | The candidates differ in the specific location of the filtered tailings and PAG waste rock deposits within the same general area. These candidates are described in detail in Section 5.2 of Appendix B. |
| 8. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | High level risk assessment | The memos note that the purpose is to "screen out alternatives with high to extreme risk based on criteria related to safety, water quality and execution": It is not consistent with that objective to screen out several slurry options with lower risk ratings than the filtered tailings options, as presumably all the slurry options with lower ratings have lower risks. It is possible that those options screened out could have other benefits through the MAA that make them a preferred alternative to the lowest ranking slurry option in the high level risk assessment. | The original MAA included in the EIS considered five locations for slurry tailings plus the FS Option that combined two locations (Site C and D) and a PAG on-land option. Therefore New Gold has already assessed and compared slurry tailings options using MAA within 10 km of the mine site. Candidates 13 and 15 are in the Turtle Creek watershed and scored much poorer in the High Level Risk Assessment compared to Candidate 1 (Section 5.2 in Appendix B). |
| 9. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | High level risk assessment | The memos note that the purpose is to "screen out alternatives with high to extreme risk based on criteria related to safety, water quality and execution":<br>• It does not seem consistent with the objectives of the TAA to limit the options carried forward to the MAA to one slurry and one filtered tailings. I cannot find anywhere this limitation was previously noted. | The first objective of the TAA is to identify BAT and therefore it is reasonable to select the best scoring technologies candidates within a given technology for further consideration in the MAA. The rationale for selection of the Candidates for the MAA is provided in Section 5 and in Appendix B. . . |
| 10. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | High level risk assessment | The memos note that the purpose is to "screen out alternatives with high to extreme risk based on criteria related to safety, water quality and execution":<br>• It is not clear from the presentation what the physical stability candidate is and how it is distinguished from the other evaluation around risk of dam failure. | The "dry" tailings and PAG waste rock candidate was identified and carried forward to the MAA to evaluate a technology that might exhibit the greatest physical stability. The Mt. Polley panel identified water content of the waste as a prime determinant of physical stability (Section 5 and in Appendix B). |
| 11. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | High level risk assessment | The memos note that the purpose is to "screen out alternatives with high to extreme risk based on criteria related to safety, water quality and execution":<br>• There is no discussion of what risk rating constitutes "high to extreme risk" versus a risk level appropriate to be brought forward to the MAA. Could there also be some filtered tailings options with risks levels that even if they are higher than the lowest ranked one, still do not cross the threshold of extreme? | As discussed above, the first objective of the TAA is to identify BAT and therefore it is reasonable to select the best scoring candidates within a given technology for further consideration in the MAA. The rationale for selection of the Candidates for the MAA will be discussed in the TAA report. |
| 12. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | High level risk assessment | The memos note that the purpose is to "screen out alternatives with high to extreme risk based on criteria related to safety, water quality and execution":<br>• It appears that all of the selected alternatives for carrying forward to the MAA are in the same location, which seems to be the one selected prior to this analysis? Am I reading that correctly, or are any alternative locations being | All the options carried forward to the multiple accounts analysis (MAA) are within the Davidson Creek valley. This is a reasonable finding from the High Level Risk Assessment since locations further from the mine site pose greater risk of tailings pipeline failure. They also render water management and closure more difficult since effects in a second watershed to the mine itself must be managed (Section 5 |

| ID # | Type | Organization | Issue/Topic | Comment | Proponent Response |
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| | | | | carried forward to the MAA? | and in Appendix B). |
| 13. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | High level risk assessment | The memos note that the purpose is to "screen out alternatives with high to extreme risk based on criteria related to safety, water quality and execution":<br>• Social risk – as discussed on the conference call, it is unclear how "perception of" potential consequences or of environmental impacts constitutes criteria for assessing "high to extreme risks". It would seem to be more appropriate to consider factors such as whether the options have the potential for loss of life or property or areas of high value to people as a result of failures. | Upon further consideration, KP agrees with the comment made by an EC representative during the presentation that the primary social hazards are considered and evaluated as part of pre-screening. These hazards include:<br>• Will the candidate result in deposition of tailings into a fish-bearing lake?<br>• Will the candidate be partially located in the Blackwater River watershed?<br>• Will the candidate be located in the ungulate winter range?<br>• Will the candidate encroach on provincially or federally designated lands (e.g. parks and protected areas) and/or private lands?<br>These criteria were identified by government representatives, First Nations and other stakeholders during consultation sessions with New Gold. Therefore KP will remove the social hazard from the High Level Risk Assessment. Note that social aspects will be considered further as part of a Human Environment account in the MAA (Section 6 and Appendix C). |
| 14. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | High level risk assessment | The memos note that the purpose is to "screen out alternatives with high to extreme risk based on criteria related to safety, water quality and execution":<br>• Damage loss in consequence ratings – is this to New Gold only, or does it take into account other economic activity (including subsistence economy) that may be affected by these events? | The damage loss in the consequence ratings used for the High Level Risk Assessment applies only to New Gold. Damage loss to the "subsistence economy" is considered in the Aboriginal Rights and Title and indirectly in the Environment consequence ratings. Potential effects on the "subsistence economy" will also be considered in the Human Environment account in the MAA (Section 9). |
| 15. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | Dam Design | It was explained that the reason filtered tailings resulted in a higher risk level than slurry was the dam to house the PAG waste rock, and the fact that the water would be right up against the rocks and there was no tailings beach. Is that considering best available design for water dams? Is there not a way to design a primarily water storage dam to address this issue? | A beach cannot be created for a dam containing only waste rock as it is not possible to segregate the limited fines in waste rock. Hydro power and water reservoir dams are constructed without beaches. |
| 16. | Tailings Alternatives Assessment Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | Consultation | The memos of July 2 and 24, 2015 noted that in Q3 there would be a meeting coordinated by UBC with key First Nations to review and seek input of the evaluation. Please provide an update on the status of that meeting (still planned? Has it occurred? What were the outcomes?). | New Gold has made approaches through UBC to hold a meeting specific to this evaluation with key First Nations but this has not taken place. However, First Nation representatives were invited and participated in the consultation meetings held in June, August and October of 2015. |
| 17. | Tailings Alternatives Assessment Presentation (August | EAO | Consultation | The memos/presentations reference "key" First Nations – assume it is all Schedule B First Nations? | The key First Nations referred to in the presentation are the Aboriginal groups listed in Schedule B of the Section 11 Order. The Aboriginal groups are listed in |

| ID # | Type | Organization | Issue/Topic | Comment | Proponent Response |
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| | 13, 2015) and Memos (July 2 and 24, 2015) | | | | Section 1.6. |
| 18. | Tailings Alternatives Assessment - Presentation (August 13, 2015) and Memos (July 2 and 24, 2015) | EAO | Consultation | The presentation talks about reviewing with "stakeholders". EAO would like clarification on New Gold's plans in this regard – are stakeholders a broader group than the working group? Are there specific potentially affected stakeholders New Gold intends to consult with? Does this include the working group? | The stakeholders include the attendees of the consultation meetings held in June, August and October of 2015. These are provided in Section 1.5 |
| 19. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | First Nations – | Gareth Mullens, asked if the sensitivity analysis will focus on First Nations (i.e., current use) only. | Tim Bekhuys confirmed that one of the sensitivity analyses will focus on First Nations. The analysis considers only *Current Use of Lands and Resources for Traditional Purposes* (Section 6.5 and detailed in Appendix C) |
| 20. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Changes to EA Application | Gabi Matscha questioned whether there would be any changes to the EA Application to incorporate the new design elements and contingency measures identified in the presentation. | Keith Ferguson noted the water balance in the EA Application captures average conditions. The new design elements would not affect average conditions. With the new design elements, the same water quality results would be predicted. The design elements are summarized in Section 8 of the TAA and Appendix D. |
| 21. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Potential environmental effects of contingency measures | Gabi noted the Ministry of Environment (MOE) needs to understand the implications of discharging to the receiving environment via the operational spillway contingency measure. | Keith responded that water quality is normally not predicted for contingency measures in environmental assessments. Potential environmental effects of the contingency measures are provided in Section 8 |
| 22. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Likelihood of use of contingency measures | Gabi noted that it depends on the likelihood of using the contingency measure and that an assessment may be required for permitting. | Keith responded the likelihood of using the operational spillway is very low. |
| 23. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Tailings reclamation | Trefor Smith questioned what kind of cover that would be used for the filtered tailings/submerged PAG option. | Keith Ferguson responded covers typically include a layer of compacted clay or till layer with overlying topsoil. |
| 24. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Expansion of TSF | Trefor questioned whether the tailings storage facility is large enough to accommodate a mine expansion. | Tim commented that New Gold is exploring other areas but has not found anything that would change the Blackwater Project as currently planned. If an additional deposit is discovered, New Gold would apply for separate approvals for any future mine expansions. This is not subject to the current environmental assessment. |
| 25. | Tailings Alternative Assessment – Presentations on | EAO | Potential environmental effects of contingency measures | Justin Himmelright referred to the new design element where water would be transferred and stored in Site C during the operation of Site D. He asked if there was a risk of losing water to the west. | Dan Fontaine responded the seepage to the west would be mitigated by the hydraulic barrier (easterly groundwater gradient in Site C TSF) controlled by the spillway elevation at Site C (addressed in Section 8. |

| ID # | Type | Organization | Issue/Topic | Comment | Proponent Response |
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| | October 8 and 13, 2015 | | | | |
| 26. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Design basis for paste tailings option | Kim Bellefontaine asked about the location of tailings discharge for the Paste Tailings option and asked if it could be moved around or whether there could be multiple discharge locations. | Dan Fontaine responded that this is not the design basis for the paste option, and that a central discharge point was most practical and appropriate given the long containment dam length. Discharge location could be moved to multiple locations if the tailings were not ultra-thickened paste; as is the case for the thickened-slurry option. |
| 27. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | MEM | Solids percentage for tailings | Heather Narynski asked about the solids percentage for thickened-slurry and paste tailings and the slopes of the filtered tailings deposit. | Dan responded that the gravimetric solids content (percent solids) in the tailings is 50% for thickened tailings and 65% for paste tailings. Dan confirmed the slope of the filtered tailings stack option would be 3 horizontal to 1 vertical (Appendix B). |
| 28. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | Source Environmental | Tailings beach maintenance | Rina Freed questioned how beaches are maintained. | Dan responded by moving the spigots and maintaining the pond water balance. |
| 29. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | Source Environmental | Pond location on paste option | Rina asked if, for the paste tailings option, consideration was given to moving the water to a separate location so there is no water against the dam. | Dan indicated that water could be decanted and removed from the impoundment, but that water would still need to be stored elsewhere on site in an impoundment or reclaim pond similar to the filtered tailings with PAG on-land option due to the site's water balance. This would still require a water retaining dam. This was not selected as the design basis for the paste option. |
| 30. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | MEM | Tailings beach | Heather Narynski asked what the minimum beach being proposed was 300 metres and was it based on the feasibility study | Dan indicated that the minimum beach being proposed was 300 metres based on the feasibility study. The feasibility study actually approaches it differently, with a freeboard requirement and 1% beach slope. Beach length can be determined as a function of these two inputs. A freeboard of 3 m at a 1% slope would be 300 m of beach. The freeboard requirement would change throughout operations as the dam is raised, and likely be 4 m or greater, which equates to at least 400 m of beach. Beach length could be discussed further in permitting and could become a quantitative performance objective (QPO). The time of measurement and method of measurement would need to be agreed upon for this to be a QPO. |
| 31. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | MEM | TSF Pond Size | Kim Bellefontaine enquired whether the Site D TSF pond would be smaller during closure | A smaller pond in closure would be located in an area and have a volume that maintains saturation of PAG waste rock disposal areas. Updating the closure concept for a smaller pond will be carried out during permitting. |

| ID # | Type | Organization | Issue/Topic | Comment | Proponent Response |
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| 32. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Dam breach | Jennifer Karmona asked about the risk of a tailings dam breach... | Keith responded that the risk (likelihood and consequences) of a tailings dam breach were incorporated into the high level risk assessment and in the MAA by considering pond location, water balance, upset conditions and other physical stability factors (Sections 5 and 6 and Appendix C) |
| 33. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Dam breach | Jennifer questioned whether failure costs of a tailings dam breach were considered. | Dan responded that the likelihood and consequence of such a failure were considered in the high level risk assessment (Appendix B). |
| 34. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | Source Environmental | Dust generation | Rina Freed asked whether there is a wind tunnel at the site like at the Endako mine site, noting Nadleh Whut'en is concerned about dust generation. | Gerry Papini responded that dust generation is considered for the technology options in the MAA. The prevailing wind direction is from the southwest and siting a TSF with respect to the prevailing wind direction can also influence air quality through fugitive dust emissions (Sections 1.6). |
| 35. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | Source Environmental | TSF pond location | Rina commented that Myra Falls does not have ponded water against the dam. | Dan indicated that water could be decanted and a portion removed from the impoundment, but that water would still need to be stored elsewhere on site in an impoundment or reclaim pond similar to the filtered tailings with PAG on-land option. This would still require a water retaining dam. This was not selected as the design basis for the paste option (Section 8 and Appendix D). |
| 36. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | MEM | Interim emergency discharge structure (operational spillway) | Kim Bellefontaine asked if spillway is built over the mine life | Dan confirmed the spillway would be built over the mine life and moved periodically, noting it would be approximately a 4 metre deep excavated channel with the capacity to convey the probable maximum flood. It would become the secondary emergency spillway during closure (Section 8 and Appendix D). . |
| 37. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | MEM | Temporary and premature shutdown | Kim asked how the water balance would be managed in extended care and maintenance with respect to the open pit | Dan commented that several scenarios will be considered: temporary shutdown, longer term shutdown care and maintenance, premature closure and long-term closure (Section 8). |
| 38. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | TSF pond location | EAO noted that at existing mines, the location of ponded surface water in Tailings Storage Facilities moves as points for depositing materials shifts. In this case, can/will appropriate beaches be maintained? | New Gold responded that a minimum beach length could be specified as a quantitative performance objective (QPO) and would therefore be maintained in operating plans. |
| 39. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Sensitivity analysis in MAA | For comparison, can a revised figure of the overall MAA results be provided that does not include the Project Economics account. | New Gold responded that a sensitivity analysis excluding the Project Economics account will be included in the report (Section 6 and Appendix C). |

| ID # | Type | Organization | Issue/Topic | Comment | Proponent Response |
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| 40. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | Source Environmental | Multiple Accounts Analysis | Rina questioned whether the Excel spread sheet (digital file) for the MAA will be provided to the Working Group. . | New Gold suggested first that the TAA report be circulated as planned to the Working Group, and offered to meet with the Working Group following circulation and review of the report. Detailed MAA tables provided in Appendix C. Should there remain additional questions and a desire to review the Excel spread sheets after that time, New Gold would then provide the spreadsheets (Appendix C). |
| 41. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Temporary closure | Will water management be including in temporary closure | New Gold indicated the report will include a description of water management during temporary closure (Section 8). |
| 42. | Tailings Alternative Assessment – Presentations on October 8 and 13, 2015 | EAO | Table of Concordance | EAO asked about inclusion of a concordance t able that outlines how the requirements of the EAO March 19, 2015 are addressed in the report. The EAO provided New Gold with a guidance document | New Gold committed to include a concordance table (Appendix A). |

# *Appendix B*

*Consultation and Engagement Meeting Minutes*

newgold™ Blackwater Project

**Meeting Dates:** June 11 and 12, 2015
**Distribution:** Attendees

**Subject:** **New Gold Blackwater Project Tailings Options Evaluation**

**June 11, 2015 Teleconference**

**Participants:**
Tim Bekhuys (New Gold)
Nolan Peterson (New Gold)
Anne Currie (ERM)
Gerry Pappini (ERM)
Keith Ferguson (Independent)
Dan Fontaine (Knight Piesold)
Shelley Murphy (EAO)
Steve McNaughton (EAO)
Jennifer Karmona (EAO)
Gabrielle Matscha (MOE)
Christal Nieman (CEA Agency)

Introductions

- Participants introduced themselves.

Discussion

- New Gold presented its proposed approach to respond to the BC EAO March 19, 2015 request to examine alternative technology options to determine the best available technology and the application of best available practices for tailings management for the Blackwater Project. The approach is adapted from Environment Canada's "Guidelines for the Assessment of Alternatives for Mine Waste Disposal" (2011) and incorporates high level and detailed (Failure Mode Effects Analysis) risk assessments. The approach set out in EC's guidelines incorporates multiple accounts analysis and provides for transparency as the rationale must be clearly presented as you advance through each step. New Gold's approach also includes engagement with Aboriginal groups and relevant government agencies. New Gold will produce a report to present the assessment and the timing for completing the report is mid-August 2015.
- In response to EAO, New Gold confirmed the tailings evaluation options are all located in the Davidson Creek and Creek 661 watersheds, and the evaluation will consider different configurations of the tailings storage facility.
- EAO commented the reasons for excluding a particular option due to risks or specific criteria must be clearly explained.
- New Gold commented it anticipated not carrying forward the lake disposal option beyond pre-screening and into the multiple accounts analysis given public and Aboriginal concerns related to use of a lake to store tailings and the anticipated difficulty in permitting the option. EAO

commented the rationale for not passing this option through pre-screening need to be documented.

- In response to a question from New Gold related to the evaluation methodology, EAO noted it is recognized that each project is different and there may be more than one way to address the EAO's request. EAO's approach is to question each proponent's proposed methodology rather than defining the methods.
- In response to Gabi, Knight Piesold advised the risk assessments will consider the likelihood and consequences of potential failures of the tailings storage facility option (e.g., tailings dam breach, water collection system failure). The detailed risk assessment (Failure Mode Effects Analysis) will be used to fine tune the alternatives to identify the best available practices.
- Gabi noted that she agreed with this approach.
- In the filtered tailings option the facility may be more geotechnically stable but the ML/ARD (geochemical) consequence may be high.
- In response to EAO regarding the consequences in the risk assessment, Keith referred to the risk assessment in the Accidents and Malfunctions chapter, noting similar criteria would be used for the tailings evaluation detailed risk assessment (focused on tailing and waste rock management).
- Gabi noted that she is interested in reviewing the risk assessment matrix. Gabi commented this is the first systematic approach that she has seen to respond to EAO's request.

**June 12, 2015 Meeting**

**Participants:**
Tim Bekhuys (New Gold)
Nolan Peterson (New Gold)
Anne Currie (ERM)
Keith Ferguson (Independent)
Dan Fontaine (Knight Piesold)
Shelley Murphy (EAO)
Steve McNaughton (EAO)
Jennifer Karmona (EAO)
Christal Nieman (CEA Agency)
Kim Bellefontaine (MEM)
Heather Narynski (MEM)

Introductions/Meeting Purpose

- Participant introduced themselves

Discussion

- New Gold presented its proposed approach to respond to the BC EAO March 19, 2015 request to examine alternative technology options to determine the best available technology and the application of best available practices for tailings management for the Blackwater Project. The approach is adapted from Environment Canada's "Guidelines for the Assessment of Alternatives for Mine Waste Disposal" (2011) and it also incorporates high level and detailed (Failure Mode Effects Analysis) risk assessments. The approach set out in EC's guidelines incorporates multiple accounts analysis and provides for transparency as the rationale must be clearly presented as you advance through each step. New Gold also plans to engage Aboriginal groups and relevant government agencies. New Gold will produce a report to present the assessment results and the timing for completing the report is mid-August 2015.
- New Gold noted that some of the environmental criteria presented on Slide 2 may be relaxed in the pre-screening step (e.g., surface water discharge during operations, seepage rates) may be relaxed to enable some options to undergo more detailed evaluation.
- MEM and EAO commented the fatal flaws that will be used to pre-screen options must be clearly explained to ensure options are not eliminated prematurely.
- There was discussion about how New Gold's report that assessed options for siting the tailings storage facility (TSF) would be considered in the tailings evaluation. MEM recommended that siting and water balance be revisited. EAO commented that beginning the analysis at the same point and with the same criteria that existed before the Mt. Polley Tailings Storage Facility breach will not be sufficient.
- MEM questioned at what point on the tailings spectrum tailings would not be liquefiable. Knight Piesold responded that liquefaction potential is related to tailings grain size, density, saturation, and the earthquake characteristics. There is a point along the tailings dewatering spectrum indicated in Slide 7 where tailings begins to behave like a soil and is no longer pumpable. This point does not mean that the material is no longer potentially liquefiable.

- MEM agreed that options that are not technically or economically feasible should be screened out as the project would not be viable.
- It was noted that potentially acid generating (PAG) waste rock behavior must be assessed with tailings alternatives (deposited in tailings versus in storage, porosity, liquefaction etc.).
- In response to MEM, New Gold confirmed options include filtered tailings on land.
- In response to EAO, Knight Piesold commented that a catastrophic breach of an impoundment holding waste rock only would move waste rock into the downstream environment but it would settle out more quickly than if it were tailings.
- Knight Piesold explained how the risk assessment would be incorporated into the multiple accounts analysis.
- EAO recommended the Project Working Group be involved as the assessment is conducted. New Gold noted it is interested in obtaining Aboriginal and government feedback on the criteria that will be used to pre-screen options and for the detailed evaluation of the remaining options.
- In response to CEA Agency, New Gold confirmed that CEAA 2012 5(1)(c) requirements and comments provided by Environment Canada previously on the EA MAA would be considered in the assessment.
- In response to MEM, New Gold confirmed that reclamation and closure and long-term costs will be considered in the report. EAO noted that costs identified by the Mt Polley panel should also be considered.
  MEM suggested the report include a preamble to discuss ARD/ML issues to help set the overall context. MEM also recommended that temporal aspects be discussed (e.g., dam maintenance and water treatment in perpetuity).

**Action Items**

| # | Action Item | Who? |
|---|---|---|
| 1. | Review and provide comment on Slide 10 - New Gold's proposed process | MOE |
| 2. | Prepare a strategy for Aboriginal and government agency engagement on tailings evaluation | New Gold |
| 3. | Update memo provided to EAO to incorporate comments provided at June 12 meeting. The memo will provide further clarification on how the high level and detailed risk assessments will be incorporated in the evaluation. | New Gold |

# Memorandum

**Date:** July 24, 2015

**To:** Tim Bekhuys, New Gold

**From:** Gerry Papini, ERM

**Cc:** Anne Currie, ERM

**Subject:** **Blackwater Project - Tailings Management Options Evaluation (EAO Reference# 276969)**

## 1. INTRODUCTION

In response to the British Columbia (BC) Environmental Assessment Office (EAO) request dated March 19, 2015 that mine proponents address the recommendations of the Independent Expert Engineering Investigation and Review Panel for the Mount Polley incident (Panel Report), New Gold is conducting an assessment of alternative technology options to determine the best available technology (BAT) and application of Best Available Practices (BAP) for tailings management at the Blackwater Project (the Project). The assessment will provide options for tailings management that consider technology, siting and water balance.

Initial meetings were held with the Environmental Assessment Agency (EAO), Ministry of Environment (MOE) and the Canadian Environmental Assessment Agency (CEA Agency) on June 11, 2015 and the Ministry of Energy and Mines (MEM), EAO and CEA Agency on June 12, 2015 to present and discuss New Gold's approach for evaluation of tailings management options. The agencies emphasized the need to consider additional facility locations outside of the Davidson Creek watershed and to provide clear rationale to explain 'fatal flaws' identified in the pre-screening stage in New Gold's assessment. In addition, the assessment will include potentially acid generating (PAG) waste rock behavior with the tailings options. Figure 1 shows a flow chart of the proposed methodology and process for completing the assessment.

New Gold's also reviewed its proposed approach to evaluating tailings management options with Nadelh Whut'en, Stellat'en and Saik'uz, Carrier Sekani Tribal Council, EAO, CEA Agency and MEM representatives on July 20th teleconference.

There have been three versions of this memo. The first version dated April 17th was revised to include the screening criteria for assessing the 'fatal flaws' of the candidate alternatives, plans for government and Aboriginal engagement, and figures and tables illustrating the proposed approach and risk assessment descriptors. This version was issued on July 2, 2015. The July 2nd memo has been revised to indicate how effects on potential effects on Aboriginal rights and interests will be considered in the assessment based on comments provided during the July 20th call.

## 2. APPROACH

In consideration of agency comments, New Gold is evaluating tailings and waste rock storage locations outside of the preferred site identified in the Tailing Storage Facility Alternatives Assessment study (Assessment of Alternatives for the Blackwater Gold Project Tailings Storage Facility, September 2014 (i.e., the Feasibility Study Alternative in the Davidson Creek catchment). New Gold proposes a four step approach for selecting the Best Available Technology (BAT) and Best Management Practices (BMP) for tailings management at the Blackwater Project (Project) (Figure 2). The steps include:

1. 'Fatal flaw' analysis (pre-screening step) to screen out alternatives that do not meet New Gold's criteria;
2. High-level risk assessment to screen out alternatives with high to extreme risk based on criteria related to safety, water quality and execution;
3. Multiple accounts analysis (MAA) based on *Guidelines for Assessment of Alternatives for Mine Waste Disposal (Environment Canada, 2011)* with evaluation criteria including natural and human (health, social, heritage and economic values) environment; amenability to closure, reclamation and post-closure management; safety; cost effectiveness; and technical applicability. Potential effects on Aboriginal rights and interests will be assessed and informed by the conclusions reached for relevant health, social, heritage and environmental evaluation criteria, including current use of lands and resources for traditional purposes, heritage, water quality, fish and fish habitat, wildlife and wildlife habitat, and vegetation;
4. Detailed risk assessment (e.g., Failure Modes Effects Analysis) for risk reduction and leading to incorporation of BMPs (e.g., risk mitigation, contingency including monitoring and emergency response plans) into the tailings and waste rock management plans.

The fatal flaw analysis or pre-screening step considers locations for potential tailings and waste rock storage sites within a radius of approximately 25 km from the deposit. The options will be screened using the following criteria:

- Will the alternative result in deposition of tailings to a fish-bearing lake?
- Will the alternative be located in the Blackwater River watershed?
- Will the alternative be located in ungulate winter range?
- Will the alternative encroach on provincially or federally designated lands and/or private lands?
- Will the alternative have sufficient capacity to store tailings produced over mine life?
- Will the alternative make prevention of surface discharges without treatment impractical or improbable?
- Will the alternative sterilize mineral resources?
- Will the alternative make the project uneconomic?

A high-level risk assessment will be used to identify options with high or extreme risk for exclusion from further analysis. The risk assessment criteria will include:

- Safety risk – likelihood and consequence of a major dam breach or failure of the waste management facility;
- Water quality risk – likelihood and consequence of untreated surface discharge; and
- Execution risk – likelihood and consequence of not meeting the Project's design criteria because of complex operations.

Likelihood and consequence descriptors and a risk matrix to differentiate extreme; high; moderate and low risks used in the risk assessment are attached (Tables 1 to 3). Low to moderate risk alternatives will undergo an MAA using evaluation criteria that rank the options on all accounts. The preferred option will then undergo a detailed risk assessment to identify risk reduction opportunities by considering BAP.

A report with clear and transparent rationale for the preferred option will be submitted to the EAO during the Application review stage.

## 3. GOVERNMENT AND ABORIGINAL ENGAGEMENT

New Gold's plans for engaging First Nations (FNs) and government agencies are described below.

Aboriginal Engagement

July 20 teleconference with Nadleh, Stellat'en and Saik'uz.

Week of August 4, 2015 – Teleconference with Saik'uz and Nadleh technical advisors to present and discuss the proposed methodology.

Q3 - Meeting co-ordinated by UBC with key First Nations, as available, to review and seek input on the evaluation.

Government Agencies

June 11/12, 2015 - Meetings with CEA Agency, EAO, MOE and MEM to discuss the proposed approach.

Q3 - Meeting with Blackwater Project Working Group to present and discuss the results of the tailings management evaluation report. As members of the Working Group, First Nations would be invited to attend this meeting.

## 4. CONCLUSION

New Gold will work with the relevant government agencies to address the recommendations of Mt. Polley panel report. New Gold proposes to use a four-step (4) approach to arrive at the BAT and BMP for the Project. The approach incorporates risk assessment methods with MAA to screen options for 'fatal flaws' and assess options using natural environment, human

environment, technical and economic criteria. The approach also includes applying BMPs for construction, operation and closure of the Project.

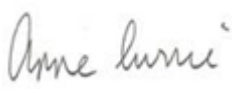
Prepared by:



Gerry Papini, P.Geo.

Attachments
Figure 1: Proposed Methodology and Process for Assessment of Tailings and Waste Rock Management Alternatives
Figure 2: Proposed Approach for Selection of BAT/BMP for Blackwater Project.
Tables 1 – 3: Risk assessment descriptors and definitions.

Reviewed by:



Anne Currie
Senior Partner

## REFERENCES

CEA Agency. 2013. *Operational Policy Statement, Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012*. Prepared by the Canadian Environmental Assessment Agency: Ottawa, ON.

Environment Canada. 2011. *Guidelines for the Assessment of Alternatives for Mine Waste Disposal*. Environment Canada: Ottawa, ON.

**Figure 1: Proposed Methodology and Process for Assessment of Tailings and Waste Rock Management Alternatives**

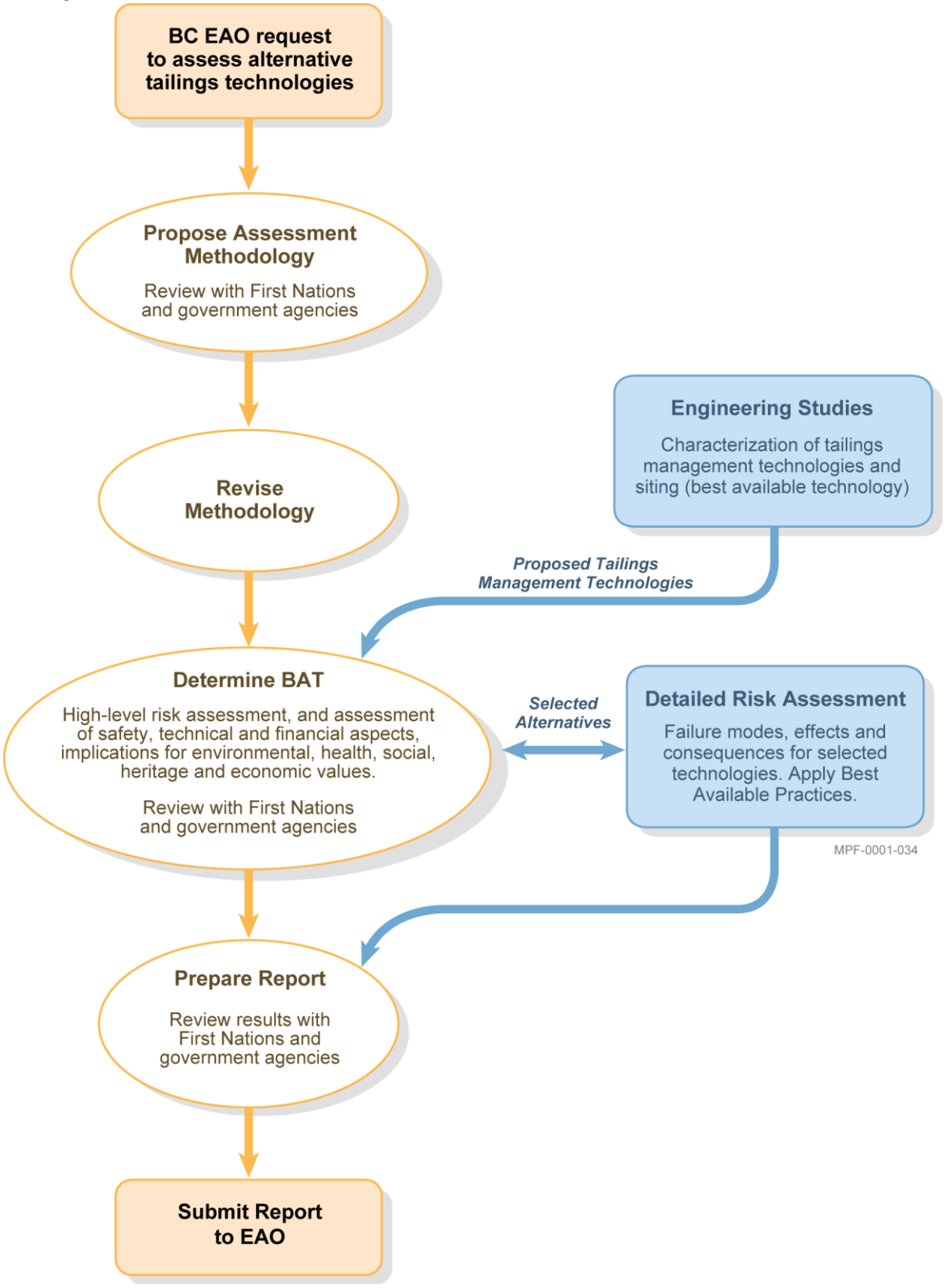


**Figure 2: Proposed Approach for Selection of BAT/BMP for Blackwater Project**

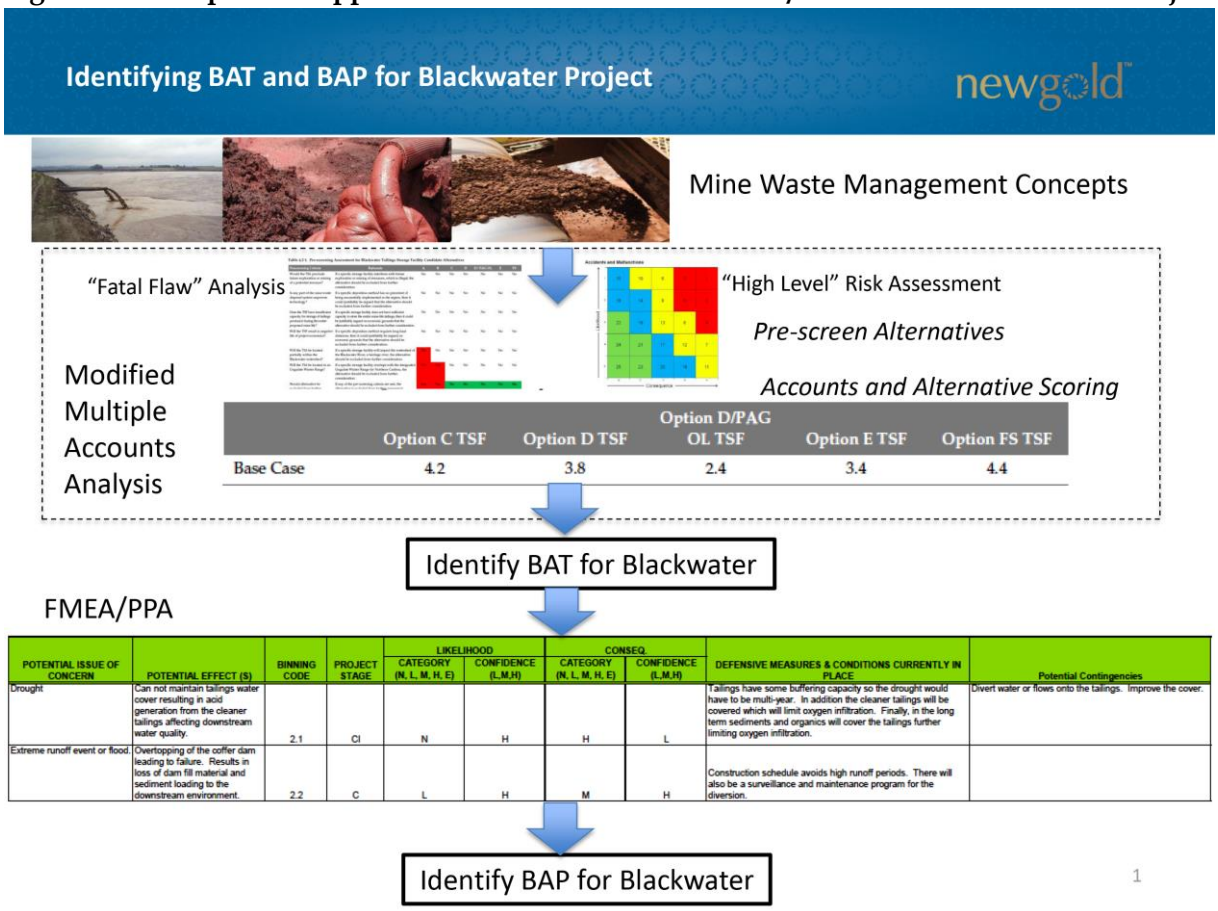


**Table 1: Likelihood Descriptors**

| Likelihood Score | Descriptor | Frequency |
|---|---|---|
| 1 | Almost Certain - happens often | More than one event per month |
| 2 | Likely - could easily happen | More than one event per year |
| 3 | Possible - could happen and has happened elsewhere | One event per 1 - 10 years |
| 4 | Unlikely - has not happened but could | One event per 10 -100 years (i.e. within life of mine) |
| 5 | Very rare - possible but only in extreme circumstances | Less than one event per 100 years (within the life of the Project) |

**Table 2: Consequence Descriptors**

| Consequence Score | Descriptor | Environment | Business | Damage / Loss |
|---|---|---|---|---|
| A | Catastrophic | Irreparable damage, very serious long term impairment, affecting whole ecosystem | > 1 month production delay | > $50 Million |
| B | Major | Serious medium-term environmental impact, affecting whole ecosystem | > 1 week and < 1 month production delay | $10 - $50 Million |
| C | Moderate | Moderate short-term effects, affecting part of ecosystem (i.e. biological or physical environment) | >1 day and < 1 week production delay | $2 - $10 Million |
| D | Minor | Small short-term effect on part of ecosystem | > 6 hour < 24 hour production delay | $0.5- $2 Million |
| E | Insignificant | Limited short-term effect in small or previously disturbed area | < 6 hour production delay | < $0.5 Million |

**Table 3: Risk Matrix and Definitions**

| Likelihood | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ↑ | 1 | 15 | 10 | 6 | 4 | 1 |
| | | 2 | 19 | 14 | 9 | 5 | 2 |
| | | 3 | 22 | 18 | 13 | 8 | 3 |
| | | 4 | 24 | 21 | 17 | 12 | 7 |
| | | 5 | 25 | 23 | 20 | 16 | 11 |
| | | | E | D | C | B | A |
| | | | → | | | | |
| | | | Consequence | | | | |

| Risk Score | Descriptor | Definition |
|---|---|---|
| 1 to 5 | Extreme | Risks that have serious negative effects that cannot |
| 6 to 13 | High | Risks that have major negative effect |
| 14 - 20 | Medium | Risks that have moderate negative effects that can b |
| 21 to 25 | Low | Risks that have minor or negligible negative effects |

newgold™ Blackwater Project

**Proposed Blackwater Project**

**Teleconference with EAO Working Group**

**Summary Notes**

**Teleconference Date:** August 13, 2015
**Distribution:** Attendees / Working Group

**Subject:** **New Gold Blackwater Project Tailings Alternatives Assessment**

**Participants:**
Tim Bekhuys (New Gold)
Nolan Peterson (New Gold)
Anne Currie (ERM)
Keith Ferguson (Knight Piesold)
Dan Fontaine (Knight Piesold)
Shelley Murphy (EAO)
Chelsea Garside (EAO)
Jennifer Karmona (EAO)
Christal Nieman (CEAA)
Eric Gross (CEAA)
Kim Belfontaine (MEM)
Heather Narynski (MEM)
Lea-Marie Bowes-Lyon (MMPO)
Gabriele Matscha (MOE)
Tracy Henderson (MOE)
Stephanie Huska (MOE)
Chelton van Geloven (FLNRO)
Tara Moorhouse (JTST)
Christie Spry (EC)
Bob More (EC)
Mike Hagen (EC)
Manon Phaneuf (EC)
Allison Denning (Health Canada)
Angelique Magee (NRCan)
Neil Gauthreau (LDN)
Georgina Farah (Source Environmental)
Trefor Smith (Firelight Group)
Jason Llewellyn (RDBN)
Brian Frenkel (District of Vanderhoof)
Emily Columbo (District of Ft St James)
Dirk van Zyl (UBC)

Introductions

- EAO welcomed participants, reviewed the agenda and everyone introduced themselves.

Discussion

- Multiple accounts analysis (MAA) to include consideration of possible effects on groundwater from releases from mine.
- Based on EAO comments, NGD to revisit how to address social aspects in the high level risk assessment including possible removal of social criteria as they are considered in the pre-screening criteria (i.e., lack of support for disposal in a fish-bearing lake and avoidance of the Blackwater River drainage, Ungulate winter range and provincially or federally designated lands)
- EAO advised that the report should explain how likelihood and consequence ratings were selected in the high-level risk assessment.
- NGD confirmed that current use of lands and resources for traditional purposes is one of the criteria considered in the multiple accounts analysis.
- NGD confirmed that geotechnical information is available for the three alternatives proceeding to the multiple accounts analysis.
- EAO advised that all of the items identified in Doug Caul's March 19, 2015 letter must be addressed.
- A dam for Potentially Acid Generating (PAG) waste rock would be water retaining with water against the dam.
- Approximate elevations of dams/structures are: FS Option – 130m, PAG dam – 100m, filtered tailings stack – 120m.
- A teleconference with the Working Group will be held during the second week of September 2015 to review results of the MAA and FMEA

newgold™ Blackwater Project

**Proposed Blackwater Project**

**Teleconference with EAO Working Group**

**Summary Notes**

**Teleconference Dates:** October 8 and 13, 2015
**Distribution:** Attendees / Working Group

**Subject:** **New Gold Blackwater Project Tailings Management Evaluation to Respond to EAO March 9, 2015 Letter**

**Participants:**

| **October 8, 2015** | **October 13, 2015** |
|---|---|
| Tim Bekhuys (New Gold) | Ryan Todd (New Gold) |
| Ryan Todd (New Gold) | Nolan Peterson (New Gold) |
| Nolan Peterson (New Gold) | Keith Ferguson (Consultant) |
| Keith Ferguson (Consultant) | Shelley Murphy (EAO) |
| Shelley Murphy (EAO) | Chelsea Garside (EAO) |
| Chelsea Garside (EAO) | Steve McNaughton (EAO) |
| Gabriele Matscha (MOE) | Heather Narynski (MEM) |
| Stephanie Huska (MOE) | Brent Beattie (MEM) |
| Philip Krauskopf (FLNRO) | Kevin Hoekstra (FLNRO) |
| Danielle Smythe (MMPO) | Kim Belfontaine (MEM) |
| Lea-Marie Bowes-Lyon (MMPO) | Shannon Carson (FLNRO) |
| Eric Gross (CEAA) | Christal Nieman (CEA Agency) |
| Angelique Magee (NRCan) | Luc Lachance (MOE) |
| Allison Denning (HC) | Dave Reedman (MARR) |
| Bob More (EC) | Thomas Clement (District of Vanderhoof) |
| Christie Spry (EC) | Rena Freed (Source Environmental) |
| Neil Gauthreau (LDN) | Jennifer Karmona |
| Trefor Smith (Firelight) | Ken Brouwer (Knight Piesold) |
| Brian Frenkel (District of Vanderhoof) | Dan Fontaine (Knight Piesold) |
| Tracey Henderson (MOE) | Anne Currie (ERM) |
| Garth Mullens (EC) | Lisa DeSandoli (ERM) |
| Nadine Parker (EC) | Gerry Papini (ERM) |
| Justin Himmelright (Saik'uz First Nation) | |
| Ken Brouwer (Knight Piesold) | |
| Dan Fontaine (Knight Piesold) | |
| Anne Currie (ERM) | |
| Lisa DeSandoli (ERM) | |
| Gerry Papini (ERM) | |

Introductions

- EAO welcomed participants, reviewed the agenda and everyone introduced themselves.

**Discussion**

- New Gold indicated the presentation presents the results of New Gold's evaluation of tailings management options. New Gold presented the proposed methodology at the June 11 and 12, 2015 meetings and reviewed the screening step (fatal flaw analysis and high level risk assessment) at the August 13, 2015 meeting. New Gold advised the results of the tailings alternative assessment (TAA) will be presented in a report to be provided to the EAO and CEA Agency for distribution to the Working Group in November 2015.

Study Overview

- Keith Ferguson reviewed New Gold's approach to identify best available technology (BAT) and best available practices (BAP).

Multiple Accounts Analysis (MAA)

- Dan Fontaine reviewed the four options identified from the high level risk assessment that have been carried into the MAA (See Appendix A for description of each option).
- Dan Fontaine noted the four candidates are located on Davidson Creek for the following reasons:
    - The location provides the best integration of waste and water management for operations and closure, including the collection of surface water runoff and interception of potential seepage.
    - All four options are able to be technically executed within the Davidson Creek catchment.
    - This location poses the lowest risk for tailings and waste rock storage for the following reasons:
        - Extending far afield and to multiple catchments increases the area at potential risk of an accident or malfunction and clustering of facilities in one area has a lower environmental footprint;
        - Extending further afield would require longer tailings pipelines (pipeline breakage could impact a secondary area);
        - Waste rock storage is expected to remain on Davidson Creek regardless of tailings location (additional hauling / handling increases the potential for material loss to environment);
        - Multiple areas of waste management separated by longer distance increases risk of failures and monitoring requirements and;
        - Filtration plants would still require secondary discharge for upset (i.e., not normal) conditions – some off-spec slurry storage is required.
    - Far afield sites are typically used when the mine site does not have good storage characteristics, water management, and/or foundation conditions for a local TSF. This is not the case for the Blackwater project.

- Lisa DeSandoli reviewed the MAA methodology noting the evaluation of tailings management options follows Environment Canada's (2011) Guidelines for the Assessment of Alternatives for Mine Waste Disposal. Step 6 (Sensitivity Analysis) is in progress and will be included in the report.
- Lisa reviewed the five Accounts (Physical Stability, Technical, Environment, Human Environment, and Project Economics) and weighting and Sub-accounts. The Account weightings have been informed by EC 2011 Guidelines. A ranking of 6 represents the lowest impact/best option.
- Lisa reviewed the results noting:
    - The Slurry Tailings and Submerged PAG has the highest scores for the Environmental, Technical, Human Environment and Economic accounts.
    - The Filtered Tailings/PAG on land option had the highest score in the Physical Stability Account with the Slurry Tailings and Submerged PAG option the second best.
- Based on the results of the MAA, the Slurry Tailings and Submerged PAG is the preferred option.

Failure Modes and Effects Assessment (FMEA)

- Dan Fontaine noted the purpose of the FMEA is to identify the BAP. The FMEA identifies and characterizes risks from accidents, failures of an engineered system, and malfunctions.
- Dan reviewed design elements to manage risk:
    - Inflow Design Flood (IDF) to reduce the likelihood of the facility overtopping in extreme rainfall/run off events.
    - Installation of instrumentation in dams to reduce the likelihood of failure with ongoing monitoring.
    - Designing dams for maximum credible earthquake to reduce the likelihood of loss.
- Dan indicated the initial risk rating for the Slurry Tailings and Submerged PAG Option (Feasibility Study/EA Option) based on design and plan for permitting identified 39 hazards (2 medium risk ratings, 17 low ratings, and 20 very low ratings). Hazards included the initial construction of cofferdams, diversion ditches, sediment control ponds, and operation and closure of TSF dams (for multiple failure modes), the TSF facility, and environmental control dam (downstream seepage collection).
- Taking into account potential measures to mitigate risks, Dan noted the following new design elements and contingencies have been identified:

  **Design Elements**
    - Installation of diversion upstream of the Site D TSF (northern diversion) and upstream of the mine facilities south of the TSF (southern diversion);
    - Relocation of water storage to Site C through operation of the Site D TSF; and

  **Contingency Measures**
    - Establishment of interim overflow structures in the Site D TSF during operations; and
    - Open Pit emergency water storage extension.
- With the implementation of additional design elements and contingency measures, Dan noted the final risk ratings for the 39 identified hazards had been reduced to 9 low ratings and 30 very low ratings.

Conclusions

- Keith reviewed the topics presented at the meeting and noted the following:

  - A comprehensive, structured and transparent approach has been taken to respond to BC EAO March 19, 2015 and CEA Agency requests.
  - The approach considers technologies, locations and practices for tailings management;
  - Davidson Creek valley location demonstrated significant benefits, and identified as best location.
  - PAG tailings and waste rock management, execution challenges and water balance are major factors in comparing tailing storage facility alternatives;
  - Thickened slurry tailings with submerged PAG waste rock is BAT for the Blackwater project.
  - The BAP were identified for Blackwater in the FMEA.
  - Enhanced water management practices (to improve physical stability and operations of the FS/EA option) have been identified and will be implemented.
- Keith noted the next step is to submit the report to the EAO and CEA Agency in November for distribution to the Working Group.

**Questions and Comments (October 8 Meeting)**

- In response to Garth Mullens, Tim Bekhuys confirmed that one of the sensitivity analysis will focus on First Nations (i.e., current use) only.
- Gabi Matscha questioned whether there would be any changes to the EA Application to incorporate the new design elements and contingency measures identified in the presentation. Keith Ferguson noted the water balance in the EA Application captures average conditions. The new design elements would not affect average conditions. With the new design elements, the same water quality results are expected.
- In response to Gabi, Keith confirmed PAG material would be kept saturated
- Gabi noted the Ministry of Environment (MOE) needs to understand the implications of discharging to the receiving environment for the contingency measures. Keith responded that water quality is normally not predicted for contingency measures in environmental assessments. New Gold is interested in discussing this issue with MOE. Gabi noted that it depends on the likelihood of using the contingency measure. Keith responded the likelihood is very low. Gabi commented this analysis would be required for permitting.
- Trefor Smith questioned what kind of cover would be used for the filtered tailings/submerged PAG option. Keith Ferguson responded covers typically include soil with a coarse layer of compacted clay or till layer, and vegetation cover. The cover would likely be 2 – 3 metres in thickness.
- Trefor questioned whether the tailings storage facility is large enough to accommodate a mine expansion. Tim commented that New Gold is exploring other areas but has not found anything that would change the Blackwater Project as currently planned. If an additional deposit is discovered, New Gold would apply for separate approvals for any future mine expansions. This is not subject to the environmental assessment.
- Justin Himmelright referred to the new design element where water would be transferred and stored in Site C during the operation of Site D. He asked if there was a risk of losing water to the west. Dan Fontaine responded the seepage to the west would be mitigated by the hydraulic barrier (higher gradient) to the east, and controlled by the spillway elevation at Site C.
- EAO asked what would be the consequences of contingency water release into the downstream environment.

- **Questions and Comments (October 13)**

  - Kim Bellefontaine asked about the location of tailings discharge for the Paste Tailings option and asked if it could be moved around or whether there could be multiple discharge locations. Dan Fontaine responded that this is not the design basis for the paste option, and that a central discharge point was most practical and appropriate given the long containment dam length. Discharge location could be moved to multiple locations if the tailings were not thickened to paste, and that is what the thickened-slurry option represents.
  - In response to Heather Narynski, Dan responded that the gravimetric solids content (percent solids) in the tailings are 50% for thickened tailings and 65% for paste tailings.
  - Dan confirmed the slope of the filtered tailings stack option would be 3 horizontal to 1 vertical.
  - In response to Kim Bellefontaine, Dan commented that the filtered tailings option would be expected to have the best score purely from a Physical Stability perspective.
  - Rina Freed questioned how beaches are maintained. Dan responded it is done by moving the spigots and keeping the water volume down.
  - Rina asked if, for the paste tailings option, consideration was given to moving the water to a separate location so there is no water against the dam. Dan indicated that water could be decanted and removed from the impoundment, but that water would still need to be stored on site elsewhere in the impoundment or in a reclaim pond similar to the filtered tailings with PAG on-land option due to the site's water balance. This would still require a water retaining dam. This was not selected as the design basis for the paste option.
  - In response to Heather Narynski, Dan indicated that the minimum beach being proposed was 300 metres based on the feasibility study. The feasibility study actually approaches it differently, with a freeboard requirement and 1% beach slope. Beach length can be determined as a function of these two inputs. A freeboard of 3 m at a 1% slope would be 300 m of beach. The freeboard requirement would change throughout operations as the dam is raised, but would always be 4 m or greater, which equates to at least 400 m of beach. Beach length could be discussed further in permitting and could become a quantitative performance objective (QPO). The time of measurement and method of measurement would need to be agreed upon for this to be a QPO.
  - In response to Kim Bellefontaine, Keith noted the pond in Site D would be smaller during closure.
  - In response to Jennifer Karmona, Keith responded that the likelihood and consequences of a tailings dam breach were incorporated into the high level risk assessment for the 12 candidates. In the MAA, it was taken into account for the four candidates by considering pond volume and other physical stability factors.
  - Jennifer questioned whether failure costs of a tailings dam breach were considered. Dan responded that the likelihood and consequence of such a failure were considered in the high level risk assessment for the 12 options that passed screening.
  - Rina Freed asked whether there is a wind tunnel at the site like at the Endako mine site, noting Nadleh Whut'en is concerned about dust generation. Gerry Papini responded that dust generation is the main consideration for air quality and was considered in the MAA.
  - Rina commented that Myra Falls does not have ponded water against the dam. Dan indicated that water could be decanted and removed from the impoundment, but that water would still need to be stored on site elsewhere in the impoundment or in a reclaim pond **similar to the**

filtered tailings with PAG on-land option. This would still require a water retaining dam. This was not selected as the design basis for the paste option.

- With respect to the interim emergency discharge structure contingency measure, Kim questioned if the spillway is being built over the mine life. Dan confirmed the spillway would be built over the mine life and moved periodically, noting it would be approximately a 4 metre deep excavated channel with the capacity to convey the probable maximum flood. It would become the secondary emergency spillway during closure.
- With respect to the open pit emergency storage contingency measure, Kim asked how the water balance would be managed in extended care and maintenance. Dan commented that several scenarios will be considered: temporary shutdown, longer term shutdown care and maintenance, premature closure and long-term closure. This will be discussed in the report. Keith commented that additional ditches and diversion structures could be constructed. With the additional design elements, the water will be maintained at an optimal level.
- EAO noted that at existing mines, the location of ponded surface water in Tailings Storage Facilities moves as points for depositing materials shifts. In this case, can/will appropriate beaches be maintained? New Gold responded that a minimum beach length could be specified in QPO's and in operating plans then would be maintained. Time and method of measurement would need to be agreed upon.
- For comparison, can a revised figure of the overall MAA results be provided that does not include the Project Economics account. New Gold responded that a sensitivity analysis excluding the Project Economics account will be included in the report.
- Rina questioned whether the Excel spread sheet (digital file) will be provided to the Working Group. Detailed MAA tables will be provided in Appendix of TAA. New Gold suggested first that the TAA report be circulated as planned to the Working Group, and offered to meet with the Working Group following circulation and review of the report. Should there remain additional questions and a desire to review the Excel spread sheets after that time, New Gold would then provide the spreadsheets.
- In response to EAO, New Gold indicated the report will include a description of water management during temporary closure.
- In response to EAO, New Gold committed to include a concordance table that outlines how the requirements of the EAO March 19, 2015 letter are addressed in the report. EAO committed to providing NG with a guidance document to assist NG address their March 19 letter. Subsequent to the meeting, this document was provided to NG.
- Kim Bellefontaine commented on the proposed BAPs, stating that the proposed refinements are consistent with the recommendations of the Panel Report. A detailed review of the report is necessary to confirm.

# *Appendix C*

*Aboriginal Consultation and Engagement Memo*

**New Gold Inc.**

# BLACKWATER GOLD PROJECT

# Consultation with Aboriginal Groups on the Evaluation of Alternative Tailings Technologies for the Blackwater Project

**December 2015**

Project #0289076-0009

Citation:
ERM. 2015. *Blackwater Gold Project: Consultation with Aboriginal Groups on the Evaluation of Alternative Tailings Technologies for the Blackwater Project* Prepared for New Gold Inc. by ERM Consultants Canada Ltd.: Vancouver, British Columbia.

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BLACKWATER GOLD PROJECT

# Consultation with Aboriginal Groups on the Evaluation of Alternative Tailings Technologies for the Blackwater Project

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# GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

| | |
|---|---|
| **Application** | Application for an Environmental Assessment Certificate |
| **BAP** | Best Available Practice |
| **BAT** | Best Available Technology |
| **BC** | British Columbia |
| **FLNRO** | Ministry of Forests, Lands and Natural Resource Operations |
| **MEM** | Ministry of Energy and Mines |
| **MOE** | Ministry of Environment |
| **CEA Agency** | Canadian Environmental Assessment Agency |
| **CEAA 2012** | *Canadian Environmental Assessment Act, 2012* |
| **CSTC** | Carrier Sekani Tribal Council |
| **EAO** | Environmental Assessment Office |
| **LDN** | Lhoosk'uz Dene Nation |
| **TLOUS** | Traditional Land Occupancy and Use Study |
| **MAA** | Multiple Accounts Analysis |
| **New Gold** | New Gold Inc. |
| **NWFN** | Nadleh Whut'en First Nation |
| **PAG** | Potentially Acid Generating |
| **The Project** | The Blackwater Gold Project |
| **SFN** | Saik'uz First Nation |
| **StFN** | Stellat'en First Nation |
| **TSF** | Tailing Storage Facility |
| **UBC** | University of British Columbia |
| **UFN** | Ulkatcho First Nation |

# 1. INTRODUCTION

This report is an appendix to New Gold's evaluation of alternative tailings technologies to determine Best Available Technology (BAT) specific to the Blackwater Gold Project (the Project) and to identify Best Available Practices (BAP) to reduce residual risk.

New Gold's evaluation of alternative tailings technologies is a result of the March 19, 2015 written request to New Gold from the British Columbia (BC) Environmental Assessment Office (EAO) to appropriately consider the recommendations of the "Report on Mount Polley Tailings Storage Facility Breach" by the Independent Expert Engineering Investigation and Review Panel (the Panel Report; IEEIRP 2015). As indicated in the March 19th EAO letter, factors to be considered in the evaluation included safety, technical and financial aspects, and implications for environmental, health, social, heritage and economic values. The March 19th letter indicates the evaluation may be of interest to Aboriginal groups potentially affected by the proposed Project and encourages New Gold to include any information in its assessment regarding potential implications of the options for Aboriginal interests (asserted or established Aboriginal rights, including title and treaty rights).

New Gold's evaluation also considers the June 3, 2015 written request from the Canadian Environmental Assessment Agency (CEA Agency) that environmental effects, as defined in section 5 of the *Canadian Environmental Assessment Act*, 2012 (CEAA 2012), be included as factors to be considered in the assessment of the preferred tailings storage facility (TSF) option.

Subsequent to the issuance of the March 19th letter, the EAO recommended to New Gold that it consult the environmental assessment (EA) Working Group, established to participate in the EA process for the Project, about the proposed methodology and findings of the evaluation. The Aboriginal groups who are members of the Working Group are identified in footnote 1.

This report provides a summary of New Gold's consultations with Aboriginal groups[1] related to evaluation of alternative tailings technologies to determine BAT specific to the Project and to identify BAP to reduce residual risk.

## 1.1 BACKGROUND

Following the receipt of the March 19, 2015 letter, New Gold provided the EAO and CEA Agency with an overview of its proposed approach for undertaking the tailings alternative assessment. This discussion was followed by teleconferences organized by the EAO on June 11th and 12th. New Gold participated on both teleconferences. The Ministry of Environment (MOE) and Canadian Environmental Assessment (CEA) Agency participated on the June 11th call and the Ministry of Energy and Mines (MEM), EAO, and CEA Agency participated on the June 12th call. The purpose of

[1] Schedule B of the Section 11 Order (July 13, 2013) issued by the EAO identifies the Aboriginal groups to be consulted during the environmental assessment (EA) of the Project. These groups include: Lhoosk'uz Dene Nation (LDN), Ulkatcho First Nation (UFN), Nadleh Whut'en First Nation (NWFN), Saik'uz First Nation (SFN), and Stellat'en First Nation (StFN). These Aboriginal groups are members of the EA Working Group based on the Section 11 Order. The Section 11 Order also provides direction to New Gold for consulting with Aboriginal groups, the public and government agencies during the pre-Application and Application review stages of the EA process.

the calls was to discuss New Gold's proposed methodology for undertaking the evaluation. MEM recommended that TSF sites outside of the Davidson Creek watershed [in addition to the sites considered in New Gold's report of potential TSF sites in the event a Metal Mining Effluent Regulations (SOR/2002-222) Schedule 2 amendment is required] be considered. Agencies also requested that New Gold's reasons for excluding a particular option due to risks or criteria be clearly explained in New Gold's Tailings Alternatives Assessment (TAA) report. New Gold incorporated this input into its approach and reporting, which was further refined through subsequent consultation activities.

# 2. SUMMARY OF CONSULTATIONS WITH ABORIGINAL GROUPS

The EAO organized teleconferences and meetings with members of the EAO Working Group, including the Aboriginal groups listed on Schedule B who are members of the Working Group, to discuss the TSF evaluation. New Gold also held individual meetings with Aboriginal groups to discuss the assessment. Provided below is a summary of consultations and comments provided during these consultations.

**June 18, 2015** – New Gold held a community meeting with UFN at Anahim Lake, with approximately 30 people attending. New Gold provided a Project update, informed the community about the 2015 mineral exploration program, and provided an overview of the Blackwater Training and Employment Strategy. New Gold also presented an overview of sites (i.e., TSF sites A through E) that were considered as part of the tailings assessment. New Gold explained that the criteria considered in siting the TSF included:

- Avoidance of ungulate winter range;
- Avoidance of the Blackwater River watershed; and
- Minimizing the TSF footprint.

The UFN comments focused on employment opportunities, communications related to the Project, and potential benefits for the Ulkatcho.

**June 29, 2015** – New Gold met with SFN in Stony Creek to discuss the SFN Traditional Land Use and Occupancy Study (TLUOS; Thomas, 2015), and recommendations in the study relating to the proposed transmission line and access road. During the meeting, New Gold offered to fund a presentation by the University of British Columbia (UBC) on tailings and tailings management and suggested SFN, StFN and NWFN attend. New Gold also offered to present at the next SFN-organized industry update meeting; the SFN industry-update presentation occurred on October 13, 2015, and is discussed below.

**July 8, 2015** – New Gold attended a NWFN community meeting in Nadleh Whut'en with approximately 15 people attending. New Gold provided a Project update and launched the employment and skills survey. New Gold also discussed the requirements from the EAO to review

the BAP and BAT for the project, and reviewed their proposed approach to the evaluation of alternative tailings technologies. Comments from NWFN attendees focused on how NWFN could benefit from the Project.

**July 2, 2015 –** New Gold distributed a memorandum to EAO Working Group members to provide an overview of New Gold's proposed approach to the evaluation of alternative tailings technologies. The memorandum described the screening criteria for assessing the 'fatal flaws' of the candidate alternatives, plans for government and Aboriginal consultation, and included figures and tables illustrating the approach and risk assessment descriptions. This memo outlined the questions being considered in siting the TSF:

- Will the alternative result in deposition of tailings to a fish-bearing lake?
- Will the alternative be location in the Blackwater River watershed?
- Will the alternative be located in ungulate winter range?
- Will the alternative encroach on provincially or federally designation lands and/or private lands?
- Will the alternative have sufficient capacity to store tailings produced over mine life?
- Will the alternative make prevention of surface discharges without treatment impractical or improbable?
- Will the alternative sterilize mineral resources?
- Will the alternative make the project uneconomic?

**July 20, 2015 –** New Gold participated on a teleconference organized by the EAO with NWFN, StFN, SFN, the Carrier Sekani Tribal Council (CSTC), CEA Agency and MEM. The purpose of the teleconference was to review and seek comments on New Gold's proposed methodology described in the July 2, 2015 memorandum, referred to above. New Gold also reviewed the environmental and social design criteria for siting the TSF (see bulleted questions referenced under July 2, 2015 heading). Based on the comments provided at the meeting, New Gold committed to including an assessment of the potential effects to Aboriginal rights and interests. New Gold also committed to revising the memorandum to address comments provided at the meeting, including clarifying how the high level and detailed risk assessments would be incorporated into the evaluation.

**July 24, 2015** - Following the July 20th teleconference and in response to comments provided at this meeting, New Gold revised the memorandum, (dated July 24, 2015, and included in Appendix B). Revisions to the memorandum included the approach to assess potential effects on Aboriginal rights and interests in the Multiple Accounts Analysis (MAA), specifically, that potential effects on Aboriginal rights and interests would be assessed and informed by the conclusion reached for relevant health, social, heritage and environmental evaluation criteria including current use of lands and resources for traditional purposes, heritage, water quality, fish and fish habitat, wildlife and wildlife habitat and vegetation. The memo also outlined the high level and detailed risk assessments included in the evaluation (e.g., Failure Modes Effects Analysis).

**August 13, 2015 –** New Gold participated on an EAO organized teleconference which invited all EA Working Group members to participate. The following Working Group members, representing Schedule B Aboriginal groups and government agencies, participated on the call: LDN, NWFN, MEM, EAO, BC Ministry of Forests, Land and Natural Resource Operations (FLNRO), BC Ministry of Jobs, Tourism, Skills and Trade, Environment Canada, Natural Resources Canada, the Regional District of Bulkley Nechako and the District of Fort St. James. During the call, New Gold confirmed that current use of land and resources for traditional purposes was one of the criteria considered in the MAA. At the meeting, New Gold noted that potential effects on the subsistence economy would be considered in the assessment of potential effects on Aboriginal rights and interests, and indirectly in the environment consequence ratings, as well as in the human environment account in the MAA. Based on comments provided at the meeting, New Gold decided the ultra-thickened/paste tailings option (Candidate 10) would be carried into the MAA.

**September 14, 2015 –** New Gold organized a helicopter tour of the Blackwater Project site for NWFN and StFN members. The tour included a flyover of the proposed transmission line route, the TSF, proposed open pit and camp. During the tour, New Gold explained its approach to evaluating alternative tailings technologies and responded to questions related to the construction of the TSF and dam requirements. Based on NWFN comments related to tailings and fisheries during the tour, New Gold offered to meet subsequently to discuss the tailings alternatives assessment as well as the locations of fish and fish habitat relative to project components. Following the flyover, New Gold followed up on their offer to meet with NWFN to discuss their interests, and subsequently provided a fish habitat distribution map to the NWFN.

**October 8 and 13, 2015 –** New Gold participated in EAO organized meetings/teleconferences which invited all EA Working Group members, including Schedule B Aboriginal groups, to participate. Two meetings were held in an effort to accommodate all interested EA Working Group members. The October 8th participants included LDN, NWFN, SFN, MOE, FLNRO, MEM, CEA Agency, Natural Resources Canada, Health Canada, Environment Canada, and the District of Vanderhoof. The October 13th participants included NWFN, MEM, FLNRO, CEA Agency, Ministry of Aboriginal Relations and Reconciliation, and District of Vanderhoof. New Gold presented the results of the pre-screening assessment, MAA and Failure Modes and Effects Assessment (FMEA), and reviewed new design elements and contingencies that had been identified based on the evaluation.

In response to questions from Aboriginal group representatives during these meetings, New Gold made the following comments:

- Confirmed that one of the sensitivity analysis will focus exclusively on Aboriginal interests (as represented by 'current Aboriginal use') with the MAA other accounts weighted zero;
- Explained the TSF beach would be maintained by moving the spigots to keep the water pond area away from the dam;
- Noted that dust generation is the main consideration for air quality and was considered in the MAA (in response to NWFN representative comment related to the wind tunnel created by the Endako mine);

- Noted that the seepage out of the TSF to the west would be mitigated by the hydraulic barrier (hydraulic gradient pushing water from west to east), and controlled by the spillway elevation at Site C; and
- In response to a question as to whether consideration was given to moving the water to a separate location so there is no water against the dam for the paste tailings option, New Gold indicated that water could be decanted and removed from the TSF impoundment but that water would still need to be stored on site elsewhere in the impoundment or in a reclaim pond similar to the filtered tailings with the PAG (potentially acid generating) on-land option due to the site's water balance. This would still require a water retaining dam, and was not selected as the design basis for the paste option. New Gold further explained that maintenance of saturated conditions within the TSF is desirable due to the geochemical nature of the site's tailings and waste rock.

New Gold noted that the results of the MAA indicate that the slurry tailings and submerged PAG option in upper Davidson Creek is the BAT for the Project.

**October 13, 2015 –** New Gold made a presentation at a SFN-organized industry update meeting, attended by 13 SFN members. The presentation provided a Project overview, described the approach to the tailings evaluation, indicated how SFN traditional knowledge had been incorporated into the environmental assessment, and identified potential employment and training opportunities. Questions from participants focused on employment opportunities.

**October 19, 2015 –** New Gold sponsored a community meeting in Anahim Lake with LDN leadership and UBC on tailings management and the evaluation of alternative tailings technologies for the Project. New Gold did not attend the meeting.

**October 21, 2015 –** New Gold participated in the external portion of the LDN Annual General Meeting to update the community on the Blackwater Project, including an overview of the tailings assessment, employment strategy and country foods monitoring program. The meeting was held in Klukus village, and approximately 14 community members attended. New Gold reviewed the approach to the tailings evaluation and changes to the approach that had been made based on consultations with government agencies and Aboriginal groups. New Gold confirmed that based on the results of the MAA, the slurry tailings and submerged PAG option in upper Davidson Creek is the BAT for the Project. New Gold explained that one of the sensitivity analyses will focus exclusively on Aboriginal interests (as represented by 'current Aboriginal use') with the other MAA accounts weighted zero. At this meeting, New Gold indicated that it is supporting UBC's involvement in providing information about tailings and mine waste to the LDN and UFN communities, and that the scope of the work is directed by the Aboriginal groups and not New Gold. Questions rose at the meeting related to water quality, size of the mine design, tailings safety and, training and employment.

**October 29, 2015 –** New Gold hosted a tour of the New Afton Mine for UFN members, following a request by the community leadership as part of ongoing education about tailings management for Chief and Council. This tour provided an opportunity to view an operational TSF. A question was asked about the toxicity of tailings pond water to animals.

In addition to these activities, New Gold is coordinating a community meeting in Vanderhoof with SFN, NWFN, StFN and UBC focusing on tailings management. The date of the meeting is not yet confirmed but the parties are aiming to meet in January or February 2016. This meeting is part of New Gold ongoing support for UBC to act as a resource to the Aboriginal communities related to improving understanding of tailings and mine waste.

# 3. CONCLUSION

Based on this report, Aboriginal groups have been provided with opportunities to review and comment on the proposed approach to the tailings alternatives assessment and conclusions related to this assessment. Aboriginal groups will have further opportunities to review and comment on New Gold's final report during the review of New Gold's Application for an Environmental Assessment Certificate / Environmental Impact Statement (2015).

# REFERENCES

*Canadian Environmental Assessment Act*, 2012. S.C. 2012, c. 19, s. 52

Independent Expert Engineering Investigation and Review Panel. 2015. *Report on Mount Polley Tailings Storage Facility Breach*. Victoria, BC.

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# *Appendix D*

*Alternative Technology Options Study*

**NEW GOLD INC.**
**BLACKWATER GOLD PROJECT**





# ALTERNATIVE TECHNOLOGY OPTIONS STUDY

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VA101-457/15-1
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# NEW GOLD INC.
# BLACKWATER GOLD PROJECT

## ALTERNATIVE TECHNOLOGY OPTIONS STUDY
## VA101-457/15-1

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|---|---|---|
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## EXECUTIVE SUMMARY

The alternatives study was developed to evaluate additional mine tailings and waste rock storage concepts for the Blackwater Gold Project, in response to requests from the British Columbia Environmental Assessment Office (BCEAO) and the Canadian Environmental Assessment Agency (CEAA). This report was prepared to support the assessment of alternatives to document a clear and transparent evaluation of the factors that supported the selection of the most suitable, site specific alternative for tailings management for the project (the Best Available Technology). The overall assessment includes a consideration of safety, technical and financial aspects, and implications for environment, health, social, heritage and economic values. This report was prepared as a companion report to provide technical input to the overall Tailings Alternatives Assessment Report prepared by ERM.

Three tailings storage technologies were considered in the study: thickened slurry tailings, ultra-thickened (paste) tailings, and filtered tailings. The assessment includes these three tailings technologies and an evaluation of alternative site locations while considering water balance implications. The alternatives assessment contemplates saturated storage of PAG and NAG3 waste rock to achieve chemical stability. Saturated storage of waste rock requires the construction a submergence facility using water retaining dams regardless of tailings disposal technology. The study also includes options for comparison that consider subaerial, unsaturated storage of these waste rock types in mine waste piles not requiring mining dams. Storage in this latter manner will not prevent the onset of acidic drainage conditions, but rather will rely on collection and treatment to manage the environmental risks associated with these options.

Concepts for management of mine waste were developed based on topographical maps of the project area, utilizing the alternative tailings storage technologies. The candidate sites are interspersed within an area of approximately 35 km by 30 km, and were roughly bounded by the Blackwater River to the south, the Nechako Reservoir to the north, Tatelkuz Lake to the east, and Entiako Provincial Park to the west. The tailings technology applied at each candidate site was chosen based on site specific constraints and professional judgement. Some candidate sites considered multiple tailings technologies, if appropriate, and others only considered a single technology. A total of twenty-three (23) candidates were developed.

A set of criteria was developed based on environmental site constraints to evaluate the group of candidates. The process of evaluating the candidates at this level was referred to as preliminary screening (pre-screening). The goal of pre-screening was to remove those candidates with obvious deficiencies. Ten (10) candidates were removed in the pre-screening process and thirteen (13) candidates were carried forward into a high level risk assessment.

The purpose of the high level risk assessment was to compare the relative risks of development for similar candidates and select the best candidates for a more detailed multiple accounts analysis. Candidates were grouped by tailings technology to prevent risk assessment bias from removing all candidates of a single technology. The hazards applying to each candidate were based in specific engineering and environmental issues which will pose the greatest risks to development. Each candidate was evaluated against reasonably similar hazards to create a meaningful comparison of relative risk. The hazards were arranged in three categories: safety, environment, and technical

execution. Four candidates (4) were selected from the high level risk assessment and carried forward a multiple accounts analysis.

A summary of the technical information related to each of the four candidates considered in the multiple accounts analysis was provided. The information includes a general description of the mine development concept, indicators of physical stability, and technical aspects including containment design, construction requirements, water management, operational execution, and closure.

The results of the multiple accounts analysis and conclusions of the overall tailings alternatives assessment are included in the Tailings Alternatives Assessment Report prepared by ERM.

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Appendix E Multiple Accounts Analysis - Starter and Ultimate Configurations

## ABBREVIATIONS

ABA ..... Acid Base Accounting
AR ..... Aqua Regia
ARD ..... Acid Rock Drainage
BAT ..... Best Available Technology
BC EAO ..... British Columbia Environmental Assessment Office
CEAA ..... Canadian Environmental Assessment Agency
CDA ..... Canadian Dam Association
EA ..... Environmental Assessment
ECD ..... Environmental Control Dam
EDGM ..... Earthquake Design Ground Motion
EIS ..... Environmental Impact Statement
FS ..... Feasibility Study
FSR ..... Forest Service Road
HLRA ..... High Level Risk Assessment
ICP ..... Inductivity Coupled Plasma
IDF ..... Inflow Design Flood
KP ..... Knight Piésold Ltd.
LGO ..... Low-Grade Ore
MAA ..... Multiple Accounts Analysis
MAP ..... Mean Annual Precipitation
MCE ..... Maximum Credible Earthquake
MEM ..... Ministry of Energy and Mines
ML ..... Metal Leaching
MSC ..... Meteorological Services Canada
NAG ..... Non Acid Generating
New Gold ..... New Gold Inc.
NPR ..... Neutralization Potential Ratio
PAG ..... Potentially Acid Generating
PEA ..... Preliminary Economic Assessment
PET ..... Potential Evapotranspiration
PGA ..... Peak Ground Acceleration
PMF ..... Probable Maximum Flood
PMP ..... Probable Maximum Precipitation
PSA ..... Particle Size Assessment
Richfield ..... Richfield Ventures Ltd.
the Panel ..... Mt. Polley Independent Investigation and Review Panel
the Project ..... Blackwater Gold Project
TPD ..... Tonnes per Day
TSF ..... Tailings Storage Facility
UCSC ..... Unified Soil Classification System
UWR ..... Ungulate Winter Range
WOL ..... Whole Ore Leach

# 1 – INTRODUCTION

## 1.1 PROJECT DESCRIPTION

The Blackwater Gold Project (the Project) is a large gold-silver deposit located approximately 112 km southwest of Vanderhoof in central British Columbia, as shown on Figure 1.1. The project involves a conventional truck-shovel open pit mine and 60,000 tonnes per day (TPD) gold processing plant. Access to low cost hydroelectric power is available at the Glennanan BC Hydro Sub-station and will require the construction of a 139.5 km transmission line. Road access will be over an upgraded existing forest service road that branches south from Highway 16 at Engen.

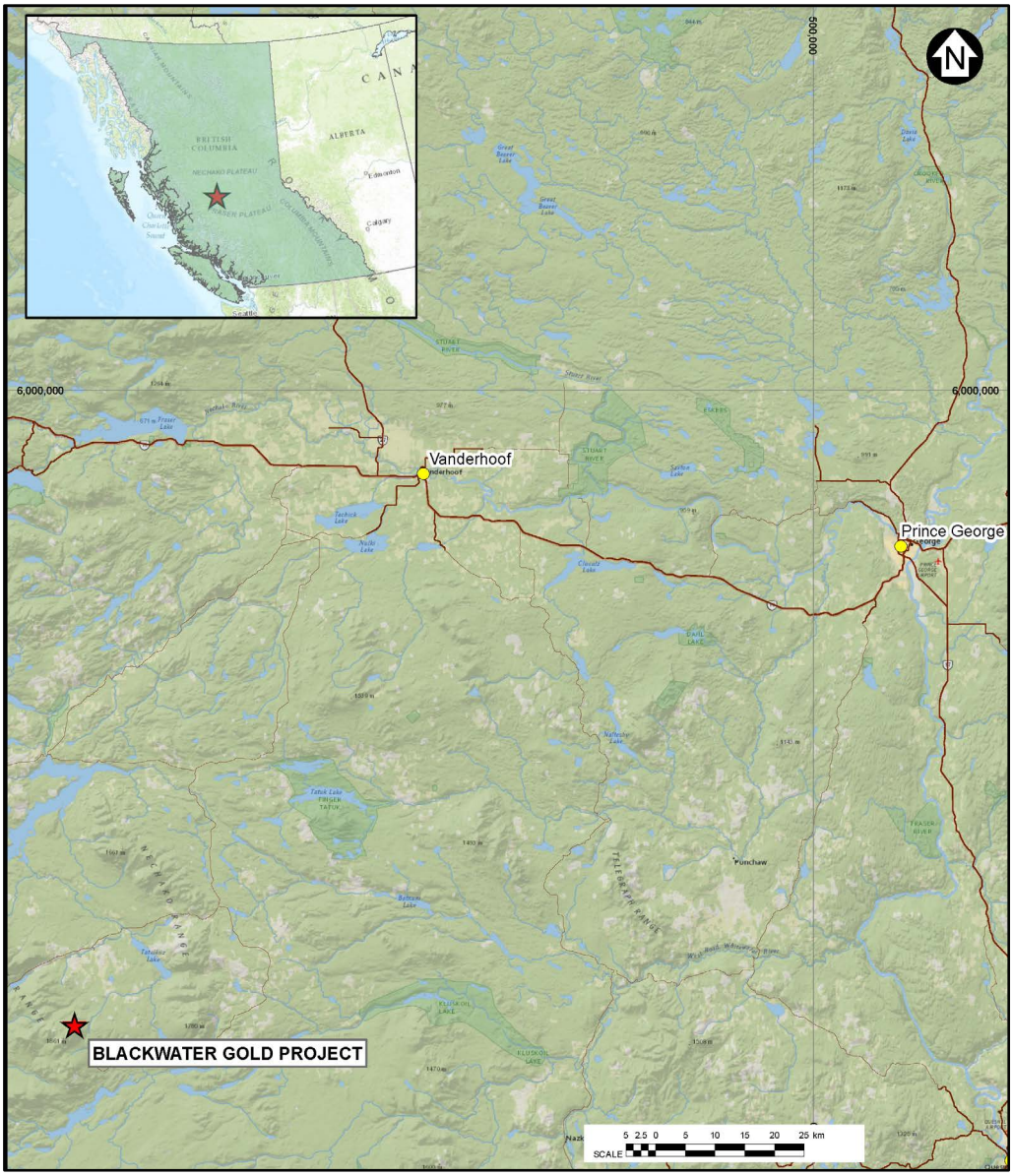



**Figure 1.1 Project Location**

## 1.2 PROJECT HISTORY

The Blackwater project area was actively explored by Richfield Ventures Corp. (Richfield) starting in 2009. New Gold obtained the Blackwater property through the acquisition of Richfield in June 2011. Knight Piésold (KP) was retained in early 2011 to complete a preliminary mine development assessment desktop study for the project. This was followed by a series of alternatives assessments for various mine development concepts for the waste and water management for the project from the middle of 2011 through early 2012. A Preliminary Economic Assessment (PEA) of the project was completed in the third quarter of 2012 with a Feasibility Study (FS) following in the fourth quarter of 2013.

KP established a hydrometric and climate monitoring network at the project site in 2011, and has monitored and expanded the network continuously since its inception.

KP was commissioned in 2012 and 2013 to complete a series of six geotechnical and hydrogeological site investigation programs to support engineering studies for the tailings and water management systems, open pit, and associated mine site infrastructure proposed in the FS project arrangement. No pre-existing geotechnical or hydrogeological information was available for the project site prior to 2012.

## 1.3 SCOPE OF WORK

The alternatives study was developed to evaluate additional mine tailings and waste rock storage concepts for the Blackwater Gold Project, in response to a request from the British Columbia Environmental Assessment Office (BCEAO) dated March 19, 2015. The BCEAO required that proponents consider the implications of the recommendations of the Mt. Polley Independent Expert Engineering Investigation and Review Panel (the Panel). The study also addresses the federal requirements related to the Panel Report (IEEIRP, 2015) as indicated in the request by the Canadian Environmental Assessment Agency (CEAA) dated June 3, 2015. These two requests are included in Appendix A for reference.

The objective of the study was to prepare this assessment of alternatives with a clear and transparent evaluation of the factors that supported the selection of the most suitable, site specific alternative for tailings management for the project (the Best Available Technology). The assessment includes a consideration of safety, technical and financial aspects, and implications for environment, health, social, heritage and economic values. This report was prepared as a companion report to provide technical input to the overall Tailings Alternatives Assessment Report (ERM, 2015a).

Three tailings storage technologies were considered in the study: thickened slurry tailings, ultra-thickened (paste) tailings, and filtered tailings. The assessment includes these three tailings technologies and an evaluation of alternative site locations while considering water balance implications.

## 1.4 PREVIOUS SITE SELECTION STUDIES

A preliminary assessment of tailings storage facility (TSF) site alternatives was conducted by KP for the Blackwater Gold Project in January 2011 (Knight Piésold Ltd., 2011a). Five potential locations for storage of 300 $Mm^3$ of tailings plus potentially acid generating (PAG) waste rock were identified

within 10 km of the deposit area. The alternatives assessment considered economic, operational, and environmental factors and concluded that Sites C and D were the best options due to:

- Relatively high storage efficiency and low embankment volumes.
- Close proximity to the mineral deposit area.
- Ability to collect all mine site drainage.
- Location within the headwaters of Davidson Creek with minimal external upslope catchment area, simplifying operational water management.
- Location outside the Ungulate winter range and Blackwater River catchment, two key environmental considerations.

The alternatives assessment for waste and water management for the project continued in 2011 with a comparison between TSF Site C and Site D (Knight Piésold Ltd., 2011b). The study considered a Base Case mine plan that contemplated a 15 year mine life that produced approximately 220 Mt of ore at a mill throughput of 40,000 TPD and 702 Mt of waste materials, which included 192 Mt of NAG waste and 510 Mt of PAG waste. An Expansion Case mine plan was evaluated that considered a 21 year mine life that produced 308 Mt of ore at a mill throughput of 40,000 TPD and 985 Mt of waste materials, which included an estimate of 271 Mt of NAG waste and 714 Mt of PAG waste. The results of the comparative economic analysis indicated that the preferred TSF, from an economic perspective, was TSF Site C. TSF Site C was marginally better than TSF Site D for both the base case and expanded case, particularly due to the lower initial capital cost for development.

KP further evaluated locations and methods for mine waste management for the project in 2011 and 2012 (Knight Piésold Ltd., 2012a). The conceptual plans assumed that tailings will be deposited around the perimeter of the TSF from the embankment crests. The NAG waste was to be disposed of in a waste dump near the pit and/or used to construct the TSF embankment. The PAG waste rock was to be managed using one of two methods:

- Co-disposal within the TSF in such a manner that it becomes progressively saturated by the supernatant pond to prevent oxidation and subsequent acid generation.
- Storage in an engineered surface stockpile with a compacted soil liner foundation and cover system.

A total of four mine development concepts were considered in the alternatives assessment. The study considered a Base Case mine plan that contemplated a 10 year mine life that produced approximately 210 Mt of ore at a mill throughput of 60,000 TPD and 501 Mt of waste materials, which included 142 Mt of NAG waste and 359 Mt of PAG waste. An Expansion Case mine plan was evaluated that considered a 15 year mine life that produced 320 Mt of ore at a mill throughput of 60,000 TPD and 867 Mt of waste materials, which included an estimate of 200 Mt of NAG waste and 667 Mt of PAG waste.

The concept of a hybrid Site C and Site D TSF was first evaluated in this alternatives assessment. The hybrid TSF C/D option with subaqueous PAG disposal was compared with TSF Site C and on-land disposal of PAG for the Base Case, and with TSF Site D and on-land disposal of PAG for the Expansion Case. The results of this alternatives assessment indicated that the preferred mine development concept for future studies should be based on the subaqueous disposal of PAG waste rock in the TSF. Subaqueous disposal was selected as the preferred method of waste rock disposal due to reduced environmental risk, reduced engineering complexity, reduced corporate liability, and lower overall costs.

The design of the hybrid TSF Site C and Site D mine development concept with subaqueous disposal of PAG waste and on-land disposal of NAG waste continued during the Preliminary Economic Assessment (PEA). The TSF design for the PEA considered a 17 year mine life that produced approximately 356 Mt of ore at a mill throughput of 60,000 TPD. Development of the Open Pit produced 839 Mt of waste materials, which included 321 Mt of NAG waste and 518 Mt of PAG waste.

The PEA contemplated five types of open pit waste materials: overburden and four types of waste rock. Overburden and NAG4 waste rock were considered to be NAG and low metal leaching and used preferentially in dam construction or disposed of in an on-land dump. NAG3 waste rock exhibits greater metal leaching potential because of elevated zinc and cadmium content despite being considered NAG. This material was planned for use in the Site C Main Dam or the upstream shell zone of the Site D Main Dam as a construction material below the final TSF Site D pond elevation, or placed in an on-land waste dump adjacent to the open pit with a low permeability overburden dump foundation platform and drainage directed towards the open pit. PAG1 and PAG2 waste rock were considered to be PAG waste with subaqueous disposal in the TSF.

The Feasibility Study (FS) considered a similar waste disposal concept to the PEA with two major exceptions – NAG3 potentially metal leaching waste rock will be disposed of in a saturated state in the TSF or used in construction of the upstream zone of TSF Site D Main Dam in order to reduce the potential for metal leaching. The FS also introduced the classification of NAG5 waste rock. Additional geochemistry testing programs and waste classification studies have identified a waste rock that has a low zinc concentration as this material is the most benign and best available waste rock material for construction of the downstream shell zones of the TSF embankments.

A Multiple Accounts Analysis (MAA) was prepared during the Environmental Assessment (EA) to assess tailings disposal and management alternatives. The initial screening within a basic economic radius of 10 km of the mineral deposit included threshold criteria to exclude sites in the area that were not feasible due to basic topographic, accessibility/cost, and technology limitations. Eight potential sites remained that were further reduced to five alternatives based on a fatal flaw analysis. The FS option resulted in the highest value for all multiple accounts and sensitivity analyses, and the MAA concluded that this option should be adopted for the project (ERM, 2014).

## 1.5 REFERENCE REPORTS

Information available in the following KP subject matter report was used to prepare this study:

- TSF Design Report – KP report, Mine Waste and Water Management Design Report, Ref. No. VA101-457/6-11 Rev. 2 dated September 12, 2014.

# 2 – MINE WASTE MANAGEMENT

## 2.1 MINE WASTE CHARACTERIZATION

### 2.1.1 Description of Acid Rock Drainage and Metal Leaching Processes

Metal leaching (ML) and the generation of Acid Rock Drainage (ARD) are natural occurring processes that can be accelerated by mining. The following excerpt summarizes the ARD generation process (MEND Manual Volume 6 – Monitoring, MEND 5.4.2f):

> *"Base metal, precious metal, uranium, diamond and coal mines often contain sulphide minerals, in the mined ore and the surrounding rock. When these sulphide minerals, particularly pyrite and pyrrhotite, are exposed to oxygen and water, they oxidize, and the drainage may become acidic unless sufficient acid-neutralizing minerals such as calcite are present.*
>
> *The acidic water may contain elevated concentrations of metals and salts. These can include typical major rock constituents (calcium, magnesium, potassium, sodium, aluminum, iron and manganese) as well as trace heavy elements such as zinc, copper, cadmium, lead, cobalt, nickel, arsenic, antimony and selenium. Rainfall and snow-melt flush leachate from the waste sites. If acidic drainage is left uncollected and untreated, the drainage can contaminate local water-courses and groundwater, affecting plants, wildlife, and fish.*
>
> *Naturally occurring alkalinity, such as carbonate minerals and carbonate ions in solution may partially or completely neutralize acidity in situ. The resulting leachate is non-acidic with very low iron concentrations but may contain elevated concentrations of sulphate, calcium and magnesium.*
>
> *Neutralization by reactions with acid consuming minerals (carbonate minerals in particular) may result in low concentrations of dissolved metals due to the low solubility of metal carbonates, basic carbonates, hydroxides and oxyhydroxides at pH 6 to 7.*
>
> *The lag time for acid drainage to appear (if at all) is controlled by the concentration and reactivity of the iron sulphides, and the availability of carbonate minerals. Acid may be generated and released by high sulphur wastes having small amounts of carbonate minerals a few days after exposure. Low sulphur (< 2%) wastes with some carbonate may not release acid for years or decades.*
>
> *Once acidic oxidation of iron sulphide minerals is initiated the rate tends to increase until a peak is reached. The general trend is for a long-term decrease in acidity release. As the readily available mineral-grains are consumed, the reactive surface shrinks and oxidation product coatings limit reactivity."*

Metal leaching occurs irrespective of whether net acidity is generated; elevated metals may be present in neutral pH drainage. The solubility of aluminum, iron and copper is greatly reduced in neutral pH drainage, but elements such as antimony, arsenic, cadmium, molybdenum, selenium and zinc remain relatively soluble and can occur in significantly high concentrations (Price and Errington, 1998).

### 2.1.2 Blackwater Mine Waste Geochemical Studies

Mine waste geochemical characterization studies for the Blackwater Project were completed to a FS/EA level and included ore, low grade ore, tailings, overburden and mine waste rock assessments. Classification of mine waste at the Project was based on the results from ML/ARD test programs, BC government and international guidance, and best mining industry practice (BC MEM 1998, INAP 2009, MEND 2009, Price 1997). The mine waste classification studies were completed by others (AMEC, 2013a). The findings are summarized below.

The following features of the geology at the Blackwater Project are relevant to the ML/ARD characterization

- The main rock types are felsic to intermediate volcanic and volcaniclastic rocks.
- The deposit host rocks have been intensely hydrofractured and silicified. This intensive silicification has generally overprinted lithological units.
- Pyrite, pyrrhotite, and sphalerite are the most common metal sulphide minerals.
- Calcite is a diagnostic feature of unmineralized andesite peripheral to the deposit.

The ML/ARD geochemical program was conducted in three phases and included both static and kinetic testing. A dedicated 14-hole drilling program was completed in 2012 to obtain additional waste rock samples for acid base accounting (ABA) and metal analyses, and were peripheral to the south and west walls of the open pit. Tailings were obtained from the metallurgical testing program. Overburden samples were collected from a sonic drilling program and surface test pits in the open pit and tailings storage facility (TSF) areas, and from surface grabs along the access road alignment in 2013. Tailings samples from metallurgical tests were tested as part of the ML/ARD characterization. In total, over 900 waste rock, ore, overburden, and tailings samples were collected and analyzed for ML/ARD parameters.

Sulphur and metal assays (inductively coupled plasma (ICP) assay following aqua regia (AR) digestion) were also completed as part of the exploration geological program on every meter of exploration drill core. This database provides extensive coverage of the project applicable to the ML/ARD assessment and includes over 250,000 sulphur and zinc assays.

Mine waste is classified based on whether it is predicted to be potentially acid generating (PAG) or non-acid generating (NAG) as shown by the calculated Neutralization Potential Ratio (NPR). NAG waste rock was further classified as to its metal leaching potential based on zinc concentration as that metal (and cadmium) is elevated in some of the mine waste. Classification criteria are as follows:

- Ore and Tailings (PAG).
- Low-Grade Ore (PAG).
- Overburden (NAG).
- Waste Rock:
  - PAG1 – NPR ≤ 1.0 (PAG).
  - PAG2 – 1.0 < NPR ≤ 2.0 (PAG).
  - NAG3 – NPR > 2.0 and Zn ≥ 1000 ppm (NAG).
  - NAG4 – NPR > 2.0 and 600 ≤ Zn <1000 ppm (NAG).
  - NAG5 – NPR > 2.0 and Zn < 600 ppm (NAG).

#### 2.1.2.1 Ore

The sulphide and transitional ore types are classified as PAG. Oxide ore contains very low sulphur; significantly less than transitional and sulphide ore types, and most of the sulphur is expected to be non-acid generating sulphate sulphur. Zinc, cadmium and arsenic are also lower in the oxide ore compared to transitional and sulphide ore types. Lead is higher in oxide ore but has low mobility at the neutral pH expected in the TSF. Oxide ore tailings could be placed as the final lift over transitional and sulphide ore tailings in the TSF to reduce the potential for ARD and metal leaching.

#### 2.1.2.2 Low-Grade Ore

Low-Grade Ore is classified as PAG with a relatively short lag time to ARD conditions; the low grade ore stockpile is expected to generate acidic drainage with elevated metals until ore processing. The LGO will be placed on a compacted till liner with a drainage collection system. Acidic drainage will be neutralized with lime prior to discharge to the TSF.

#### 2.1.2.3 Tailings

The project will use a conventional ore crushing, grinding and leaching process (whole ore leach) to produce a gold-silver doré. The tailings will report to cyanide destruction vessels using the $SO_2$/Air process before being discharged to the TSF.

Metallurgical test tailings samples were analyzed including whole ore leach (WOL) samples. The WOL tailings were PAG and had elevated solid phase concentrations of arsenic, cadmium, and zinc. Results from the humidity cell test of WOL tailings suggest a lag time of up to one year to acidic conditions (based on lab conditions) with a longer period expected in the field until ML/ARD may occur in exposed, non-saturated conditions. Metallurgical testing showed removal of sulphide minerals from the WOL tailings is not practical given the required very high mass pulls to concentrate (inefficient separation).

#### 2.1.2.4 Overburden

All overburden samples from the open pit, plant, TSF, and access road area were classified as NAG based on ABA results and the net acid generation test. However, one sample from the overburden-bedrock interface had elevated sulphur and was classified as PAG, and three interface samples had an uncertain ARD classification. Except for material near the bedrock interface, overburden can be used for construction and reclamation purposes. Overburden near the interface will be tested and if found to be PAG or ML it will be managed like PAG waste rock.

#### 2.1.2.5 Waste Rock

Waste rock has low sulphur concentrations (median of 0.3% total sulphur) and low neutralization potential (median of 10 kg $CaCO_3$/t). The median NPR for the waste rock increases across each of the five waste rock types was as follows:

2. PAG 1 = 0.3
3. PAG 2 = 1.4
4. NAG 3 = 3.8
5. NAG 4 = 6.0, and
6. NAG 5 = 9.0.

Some of the waste rock has high concentrations of solid phase metals, most notably zinc and cadmium. Zinc and cadmium are geochemically similar and occur together. Waste rock will be segregated and managed on the basis of neutralization potential ratio (NPR) and zinc concentrations as discussed above.

Median NPR values for PAG waste rock (particularly PAG1) were relatively low, indicating a relatively short lag-time to acid production, verified in laboratory kinetic (humidity cells) and field tests (field bins). The humidity cell tests showed that all the PAG1 and some of the PAG2 samples were acid generating with little to no lag time. None of the NAG humidity cell tests exhibited depressed leachate pH values. In general, cadmium, zinc, iron, and lead loads were higher in the tests with acidic pH values compared to those with neutral or alkaline values.

The results of the field bin tests for waste rock were similar to those for the humidity cell tests, but typically had a longer lag time until acid generation. Metal loads from sub-aqueous waste rock column tests were significantly lower (often by an order of magnitude) than comparable humidity cell tests, due to oxygen-deficient conditions created by the water cover inhibiting sulphide mineral oxidation.

Taken together, the results of waste rock kinetic testing indicate the time until acid generation will be longer under field conditions than in laboratory testing, metal loads under neutral pH conditions will be lower than under acidic conditions, and underwater storage of waste rock will significantly reduced ML.

## 2.2 TAILINGS CHARACTERIZATION

A laboratory testing program was conducted to determine the geotechnical and physical characteristics of the Blackwater tailings. The test program and results are described in detail in the Tailings Lab Testing Report (Knight Piésold Ltd., 2013a) and summarized below.

A sample of the tailings representing ground feed thickened tailings was provided by New Gold for testing. The test program included Index Testing to enable geotechnical classification of the materials, and slurry settling, air drying, consolidation and permeability testing to determine the characteristics of the tailings for a range expected to be representative of field conditions.

The specific gravity of the tailings solids was determined to be 2.79 and the material can be described as non-plastic sandy-silt with trace clay. The particle size distribution of the tailings sample comprised approximately 44% fine sand, 46% silt, and 10% clay.

Undrained settling, drained settling, and air drying tests were carried out to provide information on the effect of initial slurry solids content of the settling and permeability characteristics of the material and the effect on water recovery and achieved density. Slurry settling (sedimentation) tests provide an estimate of the density to which the tailings slurry will settle in a sub-aqueous environment, under drained and undrained conditions. These tests provide an indication of the tailings dry density achieved in a storage facility after settling and before any significant consolidation occurs. Air drying tests were carried out on the tailings samples to determine the effect of air drying after initial slurry settling and removal of supernatant water.

The tests were performed for the target solids content of 50% and the main findings are as follows:

- Undrained settled dry density is 1.19 tonnes/$m^3$.
- Drained settled dry density is 1.35 tonnes/$m^3$.

- Supernatant water recovery is expected to be around 52% for undrained conditions and 62% for drained settled conditions.
- Air dried final dry density is 1.49 tonnes/$m^3$ and took approximately four days to complete air drying at room temperature.

## 2.3 OVERBURDEN

The terrain in the deposit area is generally hummocky with overburden varying from 5 to 20 m in thickness. The deepest overburden is expected on the east side of the open pit, where it may be up to 110 m thick. Two geotechnical drillholes were drilled on the east side of the open pit by sonic drilling methods capable of recovering 5-inch diameter overburden core samples. The overburden from these drillholes was found to be consistently dense sandy, silty-gravel with some poorly defined sandy-silt layers.

The Unified Soil Classification System (USCS) has been used for describing and categorizing soil within groups to allow for the development of distinct soil properties. The overburden in the open pit was classified as a coarse grained soil with gravels and fines (SM-SC and GM-GC).

The overburden from the open pit will be used to construct the TSF embankments and to reclaim the TSF basin and waste rock dumps. A laboratory testing program was completed on samples collected from the overburden drillholes in the open pit to determine geotechnical properties of the overburden material for engineering design. The following laboratory tests were performed:

- Sixteen (16) particle size analyses (PSA)
- Two (2) modified proctor tests
- Four (4) triaxial shear tests, and
- Twenty-eight (28) density and moisture content tests.

The results of the laboratory program were presented in the Open Pit Slope Design Report (Knight Piésold Ltd., 2013b) and the geotechnical properties of the overburden in the open pit are summarized in Table 2.1 below.

## 2.4 MINE WASTE MANAGEMENT BEST PRACTICES FOR CHEMICAL STABILITY

In much the same way that different tailings technologies may best suit specific topographical areas or climate regions, different methods for waste rock storage can provide chemical stability (resisting or delaying the onset of ML or ARD). Concepts for management of the various classifications of waste rock to achieve chemical stability were established during the Feasibility Study (Knight Piésold Ltd., 2014a). These were:

- NAG4 and NAG5 waste rock and overburden (no expected ML or ARD):
  - Used as construction material
  - Surplus and unsuitable (geotechnical) materials disposed of in on-land dumps, progressively reclaimed during operations and revegetated at closure
- NAG3 waste rock (potentially ML):
  - Used to construct the upstream zone of the TSF embankments
  - Storage of any surplus in a TSF in such a manner that it is saturated within 3-5 years by either water or tailings will prevent ML
- PAG1 and PAG2 waste rock (expected ML and ARD):

- Storage of the PAG waste rock within a TSF in such a manner that it is saturated within 1 year by either water or tailings will prevent oxidation and subsequent acid generation

**Table 2.1 Geotechnical Properties of Open Pit Overburden**

| Laboratory Test | Geotechnical Properties | | |
|---|---|---|---|
| | Properties | Unit | Average |
| Particle Size Analysis | Gravel | % | 25 |
| | Sand % | % | 38 |
| | Silt % | % | 27 |
| | Clay % | % | 9 |
| Atterberg Limits | Liquid Limit | | 23 |
| | Plastic Limit | | 14 |
| | Plastic Index | | 10 |
| Specific Gravity | Specific Gravity | | 2.73 |
| Compaction Testing | Dry Density | $kg/m^3$ | 2116 |
| | Optimum Moisture Content | % | 8.4 |
| Triaxial Shear Testing | Cohesion (c) | kPa | 13 |
| | Friction Angle ($\varphi$) | degrees | 37 |
| Flexible Wall Permeability Laboratory Test | Permeability | m/s | $9 \times 10^{-8}$ |
| Bulk and Dry Density | Moisture Content | % | 10 |
| | Dry Density | $kg/m^3$ | 2099 |
| | Bulk Density | $kg/m^3$ | 2359 |

**NOTES:**
1. ADOPTED FROM TABLE 4.1 OF THE FEASIBILITY OPEN PIT SLOPE DESIGN REPORT (Knight Piésold Ltd., 2013b).

# 3 – MINE WATER MANAGEMENT

## 3.1 DOWNSTREAM DRAINAGE NETWORK

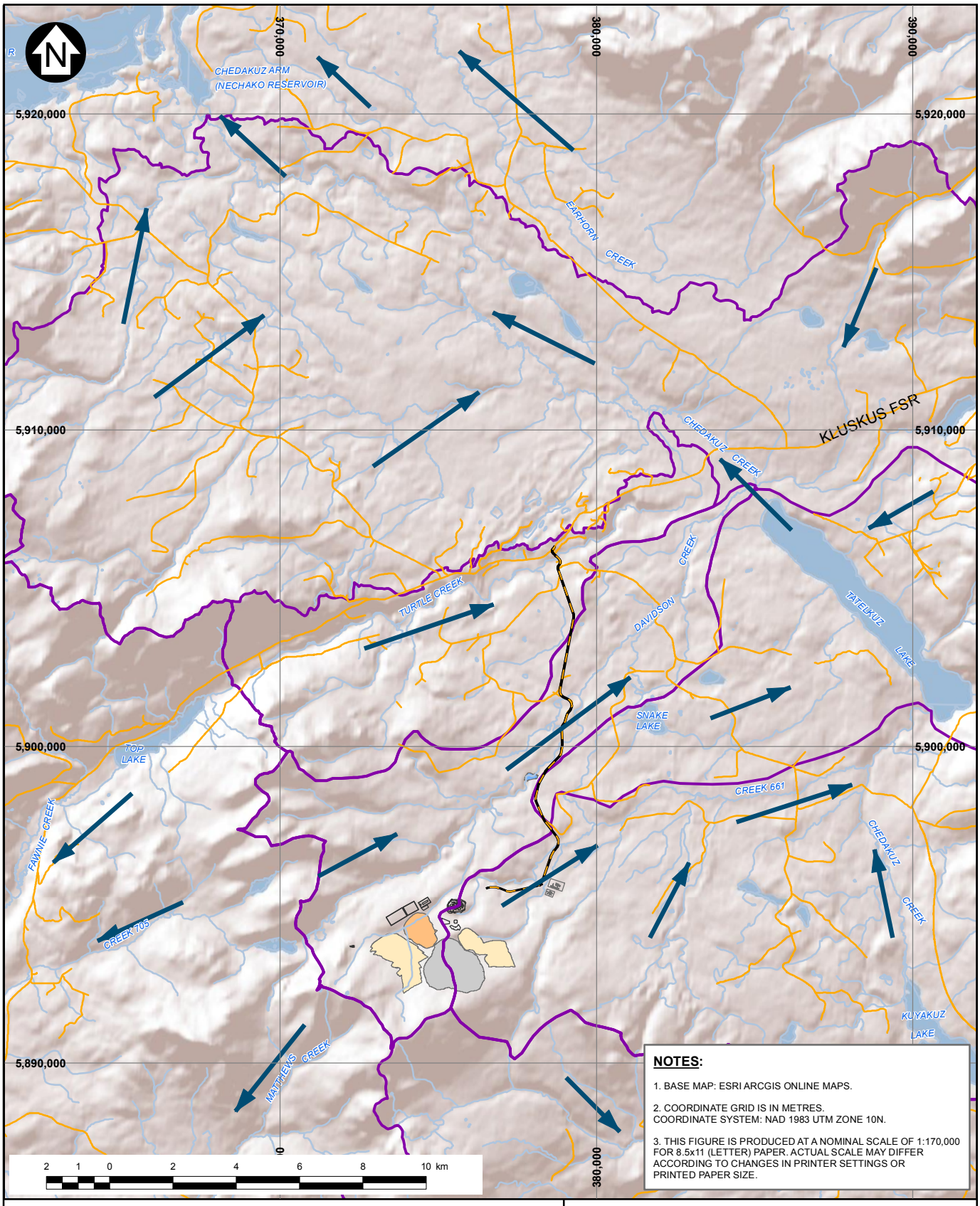
The Project site is situated on the Nechako Plateau of British Columbia, part of the Interior Plateau east of the Coast Mountain Range, in an area of moderate relief characterized by gently undulating, northwest-trending hills cut by small to medium-sized drainages. The elevation of the Blackwater property ranges from just over 1,000 m in low-lying areas northeast of the proposed mine site to 1,800 m at the summit of Mt. Davidson on the southwest side of the property; Mt. Davidson is the highest peak in the Fawnie Range. The Blackwater deposit is located on the northern flanks of the mountain.

The Davidson Creek valley is incised locally and flows northeast from the site toward Chedakuz Creek downstream of Tatelkuz Lake. The Blackwater deposit lies within the upper reaches of the Davidson Creek catchment area. The terrain within this footprint is predominantly gently inclined, except along the incised portions of Davidson Creek. Creek 661 flows northeast from the project site into Chedakuz Creek upstream of Tatelkuz Lake.

An unnamed catchment drains Snake Lake, which is located between the Davidson Creek and Creek 661 catchments. This area drains directly to Tatelkuz Lake. Chedakuz Creek drains Tatelkuz Lake before its confluence with Davidson Creek approximately 800 m downstream of the lake. Chedakuz Creek flows northwest passing under a bridge at the Kluskus Forest Service Road (FSR) approximately 2 km downstream from the Lake. Turtle Creek, located to the north of Davidson Creek, drains another undisturbed catchment running parallel to Davidson Creek towards Chedakuz Creek. Turtle Creek flows closely to Davidson Creek near the base, before flowing north under the Kluskus FSR to its confluence with Chedakuz Creek downstream of the Kluskus FSR. Chedakuz Creek flows northwest from this point for approximately 25 km to the Nechako Reservoir.

Matthews Creek and Creek 705 both flow west of the deposit area and combine with westward flowing Fawnie Creek to form a second predominant surface water flow pattern in the region. Fawnie Creek flows towards Laidman Lake and Johnny Lake, into Entiako Provincial Park, and ultimately forming a portion of the flow of the Entiako River into the Nechako Reservoir.

The catchment divide for the Blackwater River is south of the deposit area and constitutes the third major surface water flow pattern in the region. The Blackwater River is a tributary of the Fraser River and flows generally north-eastward across the Fraser Plateau in the Chilcotin region of central British Columbia. Its confluence with the Fraser River is approximately 40 km northwest of Quesnel and it forms the division between the Chilcotin Plateau and the Nechako Plateau, which are subdivisions of the Fraser Plateau. The river is of significant historical importance to First Nations and Canadian history. The Blackwater River has been designated as a heritage river by the government of British Columbia.




**NOTES:**

1. BASE MAP: ESRI ARCGIS ONLINE MAPS.

2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:170,000 FOR 8.5x11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

**LEGEND:**

- SURFACE WATER FLOW DIRECTION
- EXISTING ROADS
- CREEK
- LAKE
- CATCHMENT BOUNDARY

**PROPOSED MINE SITE FACILITIES**

- ACCESS ROAD
- OPEN PIT
- WASTE DUMPS
- LOW-GRADE STOCKPILE

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | KK | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**MINE WATER MANAGEMENT**
**DOWNSTREAM DRAINAGE NETWORK**

Knight Piésold CONSULTING

P/A NO. VA101-457/15

REF NO. 1

**FIGURE 3.1**

REV 0

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## 3.2 HYDROMETEOROLOGY

### 3.2.1 General

Hydrological and meteorological data have been collected at the project site since early 2011. The short-term site-specific data have been correlated with long-term regional data. The details of the hydrometeorology study were presented in the 2013 Hydrometeorology Report (Knight Piésold Ltd., 2013c). The study indicated that the available site and regional dataset was adequate to provide a reasonable basis for describing and quantifying the meteorological characteristics of the project area for the purpose of water balance modelling, engineering design, and environmental assessment. The key findings of the study have been summarized in the sections that follow.

### 3.2.2 Monitoring Locations

Hydrometric data are being collected at seven stations in the project area to support hydrometric characterization of the mine site area. The hydrometric stations are identified as H1 to H7. Meteorological data are being collected at two climate stations, which are identified as Blackwater High (elevation 1,470 m) and Blackwater Low (elevation 1,050 m). There are three snow survey stations (SS 1 to SS 3) that have been used to collect snowfall and snowmelt data at the site. The monitoring locations for the project site are shown on Figure 3.2.

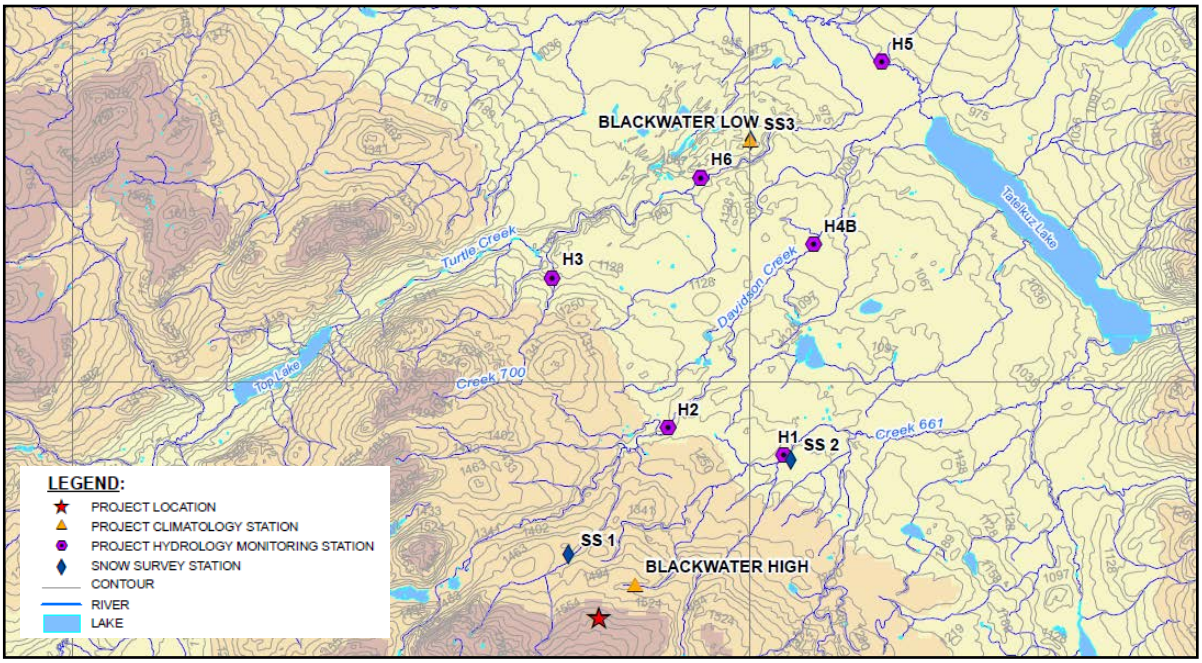



**Figure 3.2 Project Monitoring Stations**

### 3.2.3 Mean Annual Precipitation

The long-term mean annual precipitation (MAP) for the project area is estimated to be 636 mm, for an elevation of approximately 1,470 m. This value is a result of interpretation of two project site meteorological stations and several regional stations operated by the Meteorological Services of Canada (MSC) branch of Environment Canada and the BC Forest Service Wildfire Management Branch.

### 3.2.4 Evapotranspiration / Lake Evaporation

Lake evaporation for the site was estimated according to common empirical equations for potential evapotranspiration (PET). PET values are generally representative of lake evaporation. The empirical Thornthwaite equation was used with 32 complete years of values from regional stations. The estimated long-term PET value for the project is 445 mm, with little to no evapotranspiration occurring during the winter months (Knight Piésold Ltd., 2013c).

### 3.2.5 Monthly Precipitation Distribution

The monthly distribution of precipitation was estimated for the purpose of water management planning. Approximately 51% of the annual precipitation at the project site falls as snow between November and March. The remaining 49% of the annual precipitation falls as rain, which may occur in any month of the year, but largely falls in the period of April to October. The monthly precipitation statistics that define these distributions are summarized in Table 3.1.

**Table 3.1 Monthly Precipitation Distribution**

| Unit | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Precipitation (mm) | 73 | 45 | 39 | 20 | 50 | 66 | 52 | 51 | 47 | 47 | 74 | 72 | 636 |
| %/month | 12% | 7% | 6% | 3% | 8% | 10% | 8% | 8% | 7% | 7% | 12% | 11% | 100% |
| Rain (mm) | 0 | 0 | 0 | 13 | 50 | 66 | 52 | 51 | 47 | 31 | 0 | 0 | 310 |
| % Precipitation as Rain/Month | 0 | 0 | 0 | 65 | 100 | 100 | 100 | 100 | 100 | 65 | 0 | 0 | 49% |
| Snow – SWE (mm) | 73 | 45 | 39 | 7 | 0 | 0 | 0 | 0 | 0 | 16 | 74 | 72 | 326 |
| % Precipitation as Snow/Month | 100 | 100 | 100 | 35 | 0 | 0 | 0 | 0 | 0 | 35 | 100 | 100 | 51% |

**NOTES:**
1. SWE = SNOW WATER EQUIVALENT.
2. ADOPTED FROM TABLE 2.11 OF THE 2013 HYDROMETEOROLOGY REPORT (Knight Piésold Ltd., 2013c).

### 3.2.6 Mean Annual Runoff

The annual stream hydrographs in the project area are characterized by a very pronounced period of high flows during the spring freshet, followed by an extended period of steady low flows, with limited autumn storms. All creeks are affected by ice formation during the winter and the smaller systems typically freeze over during extended cold periods. Estimates of mean monthly and annual unit runoffs are summarized in Table 3.2.

**Table 3.2 Project Site Long Term Unit Runoff**

| Station | Unit | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H1 | Unit Runoff (l/s/km$^2$) | 0.7 | 0.7 | 1.2 | 3.6 | 14.5 | 13.6 | 4.0 | 1.9 | 1.5 | 1.6 | 2.1 | 1.0 | 3.8 |
| | Discharge (L/s) | 7 | 6 | 11 | 32 | 129 | 121 | 35 | 17 | 13 | 15 | 19 | 9 | 33 |
| | Runoff (mm) | 2 | 2 | 3 | 9 | 39 | 35 | 11 | 5 | 4 | 4 | 6 | 3 | 119 |
| | % of Total Runoff | 2% | 1% | 3% | 8% | 31% | 29% | 9% | 4% | 3% | 4% | 5% | 2% | 100% |
| H2 | Unit Runoff (l/s/km$^2$) | 2.8 | 2.7 | 3.3 | 6.0 | 18.5 | 17.4 | 6.3 | 4.0 | 3.4 | 3.7 | 4.1 | 3.1 | 6.1 |
| | Discharge (L/s) | 130 | 127 | 155 | 281 | 873 | 820 | 297 | 188 | 160 | 173 | 195 | 148 | 288 |
| | Runoff (mm) | 7 | 7 | 9 | 15 | 50 | 45 | 17 | 11 | 9 | 10 | 11 | 8 | 198 |
| | % of Total Runoff | 4% | 4% | 4% | 8% | 25% | 23% | 8% | 5% | 4% | 5% | 6% | 4% | 100% |
| H5 | Unit Runoff (l/s/km$^2$) | 2.4 | 2.4 | 2.7 | 4.5 | 10.8 | 9.6 | 4.6 | 2.9 | 2.4 | 2.5 | 3.1 | 2.6 | 4.2 |
| | Discharge (L/s) | 1450 | 1437 | 1610 | 2693 | 6388 | 5683 | 2726 | 1692 | 1447 | 1490 | 1840 | 1558 | 2501 |
| | Runoff (mm) | 7 | 6 | 7 | 12 | 29 | 25 | 12 | 8 | 6 | 7 | 8 | 7 | 133 |
| | % of Total Runoff | 5% | 5% | 5% | 9% | 21% | 19% | 9% | 6% | 5% | 5% | 6% | 5% | 100% |

**NOTES:**

1. STATION H2 IS REPRESENTATIVE OF THE PROJECT AREA DUE TO ITS ELEVATION AND DRAINAGE AREA BEING SIMILAR TO THAT OF THE PROJECT AREA FACILITIES.
2. THE CALCULATION OF RUNOFF IN mm ASSUMES 28 DAYS IN FEBRUARY.
3. ADOPTED FROM TABLE 3.4 OF THE 2013 HYDROMETEOROLOGY REPORT (Knight Piésold Ltd., 2013c).

The unit runoff and the hydrograph shape at H2 are expected to most appropriately represent streamflow patterns in the project area. This is due to its close proximity to the project site, the moderate size of its catchment (47.2 km$^2$), as well as similarities to the project area in terms of vegetative cover, slope, aspect, and basin elevation. Furthermore, the H2 basin does not contain any large lakes and does not appear to have unusually high groundwater recharge.

The mean annual unit runoff for the project site is estimated to be 6.1 L/s/km$^2$, as shown in Table 3.2. The highest monthly runoff tends to occur in May, with 18.5 L/s/km$^2$, and the lowest occurs in February, with 2.7 L/s/km$^2$. The annual unit runoff equates to an annual runoff depth of 198 mm.

The runoff coefficient is a dimensionless number that defines the annual ratio of runoff to precipitation. The results of analysis suggest an annual runoff coefficient of 0.31 (31%), which is consistent with regional coefficients.

### 3.2.7 Return Period Extreme Precipitation

Estimates of extreme precipitation are required for many aspects of design. Estimated 24-hour extreme rainfall values were prepared for various return periods and for the probable maximum precipitation (PMP) to support the design of the project. Extreme precipitation events for the project site are summarized in Table 3.3.

**Table 3.3 Extreme Precipitation Return Period Values**

| Return Period (years) | 24-Hour Extreme Rainfall (mm) |
|---|---|
| 2 | 37 |
| 5 | 44 |
| 10 | 50 |
| 20 | 55 |
| 50 | 61 |
| 100 | 66 |
| 200 | 71 |
| 500 | 78 |
| 1000 | 82 |
| PMP | 195 |

**NOTES:**
1. ADOPTED FROM TABLE 2.13 OF THE 2013 HYDROMETEOROLOGY REPORT (Knight Piésold Ltd., 2013c).

# 4 – DESIGN STORAGE REQUIREMENTS

## 4.1 MINE WASTE STORAGE REQUIREMENTS

The design of the mine waste (and water) management structures must take into account both the disposal of mine tailings and the disposal of waste rock. The total waste produced during development of the mine is summarized in Table 4.1 below.

**Table 4.1 Life of Mine Waste Production**

| MATERIAL | UNIT | LIFE OF MINE TOTAL |
|---|---|---|
| Tailings | tonnes | 344,455,000 |
| NAG5 | tonnes | 108,399,000 |
| NAG4 | tonnes | 44,173,000 |
| NAG3 | tonnes | 79,335,000 |
| PAG | tonnes | 366,214,000 |
| Overburden | tonnes | 87,301,000 |

**NOTES:**
1. BASED ON FEASIBILITY STUDY MINE WASTE PRODUCTION SCHEDULE (Knight Piésold Ltd., 2014a).

The geochemical characteristics of the waste materials to be incorporated in design of the TSF concepts are:

- NAG4 and NAG5 waste rock and overburden:
  - Relatively benign and used as a construction material (NAG5 and overburden preferred) or disposed in on-land waste dumps near the open pit
- NAG3 waste rock:
  - Potentially metal leaching
- Tailings, PAG1 and PAG2 waste rock:
  - Potentially acid generating

The alternatives assessment contemplates saturated storage of PAG and NAG3 waste rock to achieve chemical stability. Saturated storage of waste rock requires the construction of a submergence facility using water retaining dams regardless of tailings disposal technology. The study includes options for comparison that consider subaerial, unsaturated storage of these waste rock types in mine waste piles not requiring water retaining dams. Storage in this latter manner will not prevent the onset of acidic drainage conditions, but rather will rely on collection and treatment to manage the environmental risks associated with these options.

## 4.2 TAILINGS CONTINUUM

Mine tailings are described by their approximate solids content at delivery for TSF design. Tailings can be produced according to a range known as the tailings continuum, which qualitatively describes tailings solids content, thickening effort (and/or dewatering) required, behavior/method of conveyance, and segregation potential during placement. The tailings continuum is shown on

Figure 4.1. Certain points within the tailings continuum were recognized as 'tailings technologies' for this alternatives study. The following sections describe each of the tailings technologies used in the assessment.

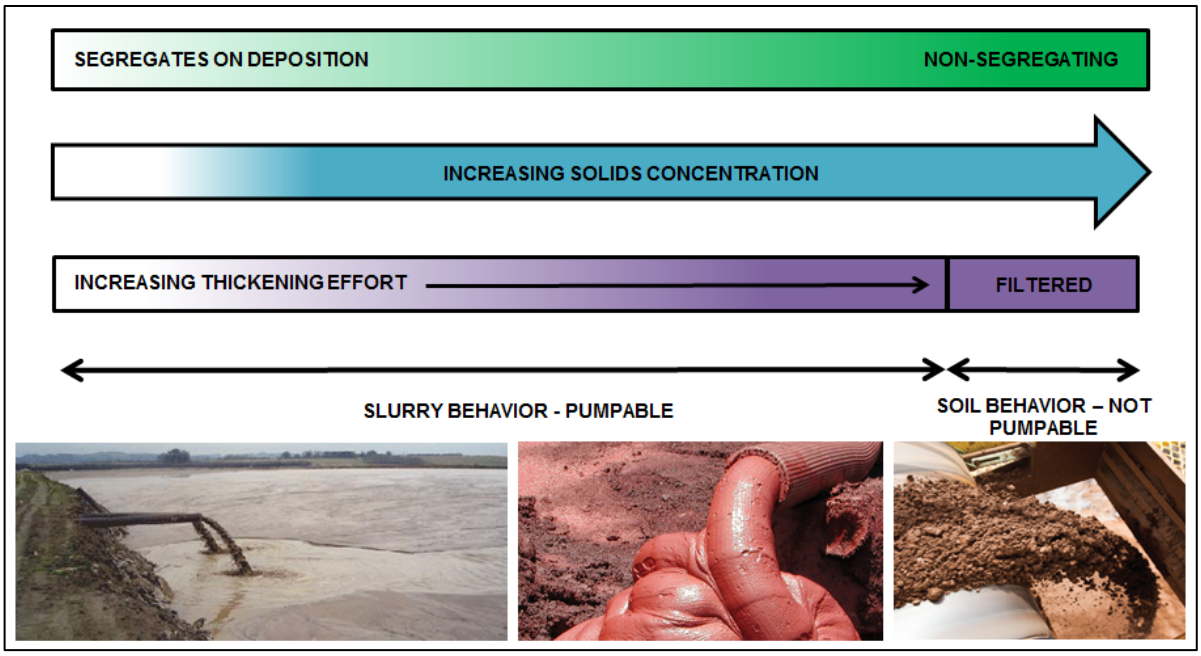



**Figure 4.1 Tailings Continuum**

### 4.2.1 Thickened Slurry

The slurry mine waste management concepts were developed for tailings slurry thickened to a gravimetric solids content of 50%. The tailings slurry at 50% solids content will be transported by pipeline (and pumps if required). The slurry tailings were assumed to settle at a beach slope of approximately 1% grade away from the discharge point. The slurry will segregate upon deposition with the coarsest sand particles settling near the discharge spigots and finer sands settling farther down slope. Finer silt and clay sized tailings particles will be carried out into the supernatant pond in suspension and will settled over a longer period of time. The tailings beach will provide separation of the containment dams from the supernatant pond.

An average dry density of 1.3 t/m$^3$ was adopted to determine the storage volume requirements for the thickened-slurry alternatives as shown in Table 4.2. The dry density will be expected to increase due to natural consolidation processes over time to a maximum dry density between 1.5 and 1.6 t/m$^3$; however, the process of consolidation and its effect on storage volume requirements was not included in this alternatives assessment.

### 4.2.2 Ultra-Thickened (Paste)

The ultra-thickened tailings technology contemplates additional thickening effort or additives to increase the solids content of the tailings. Ultra-thickened tailings are sometimes referred to as paste tailings; however the term paste is generally only applied if certain yield stress criteria are met. The paste point of tailings depends on tailings grain size, minerology, specific gravity, and other

characteristics. The method of thickening to paste tailings is immaterial to the alternatives study other than that it was assumed to be achievable. Paste tailings for the purpose of this study were considered to be tailings slurry that has been thickened to approximately 65% solids by additional thickening effort and/or the use of additives. Paste tailings are assumed to be non-segregating after discharge, settling at a beach slope of approximately 1.5% grade. Paste tailings will require positive displacement pumps and tailings pipelines for delivery.

An average dry density of 1.4 t/m$^3$ was adopted to determine the storage volume requirements for the paste tailings alternative as shown in Table 4.2. The dry density will be expected to increase due to natural consolidation processes over time to a maximum dry density between 1.5 and 1.6 t/m$^3$; however, the process of consolidation and its effect on storage volume requirements was again not included in this alternatives assessment.

### 4.2.3 Filtered

The filtered tailings alternatives consider tailings that are mechanically dewatered to a point at which they will no longer be considered slurry and will behave as a soil. Mechanical dewatering can be achieved through a variety of technologies including both vacuum and pressure filtration processes. The method of filtration adopted for the alternatives study was vacuum disk filtration. This technology was used to qualitatively describe the infrastructure required for filtration and to complete the cost evaluation. Filtered tailings were assumed to be dewatered to a moisture content of approximately 15%. Characteristics of a flowing slurry do not apply to a soil; however if these characteristics were applied to the filtered tailings it will equate to a gravimetric solids content of approximately 80 to 85%.

The filtered tailings stack was assumed to be placed with a 3H:1V slope for all alternatives developed. An average dry density of 1.7 t/m$^3$ was adopted to determine the storage volume requirements for the filtered tailings alternatives. The dry density of filtered tailings is not expected to increase significantly due to consolidation over time. An allowance for an additional 10% in storage volume was included in the layouts for inclusion of waste rock used in construction.

The tailings filtration plant is expected to be unable to provide material dewatered to the design moisture content at times, whether for maintenance or changes in tailings grind. These conditions are referred to as ‘upset conditions’ for the purposes of the study. Candidates developed for filtered tailings storage will include a location designated for upset tailings slurry storage.

**Table 4.2 Life of Mine Tailings Production**

| YEAR | TAILINGS | DISPOSAL METHOD | | |
|---|---|---|---|---|
| | | THICKENED SLURRY (1) | PASTE (2) | FILTERED (3) |
| | tonnes | $m^3$ | $m^3$ | $m^3$ |
| Pre-Production | 0 | 0 | 0 | 0 |
| 1 | 10,819,000 | 8,322,308 | 7,727,857 | 6,364,118 |
| 2 | 21,900,000 | 16,846,154 | 15,642,857 | 12,882,353 |
| 3 | 21,900,000 | 16,846,154 | 15,642,857 | 12,882,353 |
| 4 | 21,900,000 | 16,846,154 | 15,642,857 | 12,882,353 |
| 5 | 21,900,000 | 16,846,154 | 15,642,857 | 12,882,353 |
| 6 | 21,903,000 | 16,848,462 | 15,645,000 | 12,884,118 |
| 7 | 21,903,000 | 16,848,462 | 15,645,000 | 12,884,118 |
| 8 | 21,903,000 | 16,848,462 | 15,645,000 | 12,884,118 |
| 9 | 21,903,000 | 16,848,462 | 15,645,000 | 12,884,118 |
| 10 | 21,903,000 | 16,848,462 | 15,645,000 | 12,884,118 |
| 11 | 21,902,000 | 16,847,692 | 15,644,286 | 12,883,529 |
| 12 | 21,902,000 | 16,847,692 | 15,644,286 | 12,883,529 |
| 13 | 21,902,000 | 16,847,692 | 15,644,286 | 12,883,529 |
| 14 | 21,902,000 | 16,847,692 | 15,644,286 | 12,883,529 |
| 15 | 21,902,000 | 16,847,692 | 15,644,286 | 12,883,529 |
| 16 | 21,902,000 | 16,847,692 | 15,644,286 | 12,883,529 |
| 17 | 5,109,000 | 3,930,000 | 3,649,286 | 3,005,294 |
| **TOTAL** | **344,455,000** | **264,965,000** | **246,039,000** | **202,621,000** |

**NOTES:**

1. AVERAGE DRY DENSITY OF THICKENED-SLURRY TAILINGS WAS ASSUMED TO BE 1.3 t/m3.
2. AVERAGE DRY DENSITY OF PASTE TAILINGS WAS ASSUMED TO BE 1.4 t/m3.
3. AVERAGE DRY DENSITY OF FILTERED TAILINGS WAS ASSUMED TO BE 1.7 t/m3.

## 4.3 DESIGN FLOOD AND EARTHQUAKE EVENTS

The design basis requirements for flood and earthquake events are driven by dam safety guidelines for mining dams and the potential incremental consequences of failure. The Canadian Dam Association (CDA) guidelines were used to determine the suggested minimum Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for dams considered in this assessment. A technical bulletin was released by the Canadian Dam Association in 2014 (CDA, 2014), entitled Application of Dam Safety Guidelines to Mining Dams.

Two scenarios generally apply to all of the alternatives and are described in the following sections.

### 4.3.1 Design Basis for Mine Waste Impoundments

A mine waste impoundment for the purposes of this alternatives assessment was considered to be a tailing storage facility, a PAG/NAG3 waste rock submergence facility, or mine waste co-disposal facility including both tailings and PAG/NAG3 waste rock. The consequences of failure for a mine waste impoundment could be both physical and environmental, with potential released solids. Complete removal of released solids and clean-up following a failure could be impractical in many cases; however, sufficient tailings or PAG/NAG3 could be removed, possibly at very high cost, to mitigate ongoing environmental effects. The mine waste impoundment alternatives considered in this study were classified as VERY HIGH based on the preceding methodology.

This methodology and classification is consistent with the Feasibility Study classification of the tailings dams (KP, 2014a).

The following suggested design levels were adopted from the CDA guidelines for the construction and operational phases of the project:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF).
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE).

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase of the project:

- IDF – PMF.
- EDGM – MCE (1 in 10,000 year event).

The alternatives assessment makes reference to candidates that include a mine waste impoundment as being “designed for maximum credible events (MCE and PMF)”. The distinction discussed above between design levels adopted for the construction and operational phases, and the closure phase is not repeated throughout the document but applies to all candidates that include a mine waste impoundment.

### 4.3.2 Design Basis for Mine Waste Piles and Process Water Ponds

The alternatives assessment considers placement of filtered tailings into a stacked arrangement and on-land disposal of PAG waste rock. It is important to note that configuration of filtered tailings and/or PAG waste rock into a drained on-land facility could impact design requirements, oversight, and monitoring and inspection requirements. These arrangements would be classified as Mine Waste Piles, and would be subject to investigation, design and construction requirements as indicated by the B.C. Mine Waste Rock Pile Research Committee (BCMWRPRC, 1991).

Dams for water storage will still be required to contain process water for designs with separate mine waste piles. The water storage facilities for these mine development concepts are termed process water ponds in the alternatives assessment. The potential consequences of failure for a process water pond could be both physical and environmental, but will contain mine water and dam construction material only. Clean-up following a failure would not require removal of released solids or long-term degradation of habitat, and restoration or compensation would be highly possible. The process water pond dams considered in this study were classified as SIGNIFICANT based on the preceding methodology. The methodology and classification is consistent with the Feasibility Study classification of the Environmental Control Dam (ECD), which is a mine water containing dam (KP, 2014a).

The CDA guidelines suggest that a dam with a dam classification of SIGNIFICANT should be designed for the following minimum design levels for the construction and operational phases of the project:

- IDF – between 1 in 100 year and 1 in 1,000 year return period.
- EDGM – between 1 in 100 year and 1 in 1,000 year return period.

The following design flood and earthquake levels are suggested for the closure phase of the project:

- IDF – 1/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF).
- EDGM – 1 in 2,475 year return period.

# 5 – MINE WASTE MANAGEMENT CANDIDATE ALTERNATIVES

## 5.1 GENERAL

Concepts for management of mine waste were developed based on topographical maps of the project area, utilizing the alternative tailings storage technologies outlined in Section 4.3. The concepts for management of mine waste are referred to as candidates in the following sections of this report. The candidates are interspersed within an area of approximately 35 km by 30 km as shown on Figure 5.1. Candidate sites were roughly bounded by the Blackwater River to the south, the Nechako Reservoir to the north, Tatelkuz Lake to the east, and Entiako Provincial Park to the west. The tailings technology applied at each candidate site was chosen based on site specific constraints and professional judgement. Some candidate sites considered multiple tailings technologies, if appropriate, and others only considered a single technology. Full size versions of the candidate map shown on Figure 5.1 are included in Appendix B. Figure B.1 shows the candidate sites and interactions with the site constraints discussed in Section 5.3. Figure B.2 shows the interactions with asserted Aboriginal territories.

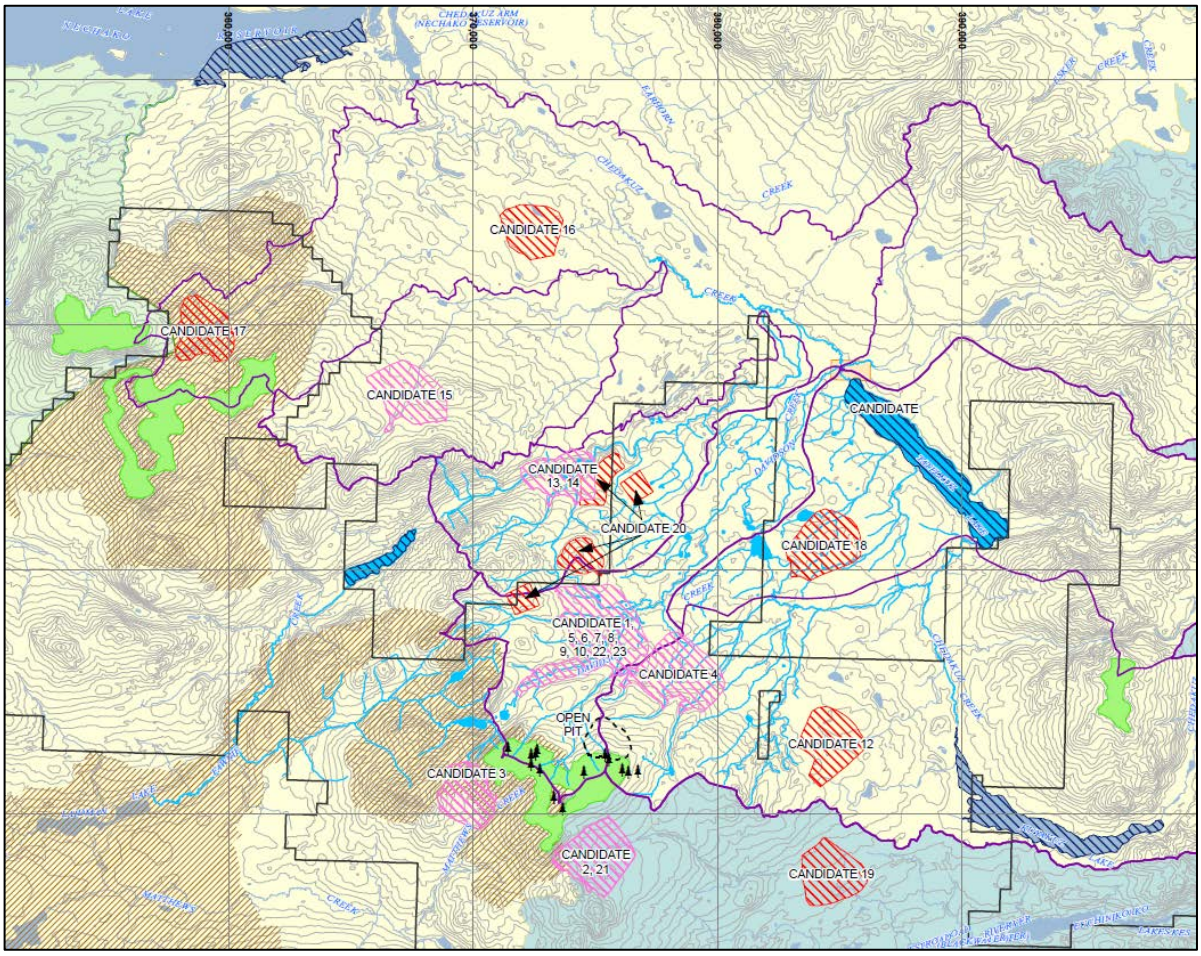



**Figure 5.1 Tailings Storage Candidate Locations**

## 5.2 CANDIDATE DEVELOPMENT

A description of the tailings storage concept, location, method of waste delivery, and pre-screening result for each candidate is provided in the following sections. The description of each candidate should be read in conjunction with the figures included in Appendix C.

### 5.2.1 Candidate 1

Candidate 1 is a thickened-slurry tailings alternative located in the upper reaches of the Davidson Creek catchment. The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in a single impoundment. The impoundment will have a footprint area of approximately 1,150 hectares (ha). The centre of the TSF site is located 4.5 km from the deposit. Tailings slurry will be conveyed by gravity in a pipeline, with the pipeline route remaining within the TSF catchment at all times. The PAG waste rock haul will be directly downhill from the pit rim to the TSF for the entire life of the mine.

The impoundment will be created in a staged manner, with two nested TSF sites. The dams will be progressively expanded using NAG waste materials from the open pit in advance of storage requirements. The upper facility (Site C) will be constructed first with two dams to contain the first two years of tailings and waste rock. A third, larger dam with a maximum height of 140 m will be constructed downstream to expand the impoundment into the lower facility (Site D) to contain the remaining 15 years of tailings and waste rock. Process water will be stored on site within the TSF and will be split between two ponds; one within each disposal area. Extensive tailings beaches will be developed to isolate the supernatant ponds from the dams.

Candidate 1 was the alternative proposed in the Feasibility Study design (Knight Piésold Ltd., 2014a). Candidate 1 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.2 Candidate 2

Candidate 2 is a thickened-slurry tailings alternative located on the south side of Mount Davidson in the upper reaches of an unnamed tributary of the Blackwater River. The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The centre of the TSF site is located 4.5 km from the deposit. Tailings slurry will be pumped in a pipeline to the TSF and the pipeline route will traverse the upper reaches of Creek 661 prior to reaching the TSF catchment. A tailings spill collection system will be required along the entire conveyance route. The PAG waste rock haul will be a net uphill haul route over a distance of 7 km for the entire life of the mine.

The impoundment will be created by constructing two large dams on the east and west sides, and will be constrained by natural topography to the north and south. The dams will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. The western extent of the facility borders the Mathews Creek catchment. Process water will be stored within the TSF and reclaimed for use in the mill. Extensive tailings beaches will be developed to isolate the supernatant pond from the dams. The candidate is located within the Blackwater River drainage and bordering the UWR on the west side of the TSF.

Candidate 2 was removed from further analysis because it was located in the Blackwater River drainage.

### 5.2.3 Candidate 3

Candidate 3 is a thickened-slurry tailings alternative located on the west side of Mount Davidson within the headwaters of Mathews Creek. The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The centre of the TSF site is located 6 km from the deposit. Tailings slurry will be pumped in a pipeline to the TSF and the pipeline will traverse the upper reaches of Davidson Creek and Creek 705 before rising sharply in elevation through an area of potentially unstable terrain to reach the TSF catchment. Alternatively, the tailings slurry will need to be conveyed over Mt. Davidson and back down to the TSF or around Mt. Davidson through the upper reaches of the Blackwater River catchment to the south. A tailings spill collection system will be required along the entire conveyance route. The PAG waste rock haul will follow a similar route, and will be a net uphill haul route over a distance of 7 to 12 km for the entire life of the mine.

The impoundment will be created by constructing two large dams to the north and south, constrained by natural topography to the east and west. The dams will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. The north extent of the facility borders the Creek 705 catchment. Process water will be stored within the TSF and reclaimed for use in the mill. Extensive tailings beaches will be developed to isolate the supernatant pond from the dams.

Candidate 3 was removed from further analysis because it was located in the UWR.

### 5.2.4 Candidate 4

Candidate 4 is a thickened-slurry tailings alternative located on the north slope of Mount Davidson in the upper reaches of the Creek 661 watershed. The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The centre of the TSF site is located 4 km from the deposit, and adjacent to the mill site. Tailings slurry will be conveyed by gravity in a pipeline to the TSF. A tailings spill collection system will be required for a 1,300 m section of tailings pipeline outside the TSF catchment. The PAG waste rock haul will be downhill from the pit rim to the TSF for the entire life of the mine.

The impoundment will be created by constructing a three-sided main dam with a maximum height of 152 m wrapping the facility, and is constrained by topography to the southwest. The impoundment will have a footprint area of approximately 800 ha. The dam will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. Process water will be stored within the TSF and reclaimed for use in the mill. Extensive tailings beaches will be developed to isolate the supernatant pond from the dams, but may be difficult to maintain due to the shape of the impoundment. The northwestern edge of the facility borders the Davidson Creek catchment.

Candidate 4 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.5 Candidate 5

Candidate 5 is a filtered tailings alternative located at the top of the Davidson Creek catchment. The filtered tailings and PAG/NAG3 waste rock will be stacked on-land in a single combined waste pile in a partially-saturated condition. The centre of the waste pile site is located 3.5 km from the deposit. The pile will have a footprint area of approximately 600 hectares (ha) with a maximum height of

approximately 200 m. Tailings will be pumped in a pipeline from the mill building to the filtration building approximately 1 km away as thickened slurry. Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. The PAG waste rock haul will be directly downhill from the pit rim to the TSF for the entire life of the mine. Waste rock and filtered tailings will be disposed of together leading to a mixed mass of tailings and waste rock.

A process water management pond will be located downstream of the mine waste pile and created by constructing a water retaining dam with a maximum height of 40 m across Davidson Creek. The footprint area will be 60 ha. Process water will be stored in the pond and reclaimed for use in the mill. An 'upset' conditions slurry tailings storage area will be required in the pond for emergency conditions.

Candidate 5 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.6 Candidate 6

Candidate 6 is a filtered tailings alternative located in the upper reaches of the Davidson Creek catchment. The filtered tailings will be stacked in a waste pile on land in a side hill arrangement in a partially-saturated condition. The centre of the waste pile site is located 5 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filtration building approximately 5 km away as thickened slurry. Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. The pile will have a footprint area of approximately 500 ha with a maximum height of approximately 100 m.

A PAG/NAG3 waste rock submergence impoundment will be positioned downstream of the filtered tailings waste pile. This impoundment will manage storm water from the filtered tailings waste pile. The impoundment will have a footprint area of approximately 650 ha and will be created by constructing a dam with a maximum height of 110 m across Davidson Creek. The dam will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. The PAG waste rock will be hauled directly downhill from the pit rim to the TSF for the entire life of the mine. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill. This option will include an 'upset' conditions slurry tailings storage area in the submergence facility for times when the filter plant cannot achieve the required tailings moisture content for placement in the waste pile.

Candidate 6 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.7 Candidate 7

Candidate 7 is a filtered tailings alternative located in the upper reaches of the Davidson Creek catchment. The filtered tailings will be stacked in a waste pile on land in a heaped valley fill arrangement in a partially-saturated condition. The centre of the waste pile site is located 3.5 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filtration building approximately 1 km away as thickened slurry. Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. The pile will have a footprint area of approximately 550 ha with a maximum height of approximately 145 m.

A PAG/NAG3 waste rock submergence impoundment will be positioned downstream of the filtered tailings waste pile. This impoundment will manage storm water from the filtered tailings waste pile. The impoundment will have a footprint area of approximately 650 ha and will be created by constructing a dam with a maximum height of 110 m across Davidson Creek. The dam will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. The PAG waste rock will be hauled directly downhill from the pit rim to the TSF for the entire life of the mine. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill. This option will include an 'upset' condition slurry tailings storage area in the submergence facility for times when the filter plant cannot achieve the required tailings moisture content for placement in the waste pile.

Candidate 7 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.8 Candidate 8

Candidate 8 is a filtered tailings alternative located in the upper reaches of the Creek 661 catchment. The filtered tailings will be stacked in a waste pile on land in a partially-saturated condition in a side hill arrangement. The centre of the waste pile site is located 4 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filtration building approximately 2 km away as thickened slurry. Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. The pile will have a footprint area of approximately 350 ha with a maximum height of approximately 125 m. Storm water from the tailings waste pile will be managed with several downstream sediment control ponds.

A PAG/NAG3 waste rock submergence impoundment will be positioned in the adjacent Davidson Creek catchment located to the northwest of the filtered tailings waste pile. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. The dam will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. The PAG waste rock will be hauled directly downhill a distance of 3.5 km from the pit rim to the TSF for the entire life of the mine. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill. This option will include an 'upset' conditions slurry tailings storage area in the submergence facility for times when the filter plant cannot achieve the required tailings moisture content for placement in the waste pile.

The location of the filtered tailings waste pile for Candidate 8 will make collection of sediment laden runoff improbable during storm events. Operational discharges from the sediment control ponds are expected. The topography of the area is generally open with several meandering creeks emanating from the waste pile footprint area. Seepage control will be challenging. Candidate 8 was removed from further analysis. The reason for removal of Candidate 8 is described further in Section 5.4.1.

### 5.2.9 Candidate 9

Candidate 9 is a filtered tailings alternative located in the upper reaches of the Davidson Creek catchment. The filtered tailings will be stacked in a waste pile on land in a side hill arrangement in a partially-saturated condition. The centre of the waste pile site is located 5 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filtration building approximately

2 km away as thickened slurry. Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. The pile will have a footprint area of approximately 375 ha with a maximum height of approximately 125 m. Storm water from the tailings waste pile will be managed with a downstream sediment control pond.

A PAG/NAG3 waste rock submergence impoundment will be positioned directly upstream of the filtered tailings waste pile. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. The filtered tailings waste pile will ultimately buttress the dam. The dams will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. The PAG waste rock will be hauled directly downhill from the pit rim to the TSF for the entire life of the mine. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill. This option will include an 'upset' conditions slurry tailings storage area in the submergence facility for times when the filter plant cannot achieve the required tailings moisture content for placement in the waste pile.

The location of the filtered tailings waste pile for Candidate 9 will make collection of sediment laden runoff improbable during storm events. Candidate 9 was removed from further analysis. The reason for removal of Candidate 9 is described further in Section 5.4.1.

### 5.2.10 Candidate 10

Candidate 10 is an ultra-thickened (paste) tailings alternative located in the upper reaches of the Davidson Creek catchment. The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The centre of the TSF site is located 4.5 km from the deposit. Paste tailings will be pumped in a pipeline to a central point in the TSF. Tailings will be discharged from a central point and will settle at angle of repose sloping towards the containment dams. Water will be collected at the toe of the slope adjacent to the containment dams. The pipeline route will remain within the TSF catchment at all times.

The impoundment will have a footprint area of approximately 975 ha and will be created by constructing two small dams and one large dam (Main Dam) with a maximum height of 130 m across Davidson Creek. The Main Dam will be progressively expanded with downstream raises using NAG waste materials from the open pit in advance of storage requirements. The PAG/NAG3 waste rock will be hauled directly downhill from the pit rim to the TSF for the entire life of the mine. Process water will be retained in the TSF against the Main Dam where it will be used to submerge PAG/NAG3 waste rock. Process water will be reclaimed from this pond for use in the mill.

Candidate 10 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.11 Candidate 11

Candidate 11 encompasses disposal of slurry tailings in a lake (or combination of lakes) surrounding the project location. The nearby lakes are all expected to be fish bearing. This option violates the pre-screening criteria set forth in this section, but is considered nonetheless for completeness of the alternatives assessment. Nearby lakes were considered based on capacity for the potential to store life-of-mine tailings:

- Tatelkuz Lake (195 $Mm^3$)

- Kuyakuz Lake (60 $Mm^3$), and
- Top Lake (15 $Mm^3$).

The largest of these lakes is Tatelkuz Lake with a capacity of 195 $Mm^3$. The tailings storage requirement is 265 $Mm^3$. Tatelkuz Lake will not provide sufficient capacity to store tailings for the life of the mine. The only way to generate enough capacity for tailings storage in nearby lakes will be to fill in all three of these lakes with tailings and displace all of the existing water.

This level of disturbance will only accommodate tailings; therefore a PAG/NAG3 waste rock submergence impoundment will be positioned near the mine site area. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. Process water will be stored in the submergence facility and reclaimed for use in the mill.

Candidate 11 will be removed from further analysis as a result of deposition of tailings in a fish-bearing lake and lack of sufficient capacity to store tailings over the entire mine life.

The only nearby natural water body large enough to contain the tailings and PAG/NAG3 waste rock in a perpetually submerged condition is the Nechako Reservoir 30 km away from the mine site. This alternative will still violate the pre-screening criteria of tailings deposition into a fish-bearing lake and will not be considered further.

### 5.2.12 Candidate 12

Candidate 12 is a filtered tailings alternative located west of Kuyakuz Lake in the upper reaches of the Chedakuz Creek catchment. The filtered tailings will be stacked in a waste pile on land in a partially-saturated condition in a side hill arrangement. The centre of the waste pile site is located 9.5 km from the deposit. Tailings will be conveyed as thickened slurry by gravity in a pipeline from the mill building to the filtration building approximately 9 km away. Water removed during filtration will be sent back to the mine site by a return water pipeline.

Tailings will be filtered and then transported by conveyer to the mine waste pile for placement. A smaller truck fleet will be required for placement in non-optimal areas. The pile will have a footprint area of approximately 550 ha with a maximum height of approximately 55 m. An area within the tailings waste pile will be required for tailings that do not meet the required moisture content for material placement in the structural areas of the waste pile. The site is located high up in the catchment and to the east of the drainages contributing to Creek 661. The catchment area for the waste pile is gently-sloped and small. Storm water from the tailings waste pile will be managed with several downstream sediment control ponds.

A PAG/NAG3 waste rock submergence impoundment will be positioned near the mine site area. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. An ‘upset’ conditions slurry tailings storage area will also be required in the impoundment for emergency conditions. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill.

Candidate 12 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.13 Candidate 13

Candidate 13 is a thickened-slurry tailings alternative located in the upper reaches of Turtle Creek approximately 11 km from the mine site area. The tailings will be permanently stored in a saturated condition in a TSF away from the mine site. The impoundment will have a footprint area of approximately 475 ha and will be created by constructing two dams with a maximum height of 90 m, and will be constrained by natural topography to the north and south. The dams will be progressively expanded using a combination of NAG waste materials from the open pit and local borrow materials. The impoundment will require that a section of the Kluskus Forest Service Road (FSR) be relocated through this area.

Tailings slurry will be conveyed to the TSF by pipeline over a distance of 15 km. Most of the water recovered during tailings deposition will be sent back to the mine site by a return water pipeline. A portion of the water will remain in the TSF for temporary storage. The pipeline route will follow the mine access road for approximately 10 km before turning northwest towards the TSF site. A combination of gravity conveyance and pumping will be required. The pipeline route will traverse the upper reaches of Creek 661, a large portion of the Davidson Creek catchment, and the Turtle Creek catchment. A tailings spill collection system will be required along the entire conveyance route.

A second impoundment will be positioned near the mine site area for PAG/NAG3 waste rock submergence. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. The dams will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. The PAG waste rock will be hauled directly downhill from the pit rim to the TSF for the entire life of the mine. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill.

Candidate 13 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.14 Candidate 14

Candidate 14 is a filtered tailings alternative located in the upper reaches of the Turtle Creek catchment (similar location as Candidate 13). The filtered tailings will be stacked in a waste pile on land in a partially-saturated condition in a side hill arrangement and positioned to the south of Turtle Creek. The centre of the waste pile site is located 11 km from the deposit. The waste pile will run directly adjacent to the Kluskus FSR and may require relocation of the road through this area. Tailings will be conveyed as thickened slurry in a pipeline from the mill building to the filtration building over a distance of 15 km. Water removed during filtration will be sent back to the mine site by a return water pipeline. The pipeline route will traverse the upper reaches of Creek 661, a large portion of the Davidson Creek catchment, and the Turtle Creek catchment. A tailings spill collection system will be required along the entire conveyance route.

Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. The pile will have a footprint area of approximately 400 ha with a maximum height of approximately 110 m. An area within the tailings waste pile will be required for tailings that do not meet the required moisture content for material placement in the structural areas of the waste pile. The site is located midway in the Turtle Creek catchment and within the Creek 700 tributary drainage. Storm water from

the tailings waste pile will be managed with upstream diversions and several downstream sediment control ponds.

A PAG/NAG3 waste rock submergence impoundment will be positioned near the mine site area. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. An 'upset' conditions slurry tailings storage area will also be required in the impoundment for emergency conditions. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill.

Candidate 14 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.15 Candidate 15

Candidate 15 is a thickened-slurry tailings alternative located in the upper reaches of an unnamed catchment north of Turtle Creek approximately 17 km from the mine site area. The tailings will be permanently stored in a saturated condition in a TSF away from the mine site. The impoundment will have a footprint area of approximately 575 ha and will be created by constructing a dam with a maximum height of 110 m, and will be constrained by natural topography to the south and west. The dams will be progressively expanded using a combination of NAG waste materials from the open pit and local borrow materials.

Tailings slurry will be conveyed to the TSF by pipeline over a distance of 25 km. Most of the water recovered during tailings deposition will be sent back to the mine site by a return water pipeline. A portion of the water will remain in the TSF for temporary storage. The pipeline route will follow the mine access road for approximately 15 km before turning west along the Kluskus FSR for 3 km and then northwest along other existing FSRs. A combination of gravity conveyance and pumping will be required. The pipeline route will traverse the upper reaches of Creek 661, the Davidson Creek catchment, and the Turtle Creek catchment before reaching the unnamed TSF catchment. A tailings spill collection system will be required along the entire conveyance route.

A second impoundment will be positioned near the mine site area for PAG/NAG3 waste rock submergence. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. The dams will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. The PAG waste rock will be hauled directly downhill from the pit rim to the TSF for the entire life of the mine. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill.

Candidate 15 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.16 Candidate 16

Candidate 16 is a filtered tailings alternative located in the lower reaches of the Chedakuz Creek catchment. The filtered tailings will be stacked in a waste pile on land in a partially-saturated condition in a heaped arrangement and positioned to the west of Chedakuz Creek roughly 10 km upstream of the Nechako Reservoir. The centre of the waste pile site is located 21 km from the deposit.

Tailings will be conveyed as thickened slurry in a pipeline from the mill building to the filtration building over a distance in excess of 30 km. A combination of gravity conveyance and pumping will be required. Water removed during filtration will be sent back to the mine site by a return water pipeline. The pipeline route will follow the mine access road for approximately 15 km before turning west along the Kluskus FSR for 3 km and then northwest along other existing FSRs. The pipeline route will traverse the upper reaches of Creek 661, the Davidson Creek catchment, the Turtle Creek catchment, and most of the lower Chedakuz Creek catchment. A tailings spill collection system will be required along the entire conveyance route.

Tailings will be filtered and then transported by conveyer to the mine waste pile for placement. A smaller truck fleet will be required for placement in non-optimal areas. The pile will have a footprint area of approximately 450 ha with a maximum height of approximately 70 m. An area within the tailings waste pile will be required for tailings that do not meet the required moisture content for material placement in the structural areas of the waste pile. The catchment area for the waste pile is gently-sloped and small. Storm water from the tailings waste pile will be managed with several downstream sediment control ponds.

A PAG/NAG3 waste rock submergence impoundment will be positioned near the mine site area. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. An ‘upset’ conditions slurry tailings storage area will also be required in the impoundment for emergency conditions. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill.

Candidate 16 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.17 Candidate 17

Candidate 17 is a filtered tailings alternative located in the upper reaches of an unnamed tributary to lower Chedakuz Creek. The filtered tailings will be stacked in a waste pile on land in a partially-saturated condition in a valley-fill arrangement. The centre of the waste pile site is located 23 km from the deposit.

Tailings will be conveyed as thickened slurry in a pipeline from the mill building to the filtration building over a distance in excess of 35 km. A combination of gravity conveyance and pumping will be required. Water removed during filtration will be sent back to the mine site by a return water pipeline. The pipeline route will follow the mine access road for approximately 15 km before turning west along the Kluskus FSR for 3 km and then northwest along other existing FSRs for 12 km. A new access road will be required along the remaining 5 km of the conveyance route. The pipeline route will traverse the upper reaches of Creek 661, the Davidson Creek catchment, the Turtle Creek catchment, and most of the lower Chedakuz Creek catchment. A tailings spill collection system will be required along the entire conveyance route.

Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. The pile will have a footprint area of approximately 475 ha with a maximum height of approximately 125 m. An area within the tailings waste pile will be required for tailings that do not meet the required moisture content for material placement in the structural areas of the waste pile. The catchment area

for the waste pile is small. Storm water from the tailings waste pile will be managed with upstream diversions and several downstream sediment control ponds.

A PAG/NAG3 waste rock submergence impoundment will be positioned near the mine site area. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. An 'upset' conditions slurry tailings storage area will also be required in the impoundment for emergency conditions. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill.

Candidate 17 was removed from further analysis because it was located in the UWR.

### 5.2.18 Candidate 18

Candidate 18 is a filtered tailings alternative located south of Tatelkuz Lake in the middle reaches of several unnamed drainages reporting directly to Tatelkuz Lake. The filtered tailings will be stacked in a waste pile on land in a partially-saturated condition in a side hill arrangement. The centre of the waste pile site is located 12 km from the deposit. Tailings will be conveyed as thickened slurry by gravity in a pipeline from the mill building to the filtration building approximately 15 km away along the same route as the fresh water supply pipeline coming from Tatelkuz Lake. Water removed during filtration will be sent back to the mine site by a return water pipeline.

Tailings will be filtered and then transported by conveyer to the mine waste pile for placement. A smaller truck fleet will be required for placement in non-optimal areas. The pile will have a footprint area of approximately 625 ha with a maximum height of approximately 60 m. An area within the tailings waste pile will be required for tailings that do not meet the required moisture content for material placement in the structural areas of the waste pile. The waste pile will be located midway down in the catchment with several existing drainages passing through the foundation area of the waste pile. Seepage from the waste pile will be managed by local seepage collection ponds. Storm water from the tailings waste pile will be managed with upstream diversions and several downstream sediment control ponds.

A PAG/NAG3 waste rock submergence impoundment will be positioned near the mine site area. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. An 'upset' conditions slurry tailings storage area will also be required in the impoundment for emergency conditions. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill.

The location of the filtered tailings stack is in an area that could be impacted by surface runoff and could make collection of sediment laden runoff improbable during storm events. Candidate 18 was removed from further analysis.

### 5.2.19 Candidate 19

Candidate 19 is a filtered tailings alternative located to the southwest of Kuyakuz Lake in the upper reaches of an unnamed tributary to the Blackwater River. The filtered tailings will be stacked in a waste pile on land in a partially-saturated condition in a side hill arrangement. The centre of the waste pile site is located 11 km from the deposit.

Tailings will be conveyed as thickened slurry in a pipeline from the mill building to the filtration building over a distance in excess of 15 km. A combination of gravity conveyance and pumping will be required. Water removed during filtration will be sent back to the mine site by a return water pipeline. The pipeline will follow new access roads and will traverse the upper reaches of Creek 661 before reaching the disposal site. A tailings spill collection system will be required along the entire conveyance route.

Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. The pile will have a footprint area of approximately 525 ha with a maximum height of approximately 80 m. An area within the tailings waste pile will be required for tailings that do not meet the required moisture content for material placement in the structural areas of the waste pile.

A PAG/NAG3 waste rock submergence impoundment will be positioned near the mine site area. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. An 'upset' conditions slurry tailings storage area will be required in the impoundment for emergency conditions. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill.

Candidate 19 was removed from further analysis because it was located in the Blackwater River drainage.

#### 5.2.20 Candidate 20

Candidate 20 is a filtered tailings alternative located in the Davidson Creek and Turtle Creek catchments. This option contemplated disposal of tailings in areas to avoid direct impact to fish habitat. All of the surface drainages in the mine site area are either known to contain kokanee and/or rainbow trout, or are presumed to contain these species of fish. This candidate requires the development of four separate filtered tailings waste piles spread over a distance of 5 km in order to avoid major surface drainages.

PAG and NAG3 waste rock will be stored in an engineered surface containment located in the upper reaches of Davidson Creek and Creek 661. The facility will have an engineered liner constructed on top of compacted overburden. Seepage passing through the liner will be collected in a seepage collection system and pumped to the water management pond via a water treatment plant and pipeline. Any unrecovered seepage will be acidic and has the potential to impact the groundwater system and the downstream drainage area. Multiple containment areas would be required to avoid direct impacts to fish and fish habitat.

A process water management pond will be required to support the mill operation and will created by constructing a water retaining dam with a maximum height of 40 m across Davidson Creek. This water management pond will impact fish habitat, notwithstanding the above efforts to avoid impacts to fish and fish habitat. Process water will be stored in the pond and reclaimed for use in the mill.

The locations of the filtered tailings and waste rock piles are spread across three different catchments, and are located in areas that will be impacted by surface runoff and make collection of sediment laden runoff improbable during storm events. A single storage area was not identified that will contain all the tailings and not impact fish or habitat, and therefore the candidate lacks sufficient

capacity to store tailings and waste rock over the entire mine life. Candidate 20 was removed from further analysis.

### 5.2.21 Candidate 21

Candidate 21 is a filtered tailings alternative located on the south side of Mount Davidson in the upper reaches of an unnamed tributary of the Blackwater River (similar location as Candidate 2). The filtered tailings will be stacked in a waste pile on land in a partially-saturated condition in a side hill arrangement. The centre of the waste pile site is located 4.5 km from the deposit. Tailings will be conveyed as thickened slurry in a pipeline from the mill building to the filtration building over a distance of 7 km. Water removed during filtration will be sent back to the mine site by a return water pipeline. The pipeline route will traverse the upper reaches of Creek 661 prior to reaching the disposal site. A tailings spill collection system will be required along the entire conveyance route. The western extent of the facility borders the Mathews Creek catchment.

Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. The pile will have a footprint area of approximately 525 ha with a maximum height of approximately 90 m. An area within the tailings waste pile will be required for tailings that do not meet the required moisture content for material placement in the structural areas of the waste pile. Storm water from the tailings waste pile will be managed with upstream diversions and several downstream sediment control ponds.

A PAG/NAG3 waste rock submergence impoundment will be positioned near the mine site area. The impoundment will have a footprint area of approximately 625 ha and will be created by constructing two small dams and one large dam with a maximum height of 110 m across Davidson Creek. An ‘upset’ conditions slurry tailings storage area will also be required in the impoundment for emergency conditions. Process water will be stored in the submergence facility, retained against the dam, and reclaimed for use in the mill.

Candidate 21 was removed from further analysis because it is located in the Blackwater River drainage.

### 5.2.22 Candidate 22

Candidate 22 is a filtered tailings alternative located at the top of the Davidson Creek catchment. The filtered tailings and PAG/NAG3 waste rock will be stacked on-land in separate waste piles in a partially-saturated condition. The centre of the tailings waste pile site is located 3.5 km from the deposit. The pile will have a footprint area of approximately 550 ha with a maximum height of approximately 145 m. Tailings will be pumped in a pipeline from the mill building to the filtration building approximately 1 km away as thickened slurry. Tailings will be filtered and then transported by conveyer to a truck load out building, where the filtered tailings will be loaded into trucks and moved to the mine waste pile for placement. An area within the tailings waste pile will be required for tailings that do not meet the required moisture content for material placement in the structural areas of the waste pile.

PAG and NAG3 waste rock will be stored in an engineered surface containment located west of the open pit excavation. The footprint of the waste rock dump is constrained further to the west by the UWR. The pile will have a footprint area of approximately 300 ha with a maximum height of

approximately 300 m. A NAG fill platform will be constructed at the base of the dump area to raise the topography and direct drainage in to multiple seepage collection ponds constructed around the toe of the facility. The fill platform will have an engineered soil liner constructed on top of compacted overburden from the open pit. Seepage passing through the soil liner and fill platform will be collected in one of the seepage collection ponds and pumped to the water management pond via a water treatment plant and pipeline. Any unrecovered seepage will be acidic and has the potential to impact the groundwater system and the downstream drainage area.

A process water management pond will be located downstream of the mine waste pile and created by constructing a water retaining dam with a maximum height of 40 m across Davidson Creek. Process water will be stored in the pond and reclaimed for use in the mill. An 'upset' conditions slurry tailings storage area will be required in the pond for emergency conditions.

Candidate 22 meets all of the pre-screening criteria and will remain in the analysis.

### 5.2.23 Candidate 23

Candidate 23 is a thickened-slurry tailings alternative located in the upper reaches of the Davidson Creek catchment. The TSF will permanently store tailings in a saturated condition in one impoundment. PAG/NAG3 waste rock will be stacked on-land in separate waste dump in a partially-saturated condition. The centre of the TSF site is located 4.5 km from the deposit. Tailings slurry will be conveyed by gravity in a pipeline to the TSF. The pipeline route will remain within the TSF catchment at all times.

The impoundment will have a footprint area of approximately 625 ha and will be created by constructing a two-sided main dam with a maximum height of 120 m, and is constrained by topography to the south and west. The dam will be progressively expanded with centreline raises using NAG waste materials from the open pit in advance of storage requirements. Process water will be stored within the TSF and reclaimed for use in the mill. Extensive tailings beaches will be developed to isolate the supernatant pond from the dam.

PAG and NAG3 waste rock will be stored in an engineered surface containment located west of the open pit excavation. The footprint of the waste rock dump is constrained further to the west by the UWR. The pile will have a footprint area of approximately 300 ha with a maximum height of approximately 300 m. A NAG fill platform will be constructed at the base of the dump area to raise the topography and direct drainage in to multiple seepage collection ponds constructed around the toe of the facility. The fill platform will have an engineered soil liner constructed on top of compacted overburden from the open pit. Seepage passing through the soil liner and fill platform will be collected in one of the seepage collection ponds and pumped to the water management pond via a water treatment plant and pipeline. Any unrecovered seepage will be acidic and has the potential to impact the groundwater system and the downstream drainage area.

Candidate 23 meets all of the pre-screening criteria and will remain in the analysis.

## 5.3 PRELIMINARY-SCREENING CRITERIA

A set of criteria was developed based on environmental site constraints to evaluate the group of candidates. The process of evaluating the candidates at this level is referred to as preliminary screening (pre-screening). The goal of pre-screening is to remove those candidates with obvious

deficiencies. The pre-screening criteria were developed to provide 'YES' or 'NO' answers, which are not subject to ambiguity. Pre-screening criteria are as follows:

- Will the alternative result in deposition of tailings into a fish-bearing lake?
- Will the alternative be partially located in the Blackwater River watershed?
- Will the alternative be located in the ungulate winter range?
- Will the alternative encroach on provincially or federally designated lands and/or private lands?
- Will the alternative have insufficient capacity to store tailings produced over the mine life?
- Will the alternative render collection and treatment of surface discharges impractical or improbable?

### 5.3.1 Fish-Bearing Lakes

Environment Canada makes note in the initial context of the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (EC, 2013) that:

*Natural water bodies frequented by fish shall be avoided to the extent practicable for the long-term disposal of mine waste; and that mine waste shall be managed to ensure the long-term protection of Canada's terrestrial and aquatic environment.*

In the interest of preserving large water bodies frequented by fish and in concordance with the Environment Canda alternatives assessment guidelines, New Gold has chosen to eliminate any candidate option that makes use of a fish bearing lake for tailings storage.

### 5.3.2 Blackwater River Watershed

The Blackwater River is listed as a Heritage River under the BC Heritage Rivers System by the BC Ministry of Environment (BC MOE, 2010). The BC Heritage Rivers System showcases outstanding examples of a representative range of BC's most important waterways. Heritage status gives these rivers a greater public profile and focus. Heritage Rivers represent the diversity of river landscapes in terms of their natural characteristics, their historical and cultural importance to the human story of the province, and the spectrum of recreational opportunities they support (BC MOE, 2010).

A Heritage River proclamation does not carry legal or regulatory power. Rather, the designation serves each river by (BC MOE, 2010):

- Providing a greater emphasis on river-related values during land-use planning processes
- Raising awareness of the importance of healthy river systems
- Helping to protect the special values of the river, and
- Helping to build stronger public support for, and involvement in, stewardship of the river.

New Gold respects the intended purpose of a Heritage River designation and has chosen not to develop any mine infrastructure within the Blackwater River drainage (AMEC, 2012) for the Project. Therefore, if any portion of a candidate lies within the Blackwater River drainage then this option will be excluded from further consideration.

### 5.3.3 Ungulate Winter Range

Ungulate Winter Range (UWR) is defined as an area that contains habitat that is necessary to meet the winter habitat requirements of an ungulate species. Sections 9 and 12 of the *Government*

*Actions Regulation* (BC Reg 582/2004) of the *Forest and Range Practices Act* (1996) outline the regulatory authority for establishing UWR. Caribou UWRs have legally established objectives with which most commercial and industrial operations must be consistent.

The Project area is adjacent to the Tweedsmuir-Entiako Northern Caribou UWR, which is key winter habitat used by the Tweedsmuir-Entiako Northern Caribou herd (Ecofor, 2013). These Northern Caribou are listed on Schedule 1 of the Canadian *Species at Risk Act* (2002) as Threatened.

The legal direction for the Tweedsmuir-Entiako Northern Caribou herd comes from the document *Order – Ungulate Winter Range #U-7-012* dated December 30, 2005 (the Order). Mineral exploration and development activities are exempt from requirements to manage Northern Caribou through Section 6 of the Order:

*The general wildlife measures outlined in Schedule 1 do not apply for the purposes of exploration, development and production activities when these activities have been authorized for the purpose of subsurface resource exploration, development or production by the Mineral Tenure Act, the Coal Act, the Mines Act, the Petroleum and Natural Gas Act, the Pipeline Act or the Geothermal Resources Act.*

In accordance with the Northern Caribou Management Plan (Ecofor, 2013) developed by New Gold, New Gold has chosen to eliminate any candidate that overlaps with UWR from further consideration.

### 5.3.4 Provincially or Federally Designated Lands

As noted on the Parks Canada website (Parks Canada, 2015):

*"National Parks are a country-wide system of representative natural areas of Canadian significance. By law, they are protected for public understanding, appreciation and enjoyment, while being maintained in an unimpaired state for future generations. National Parks have existed in Canada for well over a century."*

As noted on the BC Parks website (BC Parks):

*"BC Parks is responsible for the designation, management and conservation of a system of ecological reserves, provincial parks and recreation areas located throughout the province."*

New Gold respects the intended purpose of a Park designation and has chosen not to propose development of any mine infrastructure within these lands for the Project. Therefore, if any portion of a candidate lies within a Provincially or Federally designated Park then this option will be excluded from further consideration.

### 5.3.5 Insufficient Capacity

The use of several distinct tailings storage facilities to manage mine waste for the Project was considered grounds for exclusion of that candidate from further consideration. This criterion is intended to reflect facilities separated by a significant distance, as opposed to staged facilities within a single final footprint (i.e. Candidate 1). This practice, unless it is based on a good rationale such as separation of tailings streams or distance between satellite ore bodies, increases the construction, operational, and closure and post-closure complexities and risk of accidents/failures (e.g., tailings pipeline breaks) for the Project. Candidate locations with insufficient storage capacity were eliminated from further evaluation.

### 5.3.6 Prevention of Surface Discharges without Treatment

The location and layout of a candidate should not position mine facilities in a way that eliminates the ability to capture and treat, if necessary, the tailings facility site runoff generated during the design flood event. Excess inflow to the TSF may result in a discharge of tailings pond supernatant that could reasonably be expected to require treatment during operations prior to release. Runoff has the capacity to mobilize tailings solids into suspended sediment, and if the runoff cannot reasonably be collected or exceeds the capacity for collection (and treatment) then tailings mobilization to the downstream receiving environment will be expected.

## 5.4 CANDIDATE SCREENING

Candidates which provide a 'YES' response to at least one of the pre-screening criteria have deficiencies which warrant removal from further analysis. A summary of candidates removed during pre-screening and those candidates continuing on to the high level risk assessment are noted in the following sections. A summary of the criteria violated is provided for each candidate that was removed.

The candidate removal process, for reference, was based on the follow set of pre-screening criteria:

- Will the alternative result in deposition of tailings into a fish-bearing lake?
- Will the alternative be partially located in the Blackwater River watershed?
- Will the alternative be located in the ungulate winter range?
- Will the alternative encroach on provincially or federally designated lands and/or private lands?
- Will the alternative have insufficient capacity to store tailings produced over the mine life?
- Will the alternative makes prevention of surface discharges without treatment impractical or improbable?

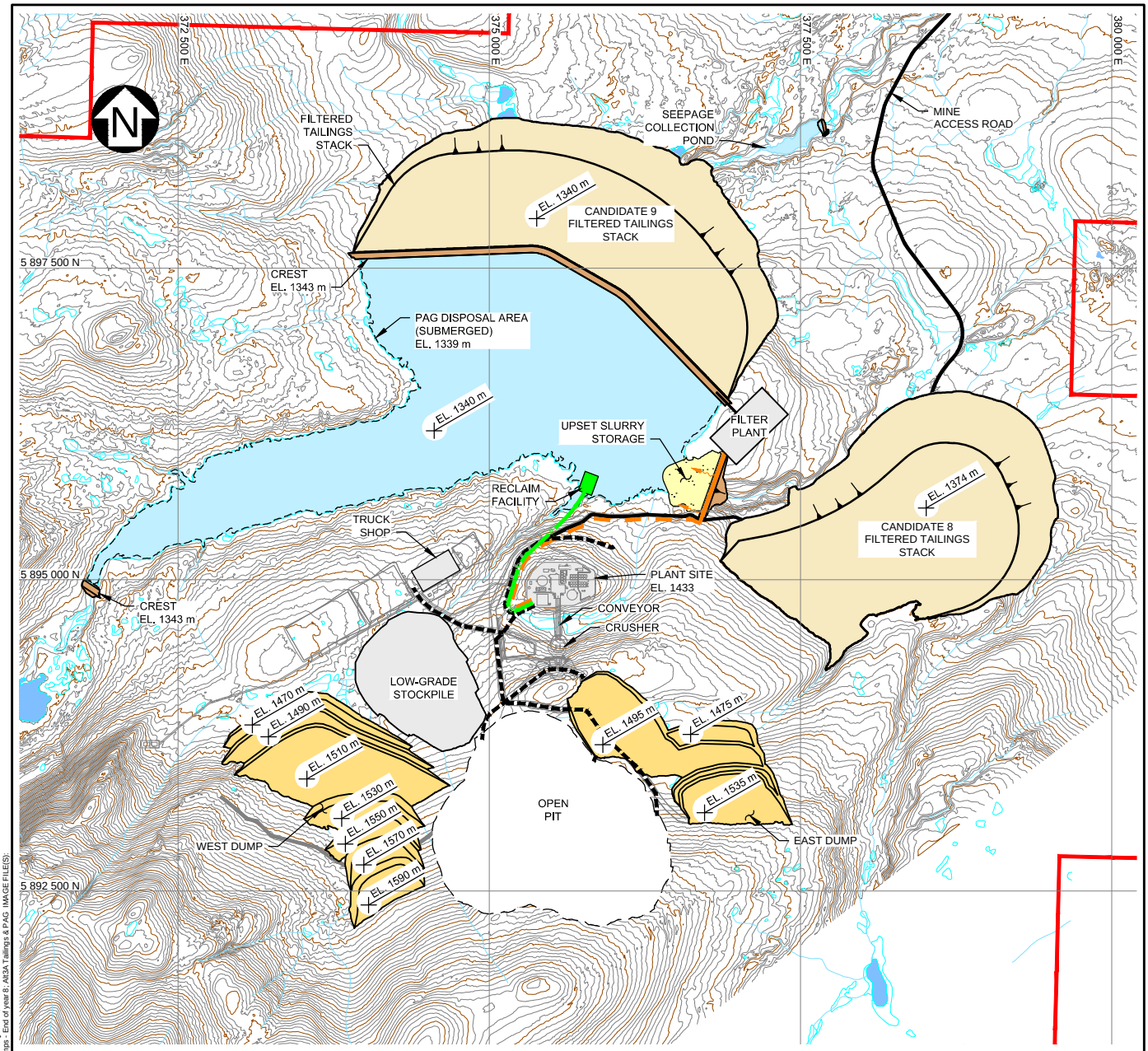
### 5.4.1 Removed Candidates

The following candidates were removed from the analysis based on the pre-screening criteria:

- Candidate 2 – located in the Blackwater River watershed
- Candidate 3 – located in the Ungulate winter range
- Candidate 8 – impractical or improbable collection of surface water discharges
- Candidate 9 – impractical or improbable collection of surface water discharges
- Candidate 11 – deposition of tailings into a fish-bearing lake, insufficient capacity to store tailings over the mine life
- Candidate 17 – located in the Ungulate winter range
- Candidate 18 – impractical or improbable collection of surface water discharges
- Candidate 19 – located in the Blackwater River watershed
- Candidate 20 – insufficient capacity to store tailings over mine life, and impractical or improbable collection of surface water discharges
- Candidate 21 – located in the Blackwater River watershed

The criteria for removal based on prevention of surface discharges without treatment being impractical or improbable is best explained by comparing layouts for two of the removed candidates (Candidate 8 and Candidate 9) shown on Figure 5.2 with two of the remaining candidates (Candidate 6 and Candidate 7) shown on Figure 5.3. The locations of the filtered tailings waste piles upstream of

the submergence impoundment for PAG/NAG3 waste rock shown on Figure 5.3 will facilitate collection of runoff during storm events. The submergence impoundment will be designed to capture a very large IDF, which includes runoff from the waste pile area. This large storage capacity will prevent discharge of sediment laden water to the environment for the largest of storm events. The downstream position of the filtered tailings waste piles shown on Figure 5.2 will rely on sediment control ponds and polishing to remove sediment before water is discharged to the environment. The IDF for a sediment control pond is a much smaller storm event than the IDF for a mine waste impoundment, and it is not practical to create another large dam downstream to create more storm surge capacity. Therefore, Candidates 8 and 9 make prevention of surface discharges without treatment improbable and they were eliminated for this fatal flaw.




**LEGEND:**

- SLURRY TAILINGS
- MINE WATER
- FRESH WATER
- EMBANKMENT
- FILTERED TAILINGS
- NAG STOCKPILE
- RECLAIM SYSTEM
- PUMPSTATION
- MINE ACCESS ROAD
- MINE HAUL ROAD
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TAILINGS PIPELINE
- SLURRY TAILINGS DISCHARGE

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

**FOR INFORMATION ONLY**

SCALE A: 500 250 0 500 1000 1500 2000 2500 m

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

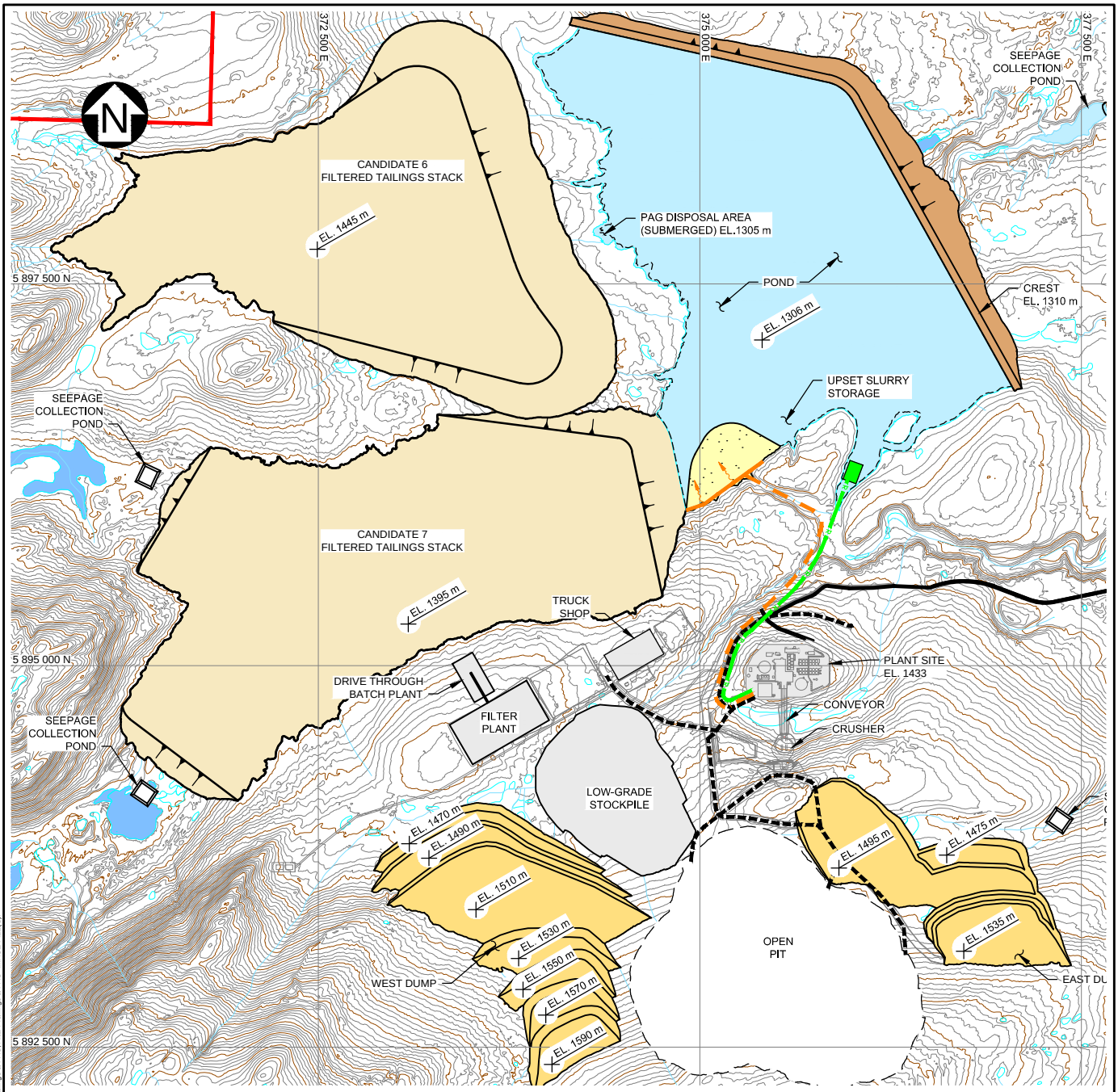
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**DOWNSTREAM FILTERED TAILINGS ARRANGEMENTS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE 5.2** | REV 0

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XREF FILE(S): Topo 5m Contours; Dumps - End of year 17; Open Pit - End of Year 17; Plant Site; Hydro; Watershed Model - Tailing's Ponds; Alt3B Tailings & PAG; Dumps - End of year 8; Alt3A Tailings & PAG IMAGE FILE(S):




**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- FILTERED TAILINGS
- NAG WASTE ROCK
- RECLAIM SYSTEM
- MINE ACCESS ROAD
- MINE HAUL ROAD
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

**FOR INFORMATION ONLY**

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| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**UPSTREAM FILTERED TAILINGS ARRANGEMENTS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15

REF NO. 1

**FIGURE 5.3**

REV 0

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XREF FILE(S): Topo 5m Contours; Dumps - End of year 17; Open Pit - End of Year 17; Plant Site; Hydro; Watershed Model - Tailing's Ponds; Alt2B Tailings & PAG; Alt2A Tailings & PAG IMAGE FILE(S):

### 5.4.2 Selected Candidates

The candidates summarized in Table 5.1 will carry on to the high level risk assessment:

**Table 5.1 Selected Candidates for High Level Risk Assessment**

| CANDIDATE NUMBER | TAILINGS TECHNOLOGY | CATCHMENT AREA (1) | PAG/NAG3 DISPOSAL (2) | CATCHMENT AREA (3) | DISPOSAL METHOD (4) |
|---|---|---|---|---|---|
| 1 | SLURRY | DAVIDSON CREEK | SUBMERGED | DAVIDSON CREEK | TOGETHER |
| 4 | SLURRY | CREEK 661 | SUBMERGED | CREEK 661 | TOGETHER |
| 5 | FILTERED | DAVIDSON CREEK | ON-LAND | DAVIDSON CREEK | TOGETHER |
| 6 | FILTERED | DAVIDSON CREEK | SUBMERGED | DAVIDSON CREEK | SEPARATE |
| 7 | FILTERED | DAVIDSON CREEK | SUBMERGED | DAVIDSON CREEK | SEPARATE |
| 10 | PASTE | DAVIDSON CREEK | SUBMERGED | DAVIDSON CREEK | TOGETHER |
| 12 | FILTERED | UPPER CHEDAKUZ CREEK | SUBMERGED | DAVIDSON CREEK | SEPARATE |
| 13 | SLURRY | TURTLE CREEK | SUBMERGED | DAVIDSON CREEK | SEPARATE |
| 14 | FILTERED | TURTLE CREEK | SUBMERGED | DAVIDSON CREEK | SEPARATE |
| 15 | SLURRY | LOWER CHEDAKUZ CREEK | SUBMERGED | DAVIDSON CREEK | SEPARATE |
| 16 | FILTERED | LOWER CHEDAKUZ CREEK | SUBMERGED | DAVIDSON CREEK | SEPARATE |
| 22 | SLURRY | DAVIDSON CREEK | ON-LAND | DAVIDSON CREEK | SEPARATE |
| 23 | FILTERED | DAVIDSON CREEK | ON-LAND | DAVIDSON CREEK | SEPARATE |

**NOTES:**

1. CATCHMENT AREA WHERE TAILINGS DISPOSAL SITE IS LOCATED.
2. PAG/NAG3 WASTE ROCK DISPOSAL TECHNIQUE: “SUBMERGED” IN AN IMPOUNDMENT OR PLACED IN AN “ON-LAND” DUMP.
3. CATCHMENT AREA WHERE PAG/NAG3 WASTE ROCK DISPOSAL SITE IS LOCATED.
4. TAILINGS AND PAG/NAG3 WASTE ROCK DISPOSAL TECHNIQUE: CO-DISPOSED “TOGETHER” OR PLACED “SEPARATE”.

# 6 – CANDIDATE HIGH LEVEL RISK ASSESSMENT

## 6.1 GENERAL

The purpose of the High Level Risk Assessment (HLRA) was to compare the relative risks to development for similar candidates. Candidates were separated by tailings technology to prevent risk assessment bias from removing all candidates of a single technology.

The two tailings technology categories were:

- Slurry tailings, consisting of the remaining thickened-slurry and paste candidates, and
- Filtered tailings, consisting of the remaining filtered candidates.

A third category was included, notwithstanding the above, that considered the most 'physically stable' candidates. This category compared a subset of the filtered tailings category where PAG/NAG3 waste rock will be disposed of in an on-land dump, and water will be stored separately from mine waste. This category directly addresses the assertion of the foremost importance of physical stability of Section 9.3.3 of the Panel Report (IEEIRP, 2015), which states the following:

*"…the Mount Polley failure shows why physical stability must remain foremost and cannot be compromised. Although the tailings released at Mount Polley were not highly reactive, it is sobering to contemplate the chemical effects had they been. No method for achieving chemical stability can succeed without first ensuring physical stability: chemical stability requires above all else that the tailings stay in one place."*

This third category also addresses the three principles of best available technology (BAT) through mechanical dewatering and placement of tailings, and separation of mine waste and water management facilities. The three BAT principles are found in Section 9.3.1 of the Panel Report (IEEIRP, 2015).

1. Eliminate surface water from the impoundment.
2. Promote unsaturated conditions in the tailings with drainage provisions.
3. Achieve dilatant conditions throughout the tailings deposit by compaction.

Storage strictly in this manner will not prevent the onset of acidic drainage conditions, but rather will rely on collection and treatment to manage the associated environmental risks.

## 6.2 LIKELIHOOD AND CONSEQUENCE DEFINITIONS

The HLRA makes certain that there will be a slurry candidate, a filtered tailings candidate, and a second filtered tailings candidate with PAG/NAG3 waste rock stored in an on-land dump advancing to the Multiple Accounts Analysis. The HLRA methodology was created to select the 'best' of each category by considering certain risks of development for each candidate.

Risk is defined as follows:

**risk = likelihood x consequence**

Candidates were analyzed based on a specific defined hazard applying to each alternative with respect to safety, environment, and technical execution.

**Hazard asks the question 'what can go wrong?'**

Candidates were individually assessed based on the likelihood of occurrence and the potential consequence of occurrence for each hazard.

**Likelihood provides a qualitative answer to the question 'how likely it is to happen?'**

AND

**Consequence provides a qualitative answer to the question 'how bad could it be?'**

The criteria for establishing the likelihood of occurrence are outlined in Table 6.1. The descriptors and frequency ratings provide a qualitative comparison of the five levels of likelihood considered. A likelihood score is included for each level and will be used to develop a semi-quantitative ranking of risk for comparison.

**Table 6.1 Likelihood of Occurrence**

| LIKELIHOOD SCORE | DESCRIPTOR | | FREQUENCY |
|---|---|---|---|
| 1 | Very rare | Possible but only in extreme circumstances | Less than one event per 1,000 years |
| 2 | Unlikely | Has not happened but could | Less than one event per 100 years |
| 3 | Possible | Could happen and has happened elsewhere | Less than one event per 20 years |
| 4 | Likely | Could easily happen | Less than one event per year |
| 5 | Almost Certain | Happens often | More than one event per year |

The criteria for consequence ratings are outlined in Table 6.2. A consequence score is included for each level and will be used to develop a semi-quantitative ranking of risk for comparison. The descriptors provide a qualitative comparison of the five levels of consequence considered. Four categories of consequences are defined and a criterion for each category and level is provided. The categories are environmental, Aboriginal rights and title, business, and damage/loss. The consequence rating for each hazard was based on the worst rating in each category (i.e. the hazard needs to meet one description not all four descriptions).

**Table 6.2 Consequence of Occurrence**

| CONSEQUENCE SCORE | DESCRIPTOR | ENVIRONMENT | ABORIGINAL RIGHTS AND TITLE | BUSINESS | DAMAGE / LOSS |
|---|---|---|---|---|---|
| 1 | Insignificant | Limited short-term effect in small or previously disturbed area | There is no change to the abundance of resources (e.g., wildlife, birds, vegetation) or to the availability of land typically accessed for the purpose of undertaking traditional Aboriginal land use activities. | < 6 hour production delay | < $0.5 Million |
| 2 | Minor | Small short-term effect on part of ecosystem | Lands and resources typically accessed to support traditional Aboriginal land use activities experience minor reductions or other effects in the short term, but access or harvesting is not compromised. | > 6 hour < 24 hour production delay | $0.5- $2 Million |
| 3 | Moderate | Moderate short-term effects, affecting part of ecosystem (i.e. biological or physical environment) | An area of land (including waterbodies) or a natural resource typically accessed by an Aboriginal group for the purpose of pursuing traditional land use activities (for subsistence or other purposes) is unavailable in the short-to medium-term. | >1 day and < 1 week production delay | $2 - $10 Million |
| 4 | Major | Serious medium-term environmental impact, affecting whole ecosystem | An area of land (including waterbodies) or a natural resource typically accessed by an Aboriginal group for the purpose of pursuing traditional land use activities (for subsistence or other purposes) is unavailable for an extended period of time. | > 1 week and < 1 month production delay | $10 - $50 Million |
| 5 | Catastrophic | Irreparable damage, very serious long term impairment, affecting whole ecosystem | An area of land (including waterbodies) or a natural resource typically accessed by an Aboriginal group for the purpose of pursuing traditional land use activities (for subsistence or other purposes) is unavailable for the foreseeable future. | > 1 month production delay | > $50 Million |

## 6.3 HAZARDS

The hazards applying to each candidate were based in specific engineering and environmental issues which will pose the greatest risks to development. Each candidate was evaluated against reasonably similar hazards to create a meaningful comparison of relative risk. Descriptions of the hazards are provided in the following sections. The hazards were arranged in three categories: safety, environment, and technical execution.

### 6.3.1 Safety

The safety hazard considered for each candidate was based on the potential for loss of containment of mine waste and/or mine water. This hazard applies to all options for tailings and waste rock management, and specific details of the hazard considered are provided in the discussion for each candidate. This hazard is often described as a dam breach for a water containing facility; however a similar hazard also exists for a waste pile. Safety of the waste pile will consider downstream impacts and resulting consequences of failure to provide a consistent basis of comparison with a tailings impoundment.

#### 6.3.1.1 Dams

Loss of containment resulting from failure of a dam confining tailings and/or waste rock and water could lead to discharge of free water from the facility. Free water will then mobilize solids, including tailings and/or waste rock from the impoundment and construction material from the dam. Failure of an earthen dam typically occurs over a matter of minutes to hours with a flood wave rising as the breach develops, peaking at some point during discharge and then receding as the flood wave subsides. A flood wave propagating downstream of the dam would cause significant erosion and inundate the downstream receiving environment.

#### 6.3.1.2 Filtered Tailings Waste Piles

Tailings slumping could occur from loading of an inadequately compacted or high moisture content area of filtered tailings, slope failure, or foundation failure. A significant storm event could also cause erosion with runoff mobilizing tailings from the waste pile. The resulting consequences downstream will depend on the magnitude of the movement or the storm event, and the infrastructure downstream of the waste pile.

Any water collection ponds located downstream of a filtered tailings waste pile will be at risk of overtopping due to tailings slumping, displacement of water, and a resulting wave. Loss of containment of a water pond due to overtopping from a tailings slump could also lead to release of the slumped tailings solids. A storm event generating runoff from the waste pile could lead to the release of tailings solids downstream if the storm event exceeded the storage capacity of the downstream water management structures.

#### 6.3.1.3 Water Retaining Dams

Loss of containment of a water retaining dam due to piping, slope failure, foundation failure, or earthquake deformation could lead to discharge of mine water. The free water will mobilized construction material from the dam. The failure will cause a flood wave that will propagate

downstream of the dam causing significant erosion and inundating the downstream receiving environment. The resulting failure will be similar to a dam containing tailings and/or waste rock, but without significant mobilization of mine waste material. The downstream consequences will be due to the impacts from the quality of water released.

#### 6.3.2 Environment

The hazard considered for each candidate was based on the potential for unplanned loss or discharge of effluent. This hazard applies to all candidates and includes unplanned spilling from a sediment/seepage control dam spillway, unplanned discharge from a water treatment facility and/or tailings pipeline rupture leading to loss of tailings to the environment.

##### 6.3.2.1 Implications of Acid Rock Drainage and Metal Leaching

PAG waste rock generated through mining was predicted to be acid generating when exposed to ambient air over for longer than approximately 1 year. NAG3 waste rock was predicted to be metal leaching when exposed to air for a period longer than 3 to 5 years. The acid generating potential of the PAG waste rock and significant ML release from NAG3 waste rock can be mitigated by submergence (i.e. reduction of oxygen transfer). The study includes options for comparison that consider subaerial, unsaturated storage of these waste rock types in mine waste piles. Storage in this latter manner will not prevent the onset of acidic drainage and metal leaching conditions, but rather will rely on collection and treatment to manage the environmental risks associated with these candidates. The consequences of failure to collect effluent are exacerbated for these candidates.

#### 6.3.3 Technical Execution

The hazard considered for each candidate was based on the application of complex technology resulting in an inability to meet design criteria. A single hazard related to the majority of the candidates. The hazard was difficult development of the design due to a failure of tailings management, distribution and placement. This hazard includes the difficulty associated with co-disposal of mine waste rock with tailings if applicable.

### 6.4 RANKING SUMMARY

The hazard description, likelihood score and consequence score for each candidate and each hazard category are shown on Table D-1, in Appendix D. The definition of each hazard and the rationale for the selection of likelihood and consequence scores are described in the following sections. The descriptions are arranged by candidate.

#### 6.4.1 Candidate 1

##### 6.4.1.1 Safety

A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the mining dam impounding tailings and PAG waste rock will pose the greatest safety risk for Candidate 1. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment was classified as ‘very rare’ because it is designed for maximum credible events (MCE and PMF) and the tailings beach will provide separation of the supernatant pond from the dam. A well maintained tailings beach can prevent loss of containment even if there is

embankment deformation, which provides increased redundancy in the design. A discharge of mine waste and water causing a flood wave has the potential to create irreparable damage and serious long term impairment to the downstream environment due to the presence of PAG materials within the impoundment. This could leave the area directly downstream unavailable for traditional land use activities for the foreseeable future and have short to medium term effects further downstream. The consequence of occurrence was classified as 'catastrophic'. The final ratings were:

- Likelihood - Very Rare (1)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 5.

#### 6.4.1.2 Environment

A loss of dam runoff and seepage from the seepage collection pond downstream of the TSF will pose the greatest environmental risk for Candidate 1. A loss effluent from the seepage collection pond downstream of the TSF will require a storm event greater than allowed for in design storage requirements and will require that the effluent during that storm is of degraded quality. Submergence within the TSF will limit the ARD potential of the PAG waste rock thereby controlling seepage quality. The likelihood was classified as 'unlikely' corresponding to a discharge during a storm event with a return period greater than 1 in 100 years. Any elevated parameters of concern would be heavily diluted by inflows. The potential consequences would be short term and limited to a small area of Davidson Creek and were classified as 'minor'. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Minor (2), and
- Overall Risk Rating – 4.

#### 6.4.1.3 Technical

A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk for Candidate 1. A beach will be developed upstream of the dam while maintaining an appropriate level of freeboard. Issues with development of the beach could occur during the mine life, especially during the early years of operation of Site D, and were classified as 'likely'. Tailings discharge locations could be easily modified or alterations to the spigot locations implemented to manage the beach location while operations continue. The consequence was classified as 'insignificant'. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Insignificant (1), and
- Overall Risk Rating – 4.

### 6.4.2 Candidate 4

#### 6.4.2.1 Safety

A flood wave in Creek 661 and Tatelkuz Lake resulting from a breach of the mining dam impounding tailings and PAG waste rock will pose the greatest safety risk for Candidate 4. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment was classified as 'very rare' because it is designed for maximum credible events (MCE and PMF) and the tailings beach will provide separation of the supernatant pond from the dam. A

well maintained tailings beach can prevent loss of containment even if there is embankment deformation, which provides increased redundancy in the design. A discharge of mine waste and water causing a flood wave has the potential to create irreparable damage and serious long term impairment to the downstream environment due to the presence of PAG materials within the impoundment. This could leave the area directly downstream unavailable for traditional land use activities for the foreseeable future and have short to medium term effects further downstream. The consequence of occurrence was classified as 'catastrophic'. The final ratings were:

- Likelihood - Very Rare (1)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 5.

#### 6.4.2.2 Environment

A loss of dam runoff and seepage from one of the seepage collection ponds downstream of the TSF will pose the greatest environmental risk for Candidate 4. A loss effluent from the seepage collection ponds will require a storm event greater than allowed for in design storage requirements and will require that the effluent during that storm is of degraded quality. Submergence within the TSF will limit the ARD potential of the PAG waste rock thereby controlling seepage quality. The likelihood was classified as 'Possible' corresponding to a discharge during a storm event with a return period greater than 1 in 20 years. The potential consequences would be short term and limited to a small area of Creek 661 and were classified as 'minor'. The final ratings were:

- Likelihood - Possible (3)
- Consequences - Minor (2), and
- Overall Risk Rating – 6.

#### 6.4.2.3 Technical

A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk for Candidate 4. A beach will be developed upstream of the dam while maintaining an appropriate level of freeboard. Issues with development of the beach could occur during the mine life due to the rate of rise and shape of the facility, and were classified as 'likely'. Tailings discharge locations could be modified but the shape of the facility cannot without substantial business impacts. The consequence was classified as 'minor' representative periodic day long shutdowns to regain control of beach development. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Minor (2), and
- Overall Risk Rating – 8.

### 6.4.3 Candidate 5

#### 6.4.3.1 Safety

A loss of containment of the process water pond will pose the greatest safety risk for Candidate 5. This could occur from slumping of the tailings and waste rock pile leading to overtopping of the process water pond dam, or from failure of the dam itself. The likelihood of failure was classified as 'unlikely' because the process water pond is susceptible to additional failure potential as a result of the tailings and waste rock pile, and because embankment deformation impacting available

freeboard could result in an overtopping failure. A discharge of mine water from the dam has the potential to create serious medium-term effects to Davidson Creek through a slug of mine water and flood wave erosion. This could leave the area directly downstream unavailable for traditional land use activities for an extended period of time but should be recoverable because the failure will not lead to a release of mine waste materials to the environment. The consequence of occurrence was classified as 'major'. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Major (4), and
- Overall Risk Rating – 8.

#### 6.4.3.2 Environment

A loss of effluent from the process water pond downstream of the TSF will pose the greatest environmental risk for Candidate 5. A loss of effluent from the water management pond will require a storm event greater than allowed for in design storage requirements and/or failure of a water treatment system. The pond was designed to contain a 1 in 200 year storm event, and to pass any larger events through a spillway. A loss of ML and ARD runoff has the potential to occur as storage of PAG waste rock on land will lead to ARD. The likelihood was classified as 'unlikely' corresponding to a discharge during a storm event with a return period greater than 1 in 200 years. A discharge of mine water from the dam has the potential to create short to medium term effects Davidson Creek through a slug of mine water and consequences were classified as 'moderate'. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Moderate (3), and
- Overall Risk Rating – 6.

#### 6.4.3.3 Technical

A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for Candidate 5. Tailings produced and maintained at moisture content approximately equal to optimum will be imperative for field compaction. Tailings dewatering at the mill will be impacted by consistency of the grind, mineralogy, and solids content delivered to the filter plant. Transport of filtered tailings to the waste pile will require a seamless operation reliant on truck and conveyor transport. Precipitation events during placement in the field will potentially increase moisture content of the tailings and inhibit compaction. Weather conditions are expected to have a greater impact during the winter months when precipitation falls as snow, and could impact short term operations and long-term stability. Areas not meeting design requirements could result in re-work to meet specifications. Issues with tailings filtering, transport, placement, and compaction were classified as 'likely'. The filtered tailings will be co-disposed with PAG waste rock, which increases the potential for delays in placement due to complications in waste disposal planning. These issues were classified as a 'major' consequence corresponding to the potential for a production delay between one week and one month. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Major (4), and
- Overall Risk Rating – 16.

### 6.4.4 Candidate 6

#### 6.4.4.1 Safety

A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the mining dam impounding PAG/NAG3 waste rock will pose the greatest safety risk for Candidate 6. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment could be considered rare because it is designed for maximum credible events (MCE and PMF); however, it is somewhat more susceptible to failure since there is no tailings beach and embankment deformation impacting available freeboard could result in an overtopping failure. Therefore, the likelihood was classified as 'unlikely'. A discharge of mine waste and water causing a flood wave has the potential to create irreparable damage and serious long term impairment to the downstream environment due to the presence of PAG materials within the impoundment. This could leave the area directly downstream unavailable for traditional land use activities for the foreseeable future and have short to medium term effects further downstream. The consequence of occurrence was classified as 'catastrophic'. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 10.

#### 6.4.4.2 Environment

A loss of dam runoff and seepage from the seepage collection pond downstream of the submergence impoundment will pose the greatest environmental risk for Candidate 6. A loss effluent from the seepage collection pond downstream of the TSF will require a storm event greater than allowed for in design storage requirements and will require that the effluent during that storm is of degraded quality. Submergence within the impoundment will limit the ARD potential of the PAG waste rock thereby controlling seepage quality. The location of the tailings waste pile in a sidehill arrangement slightly increases the potential for degraded seepage quality at the time of the event. The likelihood was classified as 'unlikely' corresponding to a discharge during a storm event with a return period greater than 1 in 100 years. Any elevated parameters of concern would be heavily diluted by inflows. The potential consequences would be short to medium term and limited to a part of Davidson Creek and were classified as 'moderate'. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Moderate (3), and
- Overall Risk Rating – 6.

#### 6.4.4.3 Technical

A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for Candidate 6. Issues with tailings filtering, transport, placement, and compaction were classified as 'likely'. These issues were classified as a 'moderate' consequence corresponding to the potential for a production delay between one day and one week. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Moderate (3), and
- Overall Risk Rating – 12.

### 6.4.5 Candidate 7

#### 6.4.5.1 Safety

A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the mining dam impounding PAG/NAG3 waste rock will pose the greatest safety risk for Candidate 7. The likelihood was classified as 'unlikely'. The consequence of occurrence was classified as 'catastrophic'. The ratings are unchanged from those described in Candidate 6. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 10.

#### 6.4.5.2 Environment

A loss of dam runoff and seepage from the seepage collection pond downstream of the submergence impoundment will pose the greatest environmental risk for Candidate 7. The likelihood was classified as 'unlikely' corresponding to a discharge during a storm event with a return period greater than 1 in 100 years. Any elevated parameters of concern would be heavily diluted by inflows. The potential consequences would be short term and limited to a part of Davidson Creek and were classified as 'minor'. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Minor (2), and
- Overall Risk Rating – 4.

#### 6.4.5.3 Technical

A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for Candidate 7. Issues with tailings filtering, transport, placement, and compaction were classified as 'likely'. These issues were classified as a 'moderate' consequence corresponding to the potential for a production delay between one day and one week. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Moderate (3), and
- Overall Risk Rating – 12.

### 6.4.6 Candidate 10

#### 6.4.6.1 Safety

A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the mining dam impounding paste tailings and PAG/NAG3 waste rock will pose the greatest safety risk for Candidate 10. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment could be considered rare because it is designed for maximum credible events (MCE and PMF); however, it is somewhat more susceptible to failure since there is no tailings beach and embankment deformation impacting available freeboard could result in an overtopping failure. Therefore, the likelihood was classified as 'unlikely'. A discharge of mine waste and water causing a flood wave has the potential to create irreparable damage and serious long term impairment to the downstream environment due to the presence of PAG materials within

the impoundment. This could leave the area directly downstream unavailable for traditional land use activities for the foreseeable future and have short to medium term effects further downstream. The consequence of occurrence was classified as ‘catastrophic’. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 10.

#### 6.4.6.2 Environment

A loss of dam runoff and seepage from the seepage collection pond downstream of the submergence impoundment will pose the greatest environmental risk for Candidate 10. The likelihood was classified as ‘unlikely’ corresponding to a discharge during a storm event with a return period greater than 1 in 100 years. Any elevated parameters of concern would be heavily diluted by inflows. The potential consequences would be short term and limited to a part of Davidson Creek and were classified as ‘minor’. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Minor (2), and
- Overall Risk Rating – 4.

#### 6.4.6.3 Technical

A failure to achieve the design level of thickening will pose the greatest technical risk for Candidate 10. A reduction in the level of thickening could result in generation of supernatant water at the surface of the facility leading to a larger than anticipated pond volume. It is expected that difficulties with thickening will be ‘likely’, occurring multiple times through the mine life. The effect of reduced thickening will be ‘minor’, as short delays to production may be required for maintenance of the plant. The TSF could be dewatered to manage excess water or the location of spigots changed to provide better coverage of PAG waste rock in the event of thickening issues. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Minor (2), and
- Overall Risk Rating – 8.

### 6.4.7 Candidate 12

#### 6.4.7.1 Safety

Candidate 12 will have a filtered tailings waste pile located in the upper reaches of Chedakuz Creek approximately 9 km from the mine site area. An impoundment will be positioned near the mine site area for PAG/NAG3 waste rock submergence. A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the impoundment will pose the greatest safety risk for Candidate 12. The likelihood was classified as ‘unlikely’. The consequence of occurrence was classified as ‘catastrophic’ due to the potential for loss of mine waste and water. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 10.

#### 6.4.7.2 Environment

A loss of tailings from the pipeline leading to the storage facility will pose the greatest environmental risk for Candidate 12. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered 'possible'. A loss of tailings could result in 'moderate' impacts with short to medium term effect on the local ecosystem and impacts to traditional land use activities.

- Likelihood - Possible (3)
- Consequences - Moderate (3), and
- Overall Risk Rating – 9.

#### 6.4.7.3 Technical

A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for Candidate 12. Issues with tailings filtering, transport, placement, and compaction were classified as 'likely'. These issues were classified as a 'moderate' consequence corresponding to the potential for a production delay between one day and one week. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Moderate (3), and
- Overall Risk Rating – 12.

### 6.4.8 Candidate 13

#### 6.4.8.1 Safety

Candidate 13 will have a TSF located in the upper reaches Turtle Creek approximately 11 km from the mine site area. A second impoundment will be positioned near the mine site area for PAG/NAG3 waste rock submergence. A flood wave in Davidson Creek or Turtle Creek and lower Chedakuz Creek resulting from a breach of either facility will pose the greatest safety risk for Candidate 13. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment could be considered rare because it is designed for maximum credible events (MCE and PMF); however, it is somewhat more susceptible to failure since there are two facilities separated by a large distance. Therefore, the likelihood was classified as 'unlikely'. The consequence of occurrence was classified as 'catastrophic' due to the potential for loss of mine waste and water. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 10.

#### 6.4.8.2 Environment

A loss of tailings from the pipeline leading to the storage facility on Turtle Creek will pose the greatest environmental risk for Candidate 13. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered 'possible'. A loss of tailings could result in 'moderate' impacts with short to medium term effects on the local ecosystem and impacts to traditional land use activities.

- Likelihood - Possible (3)

- Consequences - Moderate (3), and
- Overall Risk Rating – 9.

#### 6.4.8.3 Technical

A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk for Candidate 13. A beach will be developed upstream of the dam while maintaining an appropriate level of freeboard. Issues with development of the beach could occur during the mine life and were classified as 'likely'. Tailings discharge locations could be easily modified or alterations to the spigot locations implemented to manage the beach location while operations continue. The consequence was classified as 'insignificant'. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Insignificant (1), and
- Overall Risk Rating – 4.

### 6.4.9 Candidate 14

#### 6.4.9.1 Safety

Candidate 14 will have a filtered tailings waste pile located in the upper reaches of Turtle Creek approximately 11 km from the mine site area. An impoundment will be positioned near the mine site area for PAG/NAG3 waste rock submergence. A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the impoundment will pose the greatest safety risk for Candidate 14. The likelihood was classified as 'unlikely'. The consequence of occurrence was classified as 'catastrophic' due to the potential for loss of mine waste and water. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 10.

#### 6.4.9.2 Environment

A loss of tailings from the pipeline leading to the storage facility on Turtle Creek will pose the greatest environmental risk for Candidate 14. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered 'possible'. A loss of tailings could result in 'moderate' impacts with short to medium term effect on the local ecosystem and impacts to traditional land use activities.

- Likelihood - Possible (3)
- Consequences - Moderate (3), and
- Overall Risk Rating – 9.

#### 6.4.9.3 Technical

A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for Candidate 14. Issues with tailings filtering, transport, placement, and compaction were classified as 'likely'. These issues were classified as a 'moderate' consequence corresponding to the potential for a production delay between one day and one week. The final ratings were:

- Likelihood - Likely (4)

- Consequences - Moderate (3), and
- Overall Risk Rating – 12.

### 6.4.10 Candidate 15

#### 6.4.10.1 Safety

Candidate 15 will have a TSF located in the upper reaches an unnamed catchment north of Turtle Creek approximately 17 km from the mine site area. A second impoundment will be positioned near the mine site area for PAG/NAG3 waste rock submergence. A flood wave in Davidson Creek and/or Chedakuz Creek resulting from a breach of either facility will pose the greatest safety risk for Candidate 15. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment could be considered rare because it is designed for maximum credible events (MCE and PMF); however, it is somewhat more susceptible to failure since there are two facilities separated by a large distance. Therefore, the likelihood was classified as 'unlikely'. The consequence of occurrence was classified as 'catastrophic' due to the potential for loss of mine waste and water. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 10.

#### 6.4.10.2 Environment

A loss of tailings from the pipeline leading to the TSF will pose the greatest environmental risk for Candidate 15. The pipeline route is long and traverses multiple catchments. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered 'likely'. A loss of tailings could result in 'moderate' impacts with short to medium term effect on the local ecosystem and impacts to traditional land use activities.

- Likelihood - Likely (4)
- Consequences - Moderate (3), and
- Overall Risk Rating – 12.

#### 6.4.10.3 Technical

A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk for Candidate 15. Issues with development of the beach could occur during the mine life are classified as 'likely'. Tailings discharge locations could be easily modified or alterations to the spigot locations implemented to manage the beach location while operations continue. The consequence was classified as 'insignificant'. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Insignificant (1), and
- Overall Risk Rating – 4.

### 6.4.11 Candidate 16

#### 6.4.11.1 Safety

Candidate 16 will have a filtered tailings waste pile located in the lower reaches of the Chedakuz Creek catchment approximately 21 km from the mine site area. An impoundment will be positioned near the mine site area for PAG/NAG3 waste rock submergence. A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the impoundment will pose the greatest safety risk for Candidate 16. The likelihood was classified as 'unlikely'. The consequence of occurrence was classified as 'catastrophic' due to the potential for loss of mine waste and water. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 10.

#### 6.4.11.2 Environment

A loss of tailings from the pipeline leading to the storage facility on Turtle Creek will pose the greatest environmental risk for Candidate 16. The pipeline route is long and traverses multiple catchments. Drain back ponds will be constructed at regular intervals along the pipeline corridor, however breakage at an unanticipated location is considered 'likely'. A loss of tailings could result in 'moderate' impacts with short to medium term effect on the local ecosystem and impacts to traditional land use activities. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Moderate (3), and
- Overall Risk Rating – 12.

#### 6.4.11.3 Technical

A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for Candidate 16. Issues with tailings filtering, transport, placement, and compaction were classified as 'likely'. These issues were assigned a 'moderate' consequence corresponding to the potential for a production delay between one day and one week. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Moderate (3), and
- Overall Risk Rating – 12.

### 6.4.12 Candidate 22

#### 6.4.12.1 Safety

A loss of containment of the process water pond will pose the greatest safety risk for Candidate 22. This could occur from slumping of the filtered tailings pile leading to overtopping of the process water pond dam, or from failure of the dam itself. The likelihood of failure was classified as 'unlikely' because the process water pond is susceptible to additional failure potential as a result of the tailings pile, and because embankment deformation impacting available freeboard could result in an overtopping failure. A discharge of mine water from the dam has the potential to create serious medium-term effects to Davidson Creek through a slug of mine water and flood wave erosion. This

could leave the area directly downstream unavailable for traditional land use activities for an extended period of time but should be recoverable because the failure will not lead to a release of mine waste materials to the environment. The consequence of occurrence was classified as ‘major’. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Major (4), and
- Overall Risk Rating – 8.

#### 6.4.12.2 Environment

A loss of dam runoff and seepage from the process water pond downstream of the TSF will pose the greatest environmental risk for Candidate 5. A loss of effluent from the water management pond will require a storm event greater than allowed for in design storage requirements and/or failure of a water treatment system. The pond was design to contain a 1 in 200 year storm event, and to pass any larger events through a spillway. A loss of ML and ARD runoff has the potential to occur as storage of PAG waste rock on land will lead to ARD. The likelihood was classified as ‘unlikely’ corresponding to a discharge during a storm event with a return period greater than 1 in 200 years. A discharge of mine water from the dam has the potential to create short to medium term effects Davidson Creek through a slug of mine water and consequences were classified as ‘moderate’. The final ratings were:

- Likelihood - Unlikely (2)
- Consequences - Moderate (3), and
- Overall Risk Rating – 6.

#### 6.4.12.3 Technical

A failure to meet design specifications for filtered tailings will pose the greatest technical challenge for Candidate 22. Issues with tailings filtering, transport, placement, and compaction were classified as ‘likely’. These issues were classified as a ‘moderate’ consequence corresponding to the potential for a production delay between one day and one week. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Moderate (3), and
- Overall Risk Rating – 12.

### 6.4.13 Candidate 23

#### 6.4.13.1 Safety

A flood wave in Davidson Creek and lower Chedakuz Creek resulting from a breach of the tailings dam will pose the greatest safety risk for Candidate 23. A breach of this nature will require a physical failure of the dam. The likelihood of failure of the dam and loss of containment was classified as ‘very rare’ because it is designed for maximum credible events (MCE and PMF) and the tailings beach will provide separation of the supernatant pond from the dam. A well maintained tailings beach can prevent loss of containment even if there is embankment deformation, which provides increased redundancy in the design. A discharge of tailings and water causing a flood wave has the potential to create irreparable damage and serious long term impairment to the downstream environment due to the presence of tailings materials within the impoundment. This could leave the area directly

downstream unavailable for traditional land use activities for the foreseeable future and have short to medium term effects further downstream. The consequence of occurrence was classified as 'catastrophic'. The final ratings were:

- Likelihood - Very Rare (1)
- Consequences - Catastrophic (5), and
- Overall Risk Rating – 5.

#### 6.4.13.2 Environment

A failure of the water treatment system for the on-land PAG/NAG3 waste rock dump would pose the greatest environmental risk for Candidate 23. A discharge of untreated or inadequately treated effluent was classified as 'possible' due to the potential for rapidly changing or variable water quality coming off a dump with the potential for acid drainage. A discharge of mine water from the TSF has the potential to create short to medium term effects Davidson Creek through a slug of mine water and consequences were classified as 'moderate'. The final ratings were:

- Likelihood - Possible (3)
- Consequences - Moderate (3), and
- Overall Risk Rating – 9.

#### 6.4.13.3 Technical

A failure to meet design requirements for tailings facility filling and beach development will pose the greatest technical risk for Candidate 23. Issues with development of the beach could occur during the mine life and it was classified as 'likely'. Tailings discharge locations could be easily modified or alterations to the spigot locations implemented to manage the beach location while operations continue. The consequence was classified as 'insignificant'. The final ratings were:

- Likelihood - Likely (4)
- Consequences - Insignificant (1), and
- Overall Risk Rating – 4.

## 6.5 HIGH LEVEL RISK ASSESSMENT SCORING SUMMARY

The candidates were assigned a composite numerical ranking representing the anticipated risks to development relative to the other alternatives. The numerical ranking was based on a simple unweighted multiplication of the likelihood and consequence scores. A lower ranking number indicates an option with relatively less risk than other options. The total score for each candidate in this assessment is a sum of the safety, environment, and technical execution scores. The ranking for each candidate is shown in Table 6.3. A comparative summary of all of the rankings is shown on Figure D-1.

**Table 6.3 High Level Risk Assessment Scores**

| CANDIDATE SUMMARY | RISK SCORE | | | TOTAL SCORE |
|---|---|---|---|---|
| | SAFETY | ENVIRONMENT | TECHNICAL | |
| Reference No. | Score | Score | Score | |
| 1 | 5 | 4 | 4 | **13** |
| 4 | 5 | 6 | 8 | **19** |
| 5 | 8 | 6 | 16 | **30** |
| 6 | 10 | 6 | 12 | **28** |
| 7 | 10 | 4 | 12 | **26** |
| 10 | 10 | 4 | 8 | **22** |
| 12 | 10 | 9 | 12 | **31** |
| 13 | 10 | 9 | 4 | **23** |
| 14 | 10 | 9 | 12 | **31** |
| 15 | 10 | 12 | 4 | **26** |
| 16 | 10 | 12 | 12 | **34** |
| 22 | 8 | 6 | 12 | **26** |
| 23 | 5 | 9 | 4 | **18** |

**NOTES:**
1. RISK SCORES MUST BE READ IN CONJUNCTION WITH DESCRIPTIONS PROVIDED IN THE PRECEEDING SECTION FOR EACH CANDIDATE.

## 6.6 CANDIDATE SELECTION

The intent of the multiple accounts analysis (MAA) is to evaluate multiple candidates based on more detailed environmental, technical, economic and socio-economic considerations. The purpose of the HLRA was to compare the relative risks to development for similar candidates and select the appropriate candidates for the MAA. Candidates were separated by tailings technology to prevent risk assessment bias from removing all candidates of a single technology.

The two technology categories were:

- Slurry tailings, consisting of the remaining thickened-slurry and paste candidates, and
- Filtered tailings, consisting of the remaining filtered candidates.

A third category was included, notwithstanding the above, that considered the most ‘physically stable’ candidates. This category compared a subset of the filtered tailings category where PAG/NAG3 waste rock will be disposed of in an on-land dump, and water will be stored separately from mine waste.

### 6.6.1 Thickened-Slurry Tailings Alternative

The slurry tailings candidates in the high level risk assessment were Candidates 1, 4, 10, 13, 15 and 23. The risk scores for safety, environment, and technical execution are shown on Figure 6.1. Candidate 1 was the selected slurry tailings alternative to carry into the MAA. Candidate 1 has the lowest total risk score of the slurry tailings candidates, as well as the lowest risk score for each of the hazard categories.

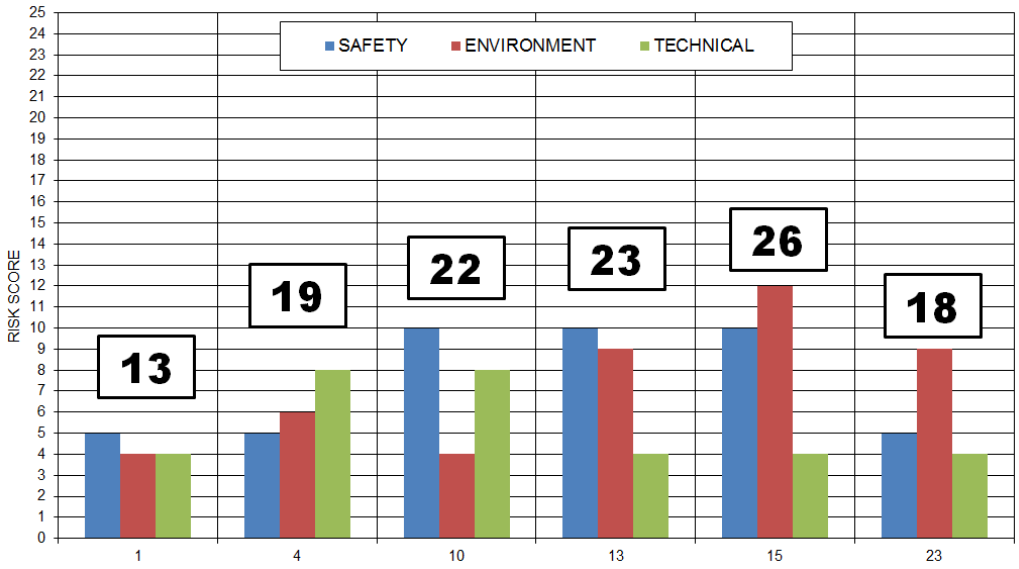



**Figure 6.1 Thickened Slurry Tailings Candidate Rankings**

### 6.6.2 Filtered Tailings Candidate

The filtered tailings candidates in the high level risk assessment were Candidates 5, 6, 7, 12, 14, 16 and 22. The risk scores for safety, environment, and technical execution are shown on Figure 6.2. Candidate 7 was the selected filtered tailings candidate to carry into the MAA. Candidate 7 has the lowest overall score (tied with Candidate 22) and the lowest score with respect to the environmental hazard. Note that Candidate 22 will also fulfill the third category, and will also be moved forward to the MAA.

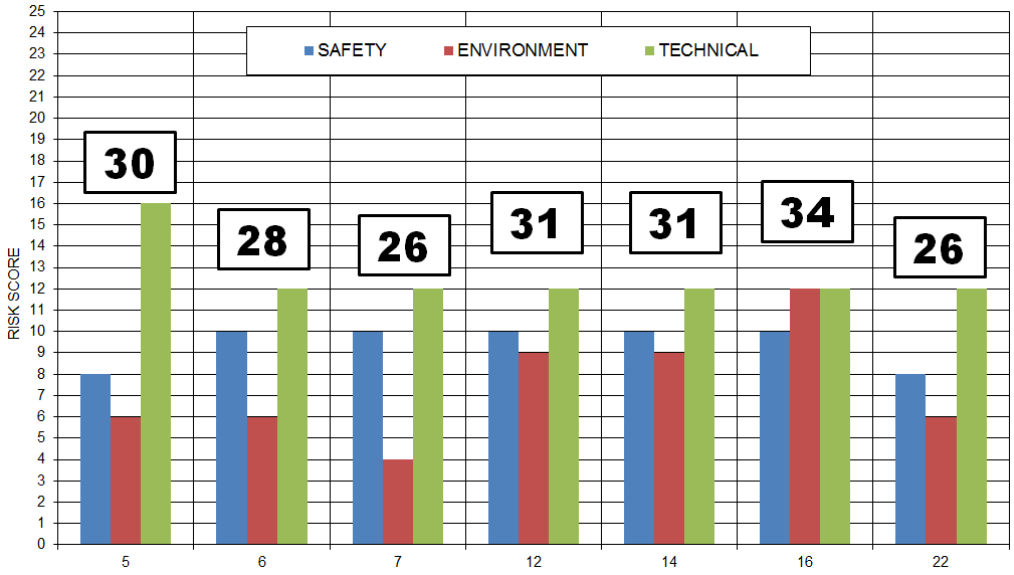



**Figure 6.2 Filtered Tailings Candidate Rankings**

### 6.6.3 Physical Stability Candidate

The third category compared a subset of the filtered tailings category where PAG/NAG3 waste rock will be disposed of in an on-land dump, and water will be stored separately from mine waste. This could be said to be the most 'physically stable' candidates. This category compares Candidates 5 and 22. Candidate 22 was selected for the MAA and includes filtered tailings and PAG/NAG3 waste rock disposed of on land in separate waste piles. Candidate 5 contemplated co-disposal in a single pile and was considered to be more complex from an execution standpoint and therefore, less preferred.

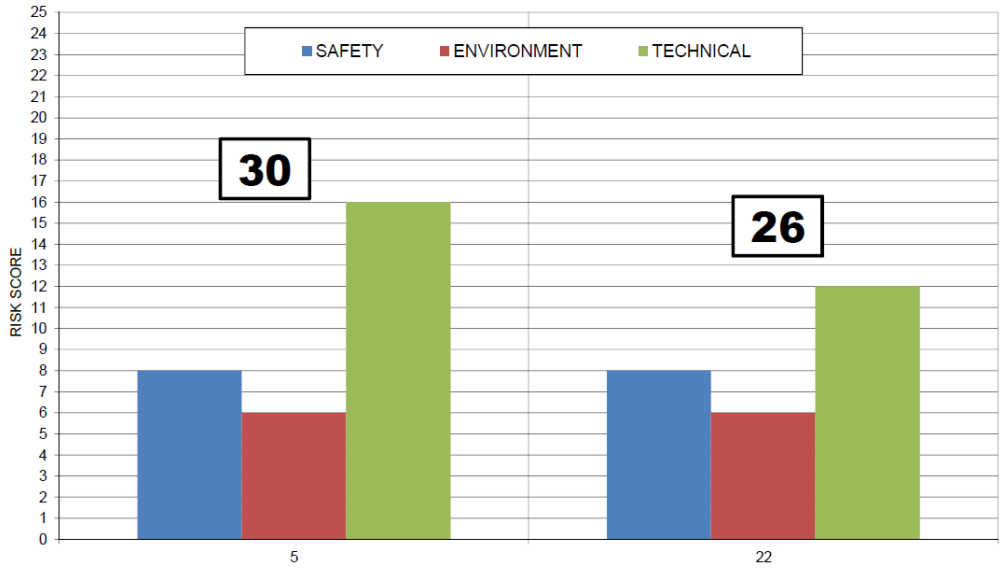



**Figure 6.3 Physical Stability Candidate Rankings**

### 6.6.4 Additional Candidate Request by Regulatory Agencies

The results of the HLRA were presented to the working group in a presentation on August 13, 2015. A request was provided to New Gold by Ministry of Energy and Mines (MEM) following that engagement to consider including Candidate 10 in the MAA, as it could be argued that the paste option differs from the other thickened-slurry options presented. New Gold agreed that the request was reasonable, and Candidate 10 will be carried forward into the subsequent analyses.

# 7 – TECHNICAL INPUT TO THE MULTIPLE ACCOUNTS ANALYSIS

## 7.1 GENERAL

A summary of the technical information related to each candidate passing the HLRA is provided in the following sections. The information includes a general description of the mine development concept, indicators of physical stability, and technical aspects including containment design, construction requirements, water management, operational execution, and closure.

The following physical stability and technical design indicators were used to develop the MAA rankings:

- Physical Stability:
  - Location of water storage
  - Tailings and waste rock interstitial water
  - Normal operating pond volume
  - Emergency water management (active) - pumping capacity
  - Emergency water management (passive) - spillways
  - Design basis / regulatory requirements
  - Tailings placement method
  - Maximum dam height
  - Operational monitoring requirements for safety
- Containment Design:
  - Style of containment
  - Number of dams
  - Construction volumes
  - Tailings average dry density
  - Drainage provisions
  - Seepage management - physical
  - Seepage management - quality
- Construction Requirements:
  - Foundation preparation for the tailings storage area (excluding dams)
  - Foundation preparation for the PAG/NAG3 waste rock facility (excluding dams)
  - Initial dam construction
  - Sustaining dam construction (excluding waste delivery)
  - Tailings infrastructure
- Water Management:
  - Catchment area
  - Flood routing
  - Water balance condition (surplus / deficit / balance)
  - Water recycle requirements
  - Water treatment
  - Surplus water management
  - Operational monitoring requirements for internal site water management
- Execution:
  - Technology precedent - tailings processing
  - Technology precedent - site conditions

  - Tailings delivery complexity
  - Tailings placement complexity
  - PAG/NAG3 waste rock delivery and placement
  - Operational flexibility
- Closure:
  - Physical
  - Geochemical
  - Active closure period
  - Long-term maintenance and monitoring
  - Concurrent closure and reclamation
  - Premature closure

## 7.2 CANDIDATE 1

### 7.2.1 Description of Mine Development Concept

Candidate 1 is a thickened-slurry tailings alternative located in the upper reaches of the Davidson Creek catchment. The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The impoundment will be created in a staged manner consisting of two nested TSF sites. The facility was designed to permanently store tailings, PAG/NAG3 waste rock, operational supernatant pond allowance, and capacity to contain the IDF with additional freeboard for wave run-up. The upper facility (Site C) will be constructed first with two dams to contain the first two years of tailings and waste rock. A third, larger dam will be constructed downstream to expand the impoundment into the lower facility (Site D) to contain the remaining 15 years of tailings and waste rock. A fourth, smaller saddle dam will be required late in mine life to maintain containment. The impoundment will form a valley fill type arrangement and will be constrained by natural topography to the south and west.

The dams will be expanded annually using NAG waste materials from the open pit in advance of storage requirements. The balance of NAG waste rock (NAG4 and NAG5) and overburden not used in construction will be combined and placed in two separate dumps adjacent to the east and west sides of the open pit. Low-grade ore will be temporarily stockpiled to the northwest of the pit and processed between Years 15 and 17.

Initial construction of the TSF dams will be completed in several stages using a contractor for initial works with subsequent support provided by the mine fleet. A total of 8 $Mm^3$ of construction material is required for the TSF dams during initial construction. Preparation of the tailings storage basin and PAG waste rock disposal area will require clearing, grubbing, and stripping of any topsoil valuable for reclamation purposes.

The TSF Site C Main and West Dams will be constructed to elevation 1353 m and TSF Site D Main and Saddle Dam constructed to elevation 1340m. Construction of the dams will require a total of 74 $Mm^3$, sourced from pit stripping and external borrow sources. The earth-rockfill dams will be comprised of a core zone, filter zone, transition zone and shell zone. Filter and transition material will be sourced from a nearby aggregate borrow. The majority of the core zone and shell zone material will come from the open pit. The maximum height of the Site D Main Dam will be approximately 140 m.

Process water will be stored on site within the TSF to maintain the saturated condition of the mine waste materials and will be split between two ponds; one within each disposal area. The normal operating pond allowance for each pond will be 10 $Mm^3$. Tailings slurry will be conveyed by gravity in a pipeline to the TSF and the pipeline route will remain within the TSF catchment at all times.

The Candidate 1 ultimate arrangement is shown on Figure 7.1. A scaled version of this figure is included in Appendix E; Figure E.1 shows the starter configuration and Figure E.2 shows the ultimate configuration.

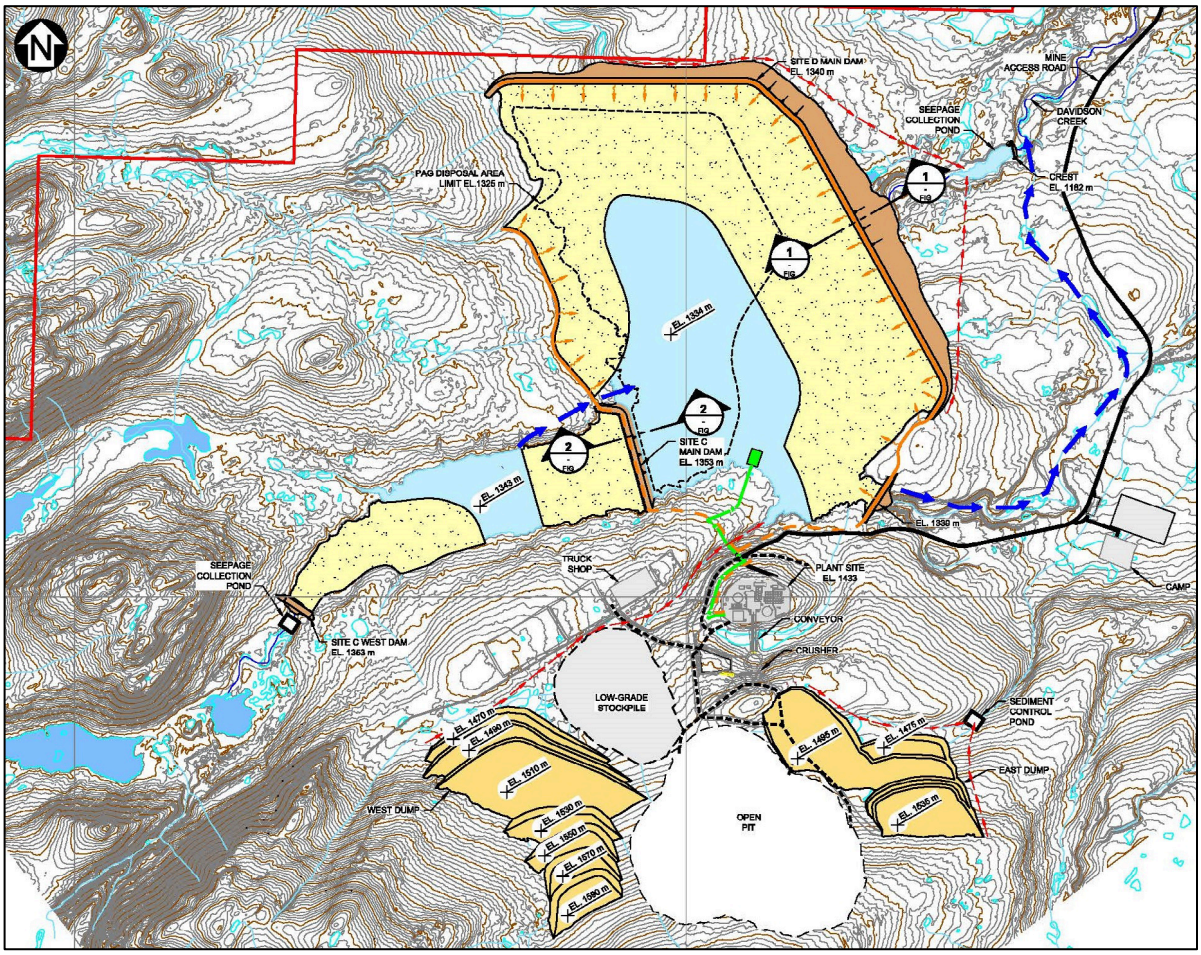



**Figure 7.1 Candidate 1 Ultimate Arrangement**

The dam safety hazard classification for the tailings facility is VERY HIGH based a technical bulletin released by the Canadian Dam Association in 2014 (CDA, 2014), entitled Application of Dam Safety Guidelines to Mining Dams. The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the tailings dams. The following suggested design levels were adopted from the CDA guidelines for Candidate 1 during the operational phase:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF)
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE)

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF
- EDGM – MCE

Tailings will be thickened to approximately 50% solids at the process plant and delivered by gravity through a pipeline to either the TSF Site C or Site D. The tailings distribution system includes a fully installed standby pipeline for operational flexibility. Tailings spigots will be located regularly along the dam crests for subaerial discharge of the tailings slurry. The segregation of coarser material will facilitate development of extensive tailings beaches providing separation of the containment dams from the supernatant pond. Beach slopes will develop at an approximate grade of 1% away from the discharge point. The slurry will segregate upon deposition with the coarsest sand particles settling near the discharge spigots and finer sands settling farther down the slope. Finer silt and clay sized tailings particles will be carried out into the supernatant pond in suspension and will settled over a longer period of time.

The PAG and NAG3 waste rock disposal area will be developed at the same or similar rate of rise as the tailings in the TSF, with the final tailings level several meters higher to provide complete submergence of PAG waste rock. The tailings beach will provide a low permeability transition between the coarse, permeable waste rock in the centre of the TSF and the tailings embankments. The extensive tailings beaches will provide seepage control and are an indicator of dam safety.

Seepage will be primarily controlled by the low-permeability core zone and cut-off trenches constructed prior to the development of tailings beaches. Seepage passing through the main embankment will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main dam. Seepage will be recycled back to the TSF. Unrecoverable seepage passing the collection and recycle system has the potential to affect one watershed; Davidson Creek.

### 7.2.2 Water Management

The catchment area without modification is 45 $km^2$ (4,500 ha), sufficient to maintain a water balance under average conditions until late in mine life. A surplus condition was predicted to develop beginning in Year 11 due to increasing runoff from the expanding disturbed areas of the mine facilities, and also from the decreases in waste rock production and corresponding decreases of water storage in waste rock voids for mine rock stored within TSF Site D. This was identified as a desirable condition during the Feasibility Study (KP, 2014a) with this surplus water used to accelerate open pit filling and limit the onset of acid rock drainage conditions in the pit walls. It was also identified as a surplus condition that was easily manageable with additional fresh water diversions.

Runoff and infiltration from the LGO stockpile will be captured and treated at the mill before being conveyed for storage in the TSF. No other operational water treatment requirements are expected.

The TSF operational pond capacity is sufficient to manage a reasonable range of surplus or deficit water conditions. Water levels and pond bathymetry will be monitored to confirm that the water balance assumptions are accurate and that an operational surface water discharge from the TSF will

not occur until closure. As a contingency, non-contact surface water diversions can be created to divert runoff away from the TSF.

The reclaim water system will initially utilize a barge-mounted pump station sized to deliver 3,200 $m^3$/hr of reclaim water (28 $Mm^3$ per year). The reclaim barge will be anchored in TSF Site C during Years 1 and 2 of operations, and then moved to TSF Site D late in Year 2 for the remainder of mine operations and closure. A reclaim structure will be constructed in TSF Site C during Year 2 with an equivalent pumping capacity to the reclaim barge. A volume of approximately 20 $Mm^3$ of water reclaim will be required each year from the tailings ponds, and will be combined with water from open pit dewatering and freshwater make-up sources to support the milling process.

A closure spillway will be constructed between Site C and Site D in Year 3 to passively control the maximum pond elevation in TSF Site C. A closure spillway will be constructed from Site D to Davidson Creek in the final year of operations.

### 7.2.3 Technical Execution

There are countless examples of the mining projects utilizing slurry tailings with ore processing throughputs higher than 60,000 TPD. The proposed tailings technology is considered proven and not subject to any major implementation challenges. Slurry tailings have a proven history of application in similar climate conditions as the project site. The tailings distribution and discharge strategy is unlikely to be affected in a significant way by any weather conditions. Extreme wet conditions can impact available storage capacity; however, this consideration was addressed in the design of the alternative. The technology is the most flexible from an operational standpoint. A fully installed backup distribution system and emergency discharge system were included in the design. Tailings discharge will not be the limiting factor for operational reliability.

### 7.2.4 Closure

Upon mine closure, surface facilities will be removed in stages and full reclamation of the TSF will be initiated. The closure plan is compatible with a premature closure event. General aspects of the closure plan include:

- Selective discharge of tailings around the facility during the final years of operations to establish and flatten the final tailings beach to facilitate surface water management and reclamation.
- Placing an oxide tailings cover up to 3 m thick on Site C beaches such that transition and sulphide tailings remain saturated over a wide range of precipitation conditions.
- Placing an oxide tailings/overburden cover up to 5 m thick on the Site D beach such that transition and sulphide tailings remain saturated over a wide range of precipitation conditions.
- Covering the exposed tailings beaches and PAG waste rock with approximately 30 cm of overburden.
- Establishing wetlands and revegetating the upland beaches.
- Pumping the tailings pond supernatant to the pit for about 18 years to expedite the development of the pit lake and flooding of the majority of PAG rock in the ultimate pit walls.
- Dismantling and removing the tailings and reclaim delivery systems and all pipeline structures, and equipment not required beyond mine closure.
- Constructing spillways and overflow channels.

- Removing the seepage collection pumpback systems at such time that suitable water quality for direct release is achieved.
- Establishing polishing wetlands for treatment of seepage.
- Removing and re-grading all access roads, ponds, ditches, and borrow areas not required beyond mine closure.
- Long-term stabilization of all exposed erodible materials.

The remaining waste rock dump areas not progressively reclaimed will be reclaimed with overburden and re-vegetated. The low grade stockpile pad will be tested for contamination and removed and disposed of as required in the open pit or TSF. The pit will be allowed to flood and, upon filling, the pit lake will discharge via a constructed channel to the TSF and hence via a closure spillway to Davidson Creek. Seepage from the TSF will pass through constructed wetlands downstream of TSF Site D and hence to Davidson Creek.

Engineering reviews and inspections of the TSF will extend approximately 20 years into the closure period or until the TSF reaches a steady-state condition, with less frequent reviews and inspections thereafter.

## 7.3 CANDIDATE 7

### 7.3.1 Description of Mine Development Concept

Candidate 7 is a filtered tailings alternative located in the upper reaches of the Davidson Creek catchment. The filtered tailings will be stacked in a waste pile on land in a heaped valley fill arrangement in a partially-saturated condition. A PAG/NAG3 waste rock submergence impoundment will be positioned downstream of the filtered tailings waste pile. The submergence impoundment was designed to permanently store PAG/NAG3 waste rock in a saturated condition and contain the process water pond with additional capacity to contain the IDF and freeboard for wave run-up. This impoundment will manage storm water from the filtered tailings waste pile. The impoundment will be created by constructing a two-sided dam that is progressively expanded over the life of the mine. The impoundment will form a valley fill type arrangement and will be constrained by natural topography to the south and west. Waste rock stored in the impoundment will eventually buttress the toe of the filtered tailings waste pile.

The dam will be expanded approximately every five years using NAG waste materials from the open pit in advance of storage requirements. The balance of NAG waste rock (NAG4 and NAG5) and overburden not used in construction will be combined and placed in two separate dumps adjacent to the east and west sides of the open pit. Low-grade ore will be temporarily stockpiled to the northwest of the pit and processed between Years 15 and 17.

Preparation of the tailings storage area will require clearing, grubbing, stripping of topsoil, removal of unsuitable foundation soils, and installation of a complex network of foundation drains. Initial construction of the impoundment dam will be completed in two stages using a contractor for initial works with subsequent support provided by the mine fleet. A total of 8 $Mm^3$ of construction material is required during initial construction. Preparation of the waste rock disposal basin will require clearing, grubbing, and stripping of any topsoil valuable for reclamation purposes.

The Candidate 7 ultimate arrangement is shown on Figure 7.2. A scaled version of this figure is included in Appendix E; Figure E.3 shows the starter configuration and Figure E.4 shows the ultimate configuration.

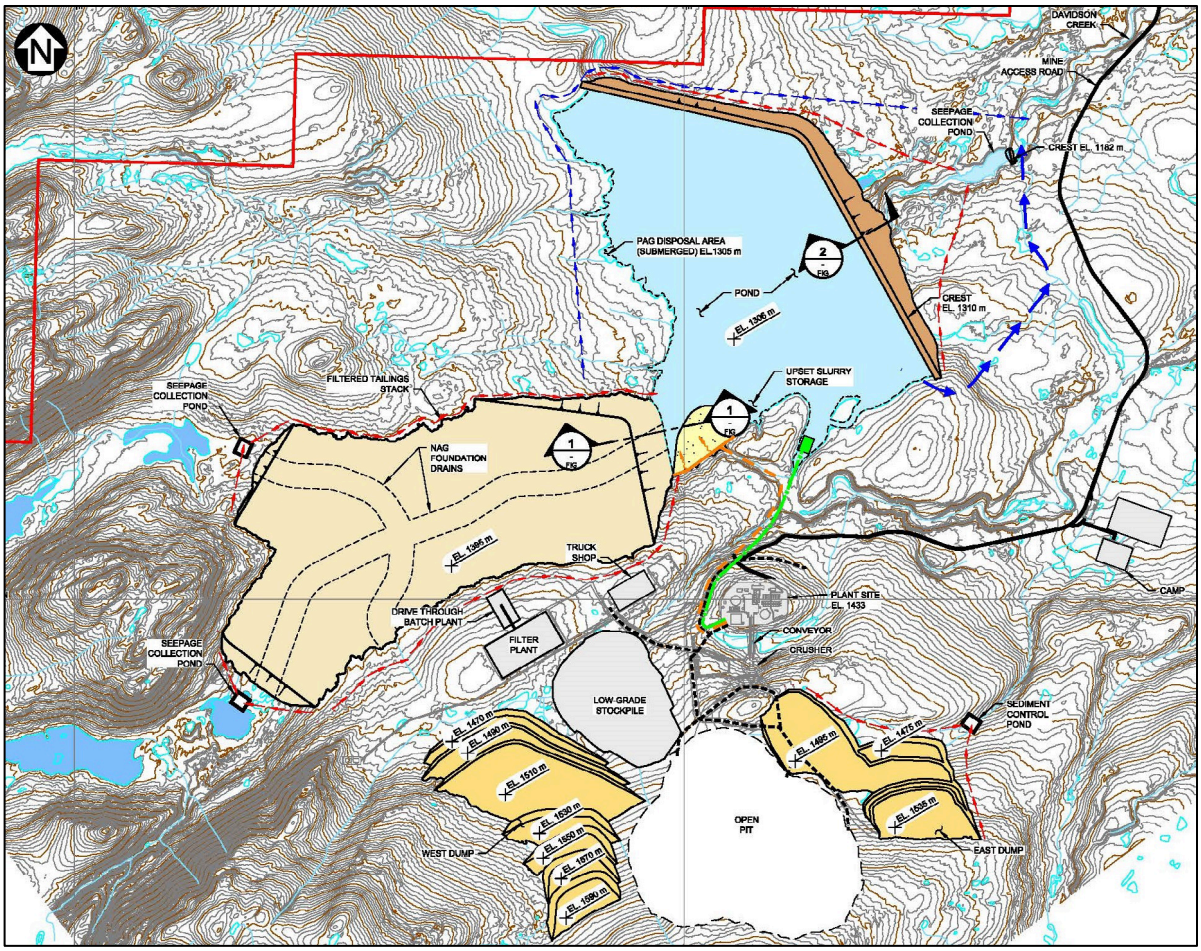



**Figure 7.2 Candidate 7 Ultimate Arrangement**

The centre of the tailings waste pile site is located 3.5 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filter plant approximately 1 km away as thickened slurry with a gravimetric solids content of 50%. Tailings will be filtered and then transported by conveyer to a truck load out building. Haul trucks will transport the filtered tailings to the stacking location where dozers will be used for placement and grading. A conveyor will be considered for placement in later years once a large working surface has been developed. Two areas of the tailings pile will be developed:

- A general area where tailings will be placed in 10 m thick platforms with surface grading and compaction to reduce infiltration and maintain trafficability, and
- A structural area with thinner lift thicknesses and compaction to maintain stability of the stack.

The filtered tailings waste pile will be constructed to elevation 1,395 m with a maximum height of approximately 145 m. The working surface of the pile at ultimate extents will be approximately 550 ha, and the rate of rise of the waste pile will be roughly 9 m per year. The filtered tailings waste

pile rises approximately 40 m higher than the TSF Site C facility contemplated in Candidate 1 in the same location. This change will alter the seepage and surface water flow regime such that some of the runoff and seepage may now report to the west of the filtered tailings pile. Two seepage collection ponds will be required on the west side of the filtered tailings pile. The waste pile slopes will be reclaimed concurrent with development; however the working surface of the pile is a large area and will require reclamation at closure.

An assessment of the stability rating for the filtered tailings waste pile was carried out using the waste dump and stockpile stability rating system as described in the interim guidelines provided by the B.C. Mine Waste Rock Pile Research Committee (BCMWRPRC, 1991). The waste pile was classified as Class III, Moderate Hazard. The specific key factors affecting stability, rated condition, and point ratings for classification of the waste pile are shown in Table 7.1.

**Table 7.1 Filtered Tailings Waste Pile Stability Rating**

| Key Factors Affecting Stability | Condition | Point Rating |
|---|---|---|
| Dump Height | 100 - 200 m | 100 |
| Dump Volume | Large | 100 |
| Dump Slope | Flat | 0 |
| Foundation Slope | Flat | 0 |
| Degree of Confinement | Moderate | 50 |
| Foundation Type | Competent | 0 |
| Dump Material Quality | Poor | 200 |
| Method of Construction | Favourable | 0 |
| Piezometric & Climatic Conditions | Unfavourable | 200 |
| Dumping Rate | Moderate | 100 |
| Seismicity | Moderate | 50 |
| **DUMP STABILITY RATING** | | **800** |
| | | |
| | **Class** | **Failure Hazard** |
| **Dump Stability Class** | III | Moderate |

The submergence impoundment dam will be constructed to elevation 1,310 m. Construction of the dam will require a total of 30 $Mm^3$. The construction material will be sourced from local borrow areas and from pre-stripping activities in the pit area. The earth-rockfill dams will be comprised of a core zone, filter zone, transition zone, and shell zone. Filter and transition material will be sourced from a nearby aggregate borrow. The majority of the core zone and shell zone material will come from the open pit. The maximum height of the dam will be approximately 110 m.

The dam safety hazard classification for the PAG/NAG3 waste rock submergence impoundment is VERY HIGH based a technical bulletin released by the Canadian Dam Association in 2014 (CDA, 2014), entitled Application of Dam Safety Guidelines to Mining Dams. The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the containment dams. The following suggested design levels were adopted from the CDA guidelines for Candidate 7 during the operational phase:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF)
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE)

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF
- EDGM – MCE

Process water will be stored on site within the submergence impoundment to maintain the saturated condition of the mine waste rock. The normal operating pond allowance will be 10 $Mm^3$. Process water will be retained by the dam, while maintaining minimum freeboard requirements, and reclaimed for use in the mill. The impoundment will include an 'upset' conditions slurry tailings storage area in the submergence facility for times when the filter plant cannot achieve the required tailings moisture content for placement in the waste pile.

Seepage from the submergence impoundment will be primarily controlled by the low-permeability core zone and cut-off trenches constructed in the containment dam. Seepage passing through the core zone will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main dam. Higher relative seepage rates are expected from the impoundment compared to Candidate 1 because this option lacks a tailings beach, which reduces seepage flows. Seepage will be recycled back to the TSF. Unrecoverable seepage rates to Davidson Creek are not expected to increase substantially and the seepage collection infrastructure in Davidson Creek is robust enough to manage the change.

Unrecoverable seepage by-passing the collection and recycle systems for the filter tailings waste pile and PAG/NAG3 submergence impoundment has the potential to affect two watersheds; Davidson Creek and Creek 705.

### 7.3.2 Water Management

The catchment area is 30 $km^2$ (3,000 ha) with diversion of undisturbed catchment areas upslope of the mine facilities. The water balance was predicted to be in a surplus condition throughout operations with a surplus of 3 $Mm^3$ to 6 $Mm^3$ per year. The surplus increases throughout operations due to runoff from the expanding disturbed areas of the mine facilities, and also from the decreases in waste rock production and corresponding decreases of water storage in waste rock voids for mine rock stored within the submergence impoundment.

Fresh water diversions have been included to the maximum practical extent in the design. The TSF operational pond capacity is sufficient to manage a reasonable range of surplus water conditions on an annual basis. The surplus will require a treated operational discharge to Davidson Creek throughout operations. The surplus site water will be used to accelerate open pit filling in closure and limit the onset of acid rock drainage conditions in the pit walls.

Runoff and infiltration from the LGO stockpile will be captured and treated at the mill before being conveyed for storage in the process water pond. Alternatively these treated flows could be diverted to Davidson Creek if they meet discharge water quality guidelines.

Surplus water management will require on-going monitoring, calibration of model predictions, and active management of water treatment to meet design objectives. Water levels and pond bathymetry will be monitored to confirm that the water balance assumptions are accurate and that permitted

operational surface water discharge allowances meet requirements to manage the water balance on an inter-annual basis.

The reclaim water system will utilize a small barge-mounted pump station sized to deliver 700 $m^3$/hr of reclaim water (6 $Mm^3$ per year). The reclaim barge will be anchored in the waste rock submergence impoundment. A volume of less than 2 $Mm^3$ of water reclaim was predicted to be required each year from the process water pond for the first ten years of operations, and will be combined with water from tailings dewatering, open pit dewatering and fresh water supply to support the milling process. Water in the submergence impoundment after Year 10 may not be required for processing, and will be used only to maintain the saturated condition of the PAG/NAG3 waste rock.

A closure spillway will be constructed from the submergence impoundment to Davidson Creek in the final year of operations.

### 7.3.3 Execution

There are only a few examples of mining projects utilizing filtered tailings with a throughput greater than 10,000 TPD. La Coipa Mine in the Atacama Desert in northern Chile is one of the longest operating projects. The throughput of La Coipa is less than 20,000 TPD (sources report a range from 15,000 to 18,000 TPD). It is a high seismic region with very little precipitation, high evaporation rates, and freezing conditions throughout the year. Filtered tailings are placed by conveyor and radial stacker. It includes an upset area where over moisture tailings are deposited as slurry at the top of a slope and allowed to settle naturally. The largest operating project utilizing filtered tailings is the Karara Mine in Western Australia at approximately 40,000 TPD. Two tailings streams are produced: coarse tailings, dewatered by screen filtration, and fine tailings, dewatered by plate press. Tailings are placed by conveyor and stacker with a nominal lift thickness of 25 m. The site is essentially a desert and has an order of magnitude higher evaporation than precipitation.

The most reasonable example of a mining project utilizing filtered tailings in climate conditions similar to the project is Greens Creek located 30 km southwest of Juneau, Alaska. The throughput at Greens Creek is 1,500 TPD; however, only approximately 50% of the tailings are filtered and the remainder used as paste backfill for underground workings.

A filter plant capable of dewatering tailings at a rate of 60,000 TPD will require a building roughly 100 m by 30 m (approximately half the size of a football field). Issues with tailings filtration plant will be expected at times due to changes in ore type, grind size, and also for unforeseen maintenance of critical components. An area will be designated in the submergence impoundment for emergency discharge where slurry tailings will be sent when the filter plant is not operational. Also, a general placement area within the filtered tailings waste pile will be required ‘upset’ conditions when the filter plant produces tailings with less than optimal moisture content.

Filtered tailings material may have to be stockpiled and allowed to dry during adverse weather conditions or unforeseen truck maintenance in order to maintain production. Coordination and planning for weather conditions will be essential for development of a filtered tailings stack at this production rate (60,000 TPD) and in the weather conditions common in central British Columbia. A covered live stockpile may be required in addition to the truck load out facility. A live stockpile with a one week capacity will be approximately 100 m in diameter and 25 m in height. Movement of any stockpiled material will subsequently impact the availability of trucks to manage normal tailings production.

Transport of tailings by truck using CAT 777 haul trucks will require approximately 40 trips per hour, 24 hours a day for 365 days a year to manage a nominal production of 60,000 TPD. The operation will require a loading arrangement that can reliably load trucks at a nominal rate of 1.5 minutes per truck. Any down time has the potential to impact mill operations. This will require an active truck fleet of 10 trucks for a haul with a round trip time of 15 minutes. The total truck fleet will have to be somewhat larger to manage temporary stockpiled material, for longer haul times, and for appropriate backup equipment during periodic and unforeseen maintenance needs. Trucks may need to be equipped with heated beds to prevent moist soil from freezing to the metal in the winter.

Filtration of tailings at a rate of 60,000 TPD will exceed anything within existing precedent; however the increase in scale of filtration alone is not insurmountable. The scale at which filtered tailings has been applied in similar site conditions is more concerning. Rainfall has the potential to reduce trafficability of the surface, making placement in areas difficult or impossible in certain cases. Winter conditions will pose a challenge for placement of the filtered tailings. Precipitation falls predominantly as snow throughout five months of the year. Accumulated snow will need to be removed prior to placement of subsequent tailings material. There is potential for entrainment of snow in the waste pile that could impact the stability of the pile in the short and long-term.

Placement of filtered tailings with a conveyor system might be simpler from a bulk material handling standpoint; however, a great deal of maneuvering will be required especially in the initial lifts. There may be an opportunity to move from trucking to a conveyor system in the later years of operation.

### 7.3.4 Closure

Upon mine closure, surface facilities will be removed in stages and full reclamation will be initiated. The closure plan is compatible with a premature closure event although it may require substantial earthworks to construct engineered covers. General aspects of the closure plan include:

- Covering PAG waste rock with approximately 1 m of overburden.
- Covering the filtered tailings waste pile with 2 m of overburden.
- Placement of an overburden wedge up to 5 m thick around the facility to separate the position of final pond from the impoundment dam crest.
- Constructing spillways and overflow channels.
- Establishing wetlands in the submergence impoundment and revegetating slopes.
- Pumping the tailings pond supernatant to the pit for about 29 years to develop the pit lake and flood the majority of PAG rock in the ultimate pit walls.
- Dismantling and removing reclaim delivery systems and all pipeline structures, and equipment not required beyond mine closure.
- Pumping seepage collection ponds located to the west of the filtered tailings waste pile to the submergence impoundment for approximately 30 years or until such time that suitable water quality is achieved.
- Removing the Davidson Creek seepage collection pumpback systems at such time that suitable water quality for direct release is achieved.
- Establishing polishing wetlands for treatment of seepage.
- Removing and re-grading all access roads, ponds, ditches, and borrow areas not required beyond mine closure.
- Long-term stabilization of all exposed erodible materials.

The remaining waste rock dump areas not progressively reclaimed will be reclaimed with overburden and re-vegetated. The low grade stockpile pad will be tested for contamination and removed and disposed of as required in the open pit. The pit will be allowed to flood and, upon filling, the pit lake will discharge via a constructed channel to the submergence impoundment and hence via a closure spillway to Davidson Creek. Seepage from the submergence impoundment will pass through constructed wetlands downstream and hence to Davidson Creek.

Engineering reviews and inspections of the TSF will extend approximately 30 years into the closure period or until the TSF reaches a steady-state condition, with less frequent reviews and inspections thereafter. Longer term monitoring and maintenance may be required following the closure period to confirm that:

- PAG/NAG3 waste rock remains saturated and that outflows through seepage match inflows to the voids, and
- The filtered tailings waste pile remains partially saturated, limiting air entry into the void space and retarding acid generation.

## 7.4 CANDIDATE 10

### 7.4.1 Description of Mine Development Concept

Candidate 10 is an ultra-thickened (paste) tailings alternative located in the upper reaches of the Davidson Creek catchment. The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The facility was designed to contain tailings, PAG/NAG3 waste rock, the operational supernatant pond allowance, and capacity to contain the IDF with additional freeboard for wave run-up. The impoundment will be created by constructing three dams in the area previously described as Site D. The main dam will be a large two sided dam across Davidson Creek. Two smaller dams will be required on the west side of the impoundment and in a small saddle on the southeast side of the facility to maintain containment.

Paste tailings will be pumped in a pipeline to a central point in the TSF. Paste tailings will be discharged from a central point and will settle at angle of repose sloping towards the containment dams. Water will be collected at the toe of the slope adjacent to the containment dams. The pipeline route will remain within the TSF catchment at all times.

The dams will be expanded every two years using NAG waste materials from the open pit in advance of storage requirements. The balance of NAG waste rock (NAG4 and NAG5) and overburden not used in construction will be combined and placed in two separate dumps adjacent to the east and west sides of the open pit. Low-grade ore will be temporarily stockpiled to the northwest of the pit and processed between Years 15 and 17.

The Candidate 10 ultimate arrangement is shown on Figure 7.3. A scaled version of this figure is included in Appendix E; Figure E.5 shows the starter configuration and Figure E.6 shows the ultimate configuration.

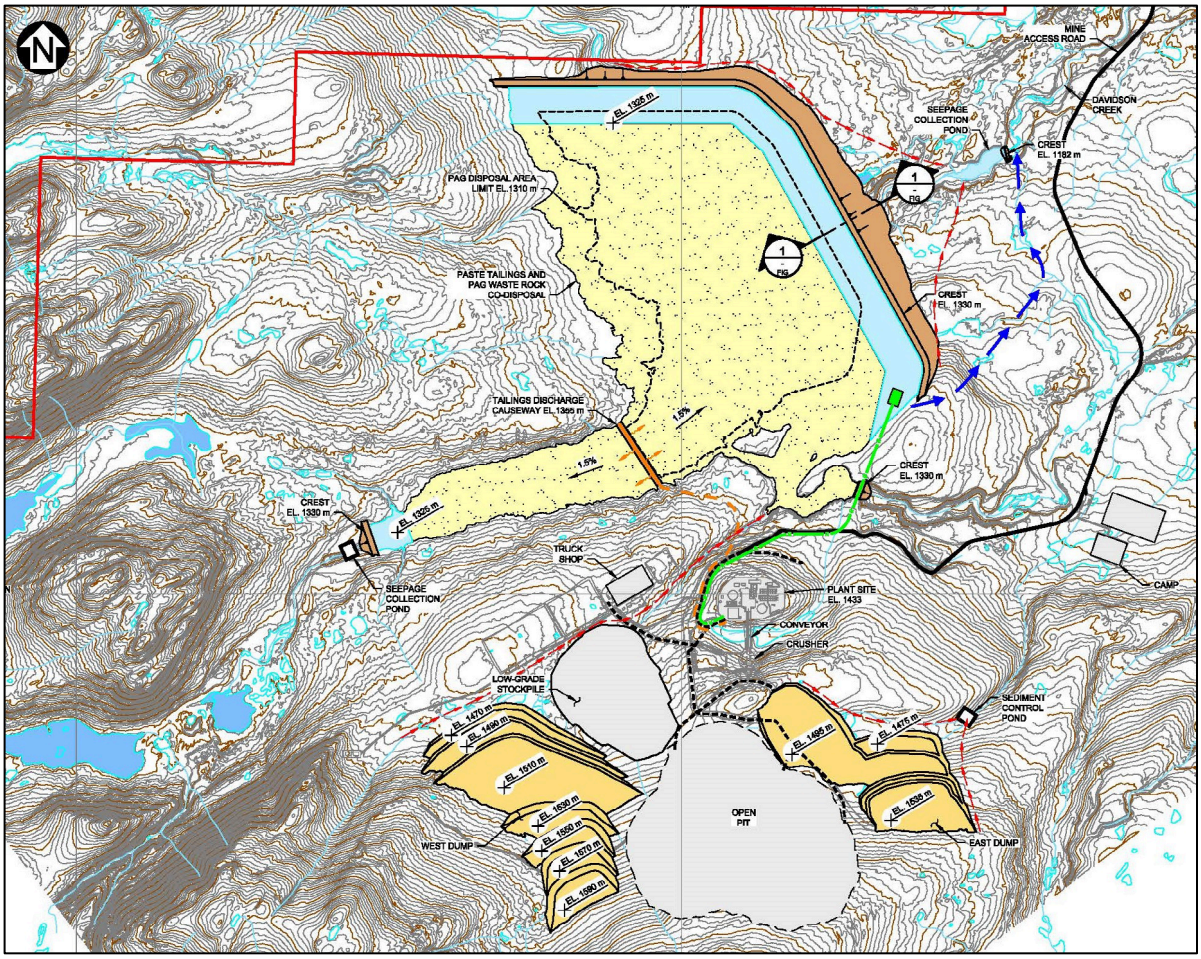



**Figure 7.3 Candidate 10 Ultimate Arrangement**

Initial construction of the TSF dams will be completed in several stages using a contractor for initial works with subsequent support provided by the mine fleet. A total of 10.5 $Mm^3$ of construction material is required for the TSF dams during initial construction. Preparation of the tailings storage basin and PAG waste rock disposal area will require clearing, grubbing, and stripping of any topsoil valuable for reclamation purposes.

The TSF dams will be constructed to elevation 1,330 m and the central discharge embankment will be raised to a final elevation of 1,355 m. Construction of the dams will require a total of 70 $Mm^3$, sourced from pit stripping and external borrow sources. The earth-rockfill dams will be comprised of a shell zone, transition and filter zones, and a low-permeability face. Filter and transition material will be sourced from a nearby aggregate borrow. The remainder of the material will come from the open pit. The maximum height of the main dam will be 130 m.

Process water will be stored on site in the TSF to maintain the saturated condition of the mine waste materials. The normal operating pond allowance will be 6 $Mm^3$. Process water will be retained by the dam, while maintaining minimum freeboard requirements, and reclaimed for use in the mill.

Alternatively, water could be decanted from the surface of the TSF and stored in a separate reclaim pond below the TSF. This will require construction of another large water retaining dam in an area downstream where there is increased risk of unrecoverable seepage due to the presence of naturally occurring higher permeability meltwater channels. Removal of water from the TSF will also negatively impact the reliability of initially flooding and subsequently maintaining PAG materials in a saturated condition. This alternative arrangement relates to the comparison of best practices for this particular technology, and will be evaluated further if the multiple accounts analysis indicates that Candidate 10 is the preferred option.

The dam safety hazard classification for the tailings facility is VERY HIGH based a technical bulletin released by the Canadian Dam Association in 2014 (CDA, 2014), entitled Application of Dam Safety Guidelines to Mining Dams. The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the tailings dams. The following suggested design levels were adopted from the CDA guidelines for Candidate 10 during the operational phase:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF)
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE)

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF
- EDGM – MCE

Tailings will be thickened to approximately 65% solids at the process plant and delivered by gravity through a pipeline to the central discharge point in the TSF. The tailings distribution system will include a fully installed standby pipeline for operational flexibility. The paste will not segregate upon deposition and very little bleed water from the tailings discharge is expected. Tailings will settle at an approximate grade of 1.5% away from the discharge point. A central discharge point will be the most practical and appropriate method given the long containment dam length. The discharge location could be along the dam crest if the tailings were not thickened to paste, and that is what the thickened-slurry option (Candidate 1) represents.

The PAG and NAG3 waste rock disposal area will be developed at the same or similar rate of rise as the tailings in the TSF. Waste rock will be used to manage the location of paste deposition during most of operations; however, the final tailings level will be several meters higher to cover the PAG waste rock.

Seepage will be primarily controlled by the low-permeability core zone and cut-off trenches constructed prior to the development of tailings beaches. Seepage passing through the main embankment will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main embankment. Seepage will be recycled back to the TSF. Higher relative seepage rates are expected from the impoundment compared to Candidate 1 because this option lacks a tailings beach in front of the dam, which reduces seepage flows. Seepage rates are expected to be less than those expected for Candidate 7. Unrecoverable seepage passing the collection and recycle system has the potential to affect one watershed; Davidson Creek.

### 7.4.2 Water Management

The catchment area without modification is 43 $km^2$ (4,300 ha). The water balance was predicted to be in a surplus condition throughout operations with a surplus of 2 $Mm^3$ to 6 $Mm^3$ per year. The surplus increases throughout operations due to runoff from the expanding disturbed areas of the mine facilities, and also from the decreases in waste rock production and corresponding decreases of water storage in waste rock voids for mine rock stored within the TSF.

The surplus water will be managed with a combination of fresh water diversions and a treated operational discharge to Davidson Creek later in operations. The TSF operational pond capacity is sufficient to manage a reasonable range of surplus water conditions on an annual basis. The surplus site water will be used to accelerate open pit filling in closure and limit the onset of acid rock drainage conditions in the pit walls. Fresh water diversions could remove approximately 3 $Mm^3$ per year from the water surplus under average conditions.

Runoff and infiltration from the LGO stockpile will be captured and treated at the mill before being conveyed for storage in the process water pond. Alternatively, these treated flows could be diverted to Davidson Creek if they meet discharge water quality guidelines.

Surplus water management will require on-going monitoring, calibration of model predictions, and active management of water treatment to meet design objectives. Water levels and pond bathymetry will be monitored to confirm that the water balance assumptions are accurate and that permitted operational surface water discharge allowances meet requirements to manage the water balance on an inter-annual basis.

The reclaim water system will utilize a barge-mounted pump station sized to deliver 1,600 $m^3$/hr of reclaim water (14 $Mm^3$ per year). The reclaim barge will be anchored in the TSF. A volume of less than 10 $Mm^3$ of water reclaim was predicted to be required each year from the process water pond, and will be combined with water from tailings dewatering, open pit dewatering and fresh water supply to support the milling process.

A closure spillway will be constructed from the TSF to Davidson Creek in the final year of operations.

### 7.4.3 Execution

The tailings processing for Candidate 1 included a thickening step to 60% solids during the cyanide destruction process followed by re-pulping to 50% solids content for tailings discharge. Candidate 10 contemplates an alternative tailings dewatering strategy where tailings will be dewatered further (instead of being re-pulped) and discharged as a non-segregating paste in the TSF. A paste surface disposal facility at this throughput is not beyond Canadian precedent, although it is not common in British Columbia or Canada.

Tailings will be thickened above approximately 65% solids and pumped with positive displacement pumps to a discharge berm constructed in the centre of the TSF. The discharge strategy relies on pumping and execution depends on the reliability of the pumping systems. An area will be designated in the TSF for emergency discharge where slurry tailings will be sent when the paste plant or pumps are not operational.

### 7.4.4 Closure

Upon mine closure, surface facilities will be removed in stages and full reclamation of the TSF will be initiated. The closure plan is compatible with a premature closure event. General aspects of the closure plan include:

- Selective discharge of thickened (not paste) tailings from dam crests around the facility during the final years of operations to fill in low spots and facilitate surface water management and reclamation.
- Placing an oxide tailings cover up to 3 m thick on tailings surfaces such that transition and sulphide tailings remain saturated over a wide range of precipitation conditions.
- Covering the exposed tailings beaches with approximately 30 cm of overburden.
- Establishing wetlands and revegetating the upland beaches.
- Pumping the tailings pond supernatant to the pit for about 19 years to expedite the development of the pit lake and flooding of the majority of PAG rock in the ultimate pit walls.
- Dismantling and removing the tailings and reclaim delivery systems and all pipeline structures, and equipment not required beyond mine closure.
- Constructing spillways and overflow channels.
- Removing the seepage collection pumpback systems at such time that suitable water quality for direct release is achieved.
- Establishing polishing wetlands for treatment of seepage.
- Removing and re-grading all access roads, ponds, ditches, and borrow areas not required beyond mine closure.
- Long-term stabilization of all exposed erodible materials.

The remaining waste rock dump areas not progressively reclaimed will be reclaimed with overburden and re-vegetated. The low grade stockpile pad will be tested for contamination and removed and disposed of as required in the open pit or TSF. The pit will be allowed to flood and, upon filling, the pit lake will discharge via a constructed channel to the TSF and hence via a closure spillway to Davidson Creek. Seepage from the TSF will pass through constructed wetlands downstream of the TSF and hence to Davidson Creek.

Engineering reviews and inspections of the TSF will extend approximately 20 years into the closure period or until the TSF reaches a steady-state condition, with less frequent reviews and inspections thereafter.

## 7.5 CANDIDATE 22

### 7.5.1 Description of Mine Development Concept

Candidate 22 is a filtered tailings alternative located at the top of the Davidson Creek catchment. The filtered tailings will be stacked in a waste pile on land in a heaped valley fill arrangement in a partially-saturated condition. The tailings waste pile is the same size and is located at the same site as Candidate 7. PAG and NAG3 waste rock will be stored in a separate engineered surface containment in a heaped arrangement. The PAG waste rock dump is constrained from expanding further to the east by the open pit and to the west by the ungulate winter range. A process water management pond will be located downstream of the mine waste pile and created by constructing a water retaining dam in a single stage with a maximum height of 40 m across Davidson Creek.

Process water will be stored in the pond and reclaimed for use in the mill. An 'upset' conditions slurry tailings storage area will be required in the pond for emergency conditions.

The Candidate 22 ultimate arrangement is shown on Figure 7.4. A scaled version of this figure is included in Appendix E; Figure E.7 shows the starter configuration and Figure E.8 shows the ultimate configuration.

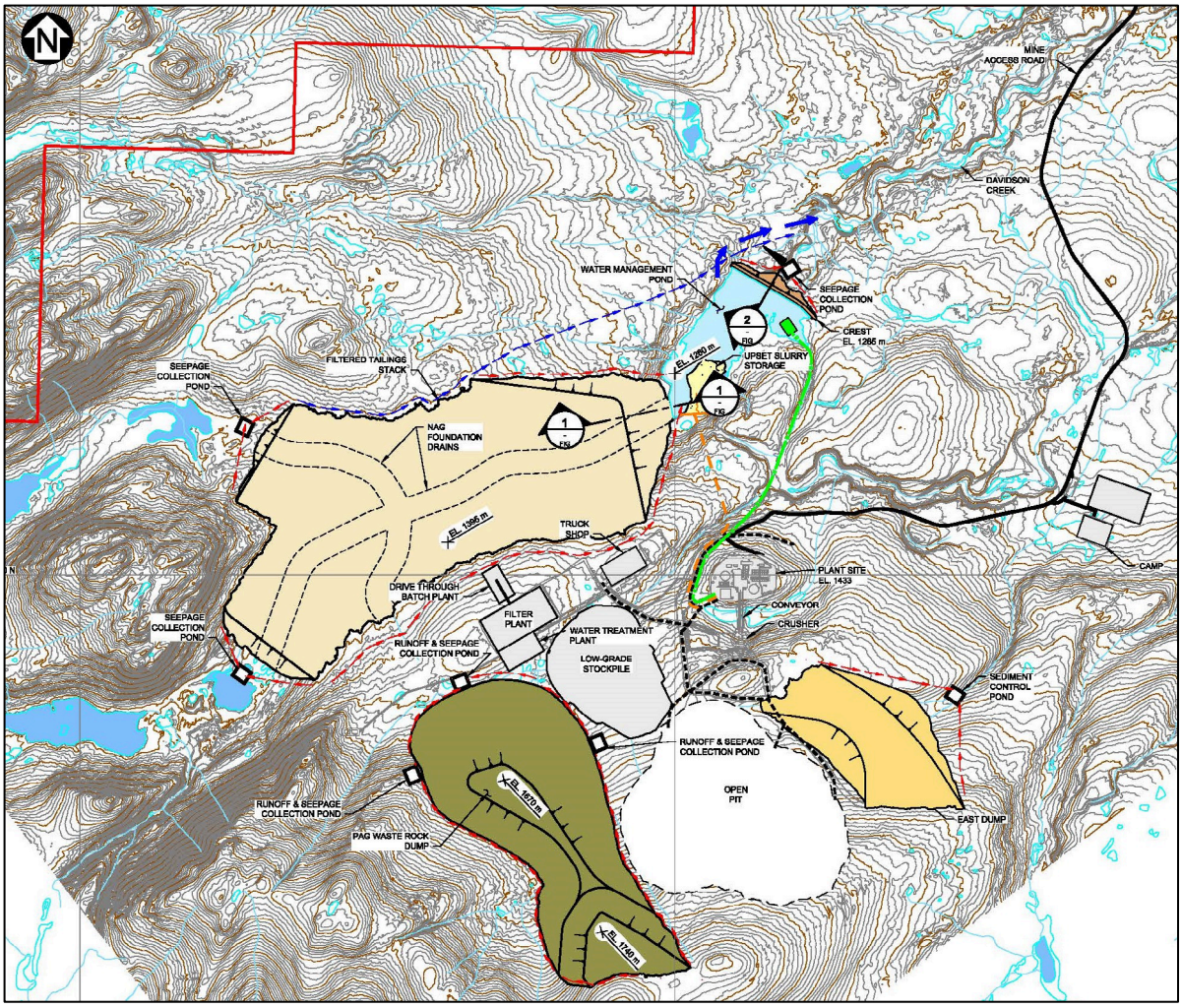



**Figure 7.4 Candidate 22 Ultimate Arrangement**

The process water pond dam safety hazard classification is SIGNIFICANT based on a technical bulletin released by the Canadian Dam Association in 2014 (CDA, 2014), entitled Application of Dam Safety Guidelines to Mining Dams. The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the process water pond dam. The following suggested design levels were adopted from the CDA guidelines for Candidate 22 during the operational phases of the project:

- IDF – 1 in 200 year return period.
- EDGM – 1 in 1,000 year return period.

The following design flood and earthquake levels were adopted for the closure phase:

- IDF – 1/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF).
- EDGM – 1 in 2,475 year return period.

Seepage from the process water pond will be primarily controlled by the low-permeability core zone and cut-off trenches constructed in the containment dam. Seepage passing through the core zone will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main dam. Lower relative seepage rates are expected from the pond compared to other options because the pond is significantly smaller. Seepage will be recycled back to the pond or treated and discharged.

The centre of the tailings waste pile site is located 3.5 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filter plant approximately 1 km away as thickened slurry with a gravimetric solids content of 50%. Tailings will be filtered and then transported by conveyer to a truck load out building. Haul trucks will transport the filtered tailings to the stacking location where dozers will be used for placement and grading. A conveyor will be considered for placement in later years once a large working surface has been developed. Two areas of the tailings pile will be developed:

- A general area where tailings will be placed in 10 m thick platforms with surface grading and compaction to reduce infiltration and maintain trafficability, and
- A structural area with thinner lift thicknesses and compaction to maintain stability of the stack.

Preparation of the tailings storage area will require clearing, grubbing, stripping of topsoil, removal of unsuitable foundation soils, and installation of a complex network of foundation drains. The filtered tailings waste pile will be constructed to elevation 1,395 m with a maximum height of approximately 145 m. The working surface of the pile at ultimate extents will be approximately 800 ha, and the rate of rise of the waste pile will be roughly 9 m per year. The filtered tailings waste pile rises approximately 40 m higher than the TSF Site C facility contemplated in Candidate 1 in the same location. This change will alter the seepage and surface water flow regime such that runoff and seepage may now report to the west of the filtered tailings pile. Two seepage collection ponds will be required on the west side of the filtered tailings pile. The waste pile slopes will be reclaimed concurrent with development; however the working surface of the pile is a large area and will require reclamation at closure.

An assessment of the stability rating for the filtered tailings waste pile was carried out using the waste dump and stockpile stability rating system as described in the interim guidelines provided by the B.C. Mine Waste Rock Pile Research Committee (BCMWRPRC, 1991). The waste pile was classified as Class III, Moderate Hazard. The specific key factors affecting stability, rated condition, and point ratings for classification of the waste pile were shown in Table 7.1 in Section 7.3.

The PAG waste rock dump will have a maximum height of approximately 300 m. A NAG fill platform will be constructed at the base of the dump area to raise the topography and direct drainage in to multiple seepage collection ponds constructed around the toe of the facility. The fill platform will have an engineered soil liner constructed on top of compacted overburden from the open pit. Seepage passing through the soil liner and fill platform will be collected in one of the seepage collection ponds and pumped to the water management pond via a water treatment plant and pipeline.

Unrecoverable seepage by-passing the collection and recycle systems for the process water pond, filtered tailings waste pile and PAG/NAG3 submergence impoundment has the potential to affect two watersheds; Davidson Creek and Creek 705. Any unrecovered seepage will be acidic and has the potential to impact the groundwater system and the downstream drainage area.

An assessment of the stability rating for the PAG waste rock dump was carried out using the waste dump and stockpile stability rating system as described in the interim guidelines provided by the B.C. Mine Waste Rock Pile Research Committee (BCMWRPRC, 1991). The waste pile was classified as Class III, Moderate Hazard. The specific key factors affecting stability, rated condition, and point ratings for classification of the waste pile were shown in Table 7.2.

**Table 7.2 PAG Waste Rock Dump Stability Rating**

| Key Factors Affecting Stability | Condition | Point Rating |
|---|---|---|
| Dump Height | > 200 m | 200 |
| Dump Volume | Large | 100 |
| Dump Slope | Flat | 0 |
| Foundation Slope | Moderate | 50 |
| Degree of Confinement | Moderate | 50 |
| Foundation Type | Intermediate | 100 |
| Dump Material Quality | Moderate | 100 |
| Method of Construction | Favourable | 100 |
| Piezometric & Climatic Conditions | Intermediate | 100 |
| Dumping Rate | Moderate | 100 |
| Seismicity | Moderate | 50 |
| **DUMP STABILITY RATING** | | **950** |
| | | |
| | **Class** | **Failure Hazard** |
| **Dump Stability Class** | III | Moderate |

### 7.5.2 Water Management

The catchment area is 22.5 $km^2$ (2,250 ha) with diversion of undisturbed catchment areas upslope of the mine facilities. The water balance was predicted to be in a surplus condition throughout operations with a surplus of 3 $Mm^3$ to 6 $Mm^3$ per year. The surplus increases throughout operations as runoff from disturbed areas increases. Fresh water diversions have been included to the maximum practical extent in the design. The TSF operational pond capacity is sufficient to manage a small range of surplus water conditions on an annual basis. The surplus will require a treated operational discharge to Davidson Creek throughout operations.

Runoff and infiltration from the LGO stockpile and PAG waste rock dump will be captured and treated at the mill before being conveyed for storage in the process water pond. Alternatively these treated flows could be diverted to Davidson Creek if they meet discharge water quality guidelines.

Surplus water management will require on-going monitoring, calibration of model predictions, and active management of water treatment to meet design objectives and to confirm that permitted operational surface water discharge allowances meet requirements to manage the water balance on

an inter-annual basis. There is limited excess storage to manage surplus water in the event that predictions do not match actual conditions or if there are issues with water treatment efficacy.

The reclaim water system will utilize a small barge-mounted pump station sized to deliver 700 $m^3$/hr of reclaim water (6 $Mm^3$ per year). The reclaim barge will be anchored in the process water pond. A volume of less than 2 $Mm^3$ of water reclaim was predicted to be required each year from the process water pond for the first ten years of operations, and will be combined with water from tailings dewatering, open pit dewatering and fresh water supply to support the milling process. Water in the process water pond after Year 10 may not be required for processing, and will be used as a temporary holding pond for the water treatment plant.

### 7.5.3 Execution

There are only a few examples of mining projects utilizing filtered tailings with a throughput greater than 10,000 TPD. La Coipa Mine in the Atacama Desert in northern Chile is one of the longest operating projects. The throughput of La Coipa is less than 20,000 TPD (sources report a range from 15,000 to 18,000 TPD). It is a high seismic region with very little precipitation, high evaporation rates, and freezing conditions throughout the year. Filtered tailings are placed by conveyor and radial stacker. It includes an upset area where over moisture tailings are deposited as slurry at the top of a slope and allowed to settle naturally. The largest operating project utilizing filtered tailings is the Karara Mine in Western Australia at approximately 40,000 TPD. Two tailings streams are produced: coarse tailings, dewatered by screen filtration, and fine tailings, dewatered by plate press. Tailings are placed by conveyor and stacker with a nominal lift thickness of 25 m. The site is essentially a desert and has an order of magnitude higher evaporation than precipitation.

The most reasonable example of a mining project utilizing filtered tailings in climate conditions similar to the project is Greens Creek located 30 km southwest of Juneau, Alaska. The throughput at Greens Creek is 1,500 TPD; however, only approximately 50% of the tailings are filtered and the remainder is used as paste backfill for underground workings.

A filter plant capable of dewatering tailings at a rate of 60,000 TPD will require a building roughly 100 m by 30 m (approximately half the size of a football field). Issues with the tailings filtration plant will be expected at times due to changes in ore type, grind size, and also for unforeseen maintenance of critical components. An area will be designated in the submergence impoundment for emergency discharge where slurry tailings will be sent when the filter plant is not operational. Also, a general placement area within the filtered tailings waste pile will be required ‘upset’ conditions when the filter plant produces tailings with less than optimal moisture content.

Filtered tailings material may have to be stockpiled and allowed to dry during adverse weather conditions or unforeseen truck maintenance in order to maintain production. Coordination and planning for weather conditions will be essential for development of a filtered tailings stack at this production rate (60,000 TPD) and in the weather conditions common in central British Columbia. A covered live stockpile may be required in addition to the truck load out facility. A live stockpile with a one week capacity will be approximately 100 m in diameter and 25 m in height. Movement of any stockpiled material will subsequently impact the availability of trucks to manage normal tailings production.

Transport of tailings by truck using CAT 777 haul trucks will require approximately 40 trips per hour, 24 hours a day for 365 days a year to manage a nominal production of 60,000 TPD. The operation

will require a loading arrangement that can reliably load trucks at a nominal rate of 1.5 minutes per truck. Any down time has the potential to impact mill operations. This will require an active truck fleet of 10 trucks for a haul with a round trip time of 15 minutes. The total truck fleet will have to be somewhat larger to manage temporary stockpiled material, for longer haul times, and for appropriate backup equipment during periodic and unforeseen maintenance needs. Trucks may need to be equipped with heated beds to prevent moist soil from freezing to the metal in the winter.

Filtration of tailings at a rate of 60,000 TPD will exceed anything within existing precedent; however the increase in scale of filtration alone is not insurmountable. The scale at which filtered tailings has been applied in similar site conditions is more concerning. Rainfall has the potential to reduce trafficability of the surface, making placement in areas difficult or impossible in certain cases. Winter conditions will pose a challenge for placement of the filtered tailings. Precipitation falls predominantly as snow throughout five months of the year. Accumulated snow will need to be removed prior to placement of subsequent tailings material. There is potential for entrainment of snow in the waste pile that could impact the stability of the pile in the short and long-term.

Placement of filtered tailings with a conveyor system might be simpler from a bulk material handling standpoint; however, a great deal of maneuvering will be required especially in the initial lifts. There may be an opportunity to move from trucking to a conveyor system in the later years of operation.

### 7.5.4 Closure

Upon mine closure, surface facilities will be removed in stages and reclamation will be initiated. Candidate 22 is anticipated to have an indefinite active closure period with some water management facilities remaining and being maintained in perpetuity. The closure plan is compatible with a premature closure event, but it will require substantial earthworks to construct engineered covers. General aspects of the closure plan include:

- Covering PAG waste rock with approximately 2 m of overburden.
- Covering the filtered tailings waste pile with 2 m of overburden.
- Constructing a pit discharge channel.
- Establishing wetlands and revegetating slopes.
- Pumping the surplus water reporting to the process water pond to the pit for about 30 years to develop the pit lake and flood of the majority of PAG rock in the ultimate pit walls.
- Dismantling and removing tailings dewatering and delivery structures, and equipment not required beyond mine closure.
- Pumping seepage collection ponds located to the west of the filtered tailings waste pile to the pit lake for approximately 30 years or until such time that suitable water quality is achieved.
- Removing the Davidson Creek seepage collection pumpback systems at such time that suitable water quality for direct release is achieved.
- Establishing polishing wetlands for treatment of seepage.
- Removing and re-grading all access roads, ponds, ditches, and borrow areas not required beyond mine closure.
- Long-term stabilization of all exposed erodible materials.

The remaining waste pile areas not progressively reclaimed will be reclaimed with overburden and re-vegetated. The low grade stockpile pad will be tested for contamination and removed and disposed of as required in the open pit. The pit will be allowed to flood and, upon filling, the pit lake

will discharge via a constructed channel to the process water pond and hence via a closure spillway to Davidson Creek. Seepage from the pond will pass through constructed wetlands downstream and hence to Davidson Creek.

Regular engineering reviews and inspections of the site will extend for at least 30 years into the closure period or until the site reaches a steady-state condition, with less frequent reviews and inspections thereafter.

Long-term active management is expected to continue following the initial closure period to:

- Confirm that the filtered tailings waste pile remains partially saturated, limiting air entry into the void space and retarding acid generation, and
- To operate the long-term water treatment plant(s) for the project.

Periodic engineering reviews and inspections will be needed to confirm the performance of the water treatment systems, and to manage changing conditions. This long-term active closure period is assumed to extend into perpetuity due to the likely acid generating nature of the waste rock and potential for acid generation from the filtered tailings waste pile.

# 8 – COST COMPARISON

Preliminary scoping level costs were developed for the selected candidates to provide a basis for relative comparison in the MAA. The cost estimate included an analysis of the full life cycle of the project including construction, operations, and closure phases. The quantities (material takeoffs) for developing the initial capital, and sustaining capital and operating cost estimates were derived from the figures developed for the study and/or adopted from similar costs determine during the FS, if applicable and at the appropriate level of detail.

The development of the candidate cost estimates was based on the cost of additional tailings processing (to create a slurry thickened beyond 50% solids and/or filtration of the tailings), preparation and development of the tailings storage area, preparation and development of a PAG storage area (if required) as well as costs for water management.

## 8.1 CANDIDATE 1

Candidate 1 is a thickened slurry tailings alternative and will not require any additional processing prior to tailings disposal above that already assumed in the FS. Quantities and costs were estimated for site preparation of the Site C and Site D TSF footprints, and quantities and costs were estimated for construction of the Site C and Site D dams. The costs for development of infrastructure supporting the TSF (including electrical, mechanical and instrumentation/monitoring), were included in the estimate. A separate PAG storage area is not required for Candidate 1 with submergence of waste rock within the TSF. Water management quantities and costs are included for sediment and seepage collection ponds as shown on Figure A-1 and Figure A-2.

The initial capital cost for development of Candidate 1 is estimated to be less than $ 100M, noted in Table 8.1.

The sustaining capital and operating costs for Candidate 1 are estimated to be between $ 175M and $ 349M, noted in Table 8.2.

The closure cost for Candidate 1 is estimated to be between $ 25M and $ 49M, noted in Table 8.3.

## 8.2 CANDIDATE 7

Candidate 7 is a filtered tailings alternative and will require additional processing in the form of filtration to produce tailings, which can be stored in a stacked arrangement. Quantities and costs were estimated for preparation of the filtered tailings storage area and PAG waste rock storage area, and quantities and costs estimated for construction of a dam to submerge the waste rock. The costs for development of infrastructure supporting the filtered tailings and PAG waste rock storage areas (including electrical, mechanical and instrumentation/monitoring), were included in the estimate. Water management quantities and costs are included in the estimate for sediment and seepage collection ponds as shown on Figure A-3 and Figure A-4.

The initial capital cost for development of Candidate 7 is estimated to be between $ 175M and $ 200M, noted in Table 8.1.

The sustaining capital and operating costs for Candidate 7 are estimated to be greater than $ 875M, noted in Table 8.2.

The closure cost for Candidate 7 is estimated to be between $ 100M and $ 125M, noted in Table 8.3.

## 8.3 CANDIDATE 10

Candidate 10 is a paste tailings alternative and will require additional thickening to produce tailings at a solids content greater than that assumed in the FS. Quantities and costs were estimated for preparation of the paste tailings storage facility area and quantities and costs were estimated for construction of a west and east dam to contain tailings discharged from a central location north of the Plant Site. The costs for development of infrastructure supporting the paste tailings and PAG waste rock storage facility (including electrical, mechanical and instrumentation/monitoring), were included in the estimate. Water management quantities and costs are included in the estimate for sediment and seepage collection ponds as shown on Figure A-5 and Figure A-6.

The initial capital cost for development of Candidate 10 is estimated to be between $ 100M and $ 124M, noted in Table 8.1.

The sustaining capital and operating costs for Candidate 10 are estimated to be between $ 175M and $ 349M, noted in Table 8.2.

The closure cost for Candidate 10 is estimated to be between $ 50M and $ 74M, noted in Table 8.3.

## 8.4 CANDIDATE 22

Candidate 22 is a filtered tailings alternative and will require additional processing in the form of filtration to produce tailings which can be stored in a stacked arrangement. Quantities and costs were estimated for preparation of the filtered tailings storage area and quantities and costs estimated for construction of a dam downstream of the stack area for development of a process water pond. Quantities and costs were developed for storage of PAG waste rock in an on-land dump. The costs for development of infrastructure supporting the filtered tailings and PAG waste rock storage areas (including electrical, mechanical and instrumentation/monitoring), were included in the estimate. Water management quantities and costs are included in the estimate for sediment and seepage collection ponds as shown on Figure A-7 and Figure A-8.

The initial capital cost for development of Candidate 22 is estimated to be between $ 125M and $ 149M, noted in Table 8.1.

The sustaining capital and operating costs for Candidate 22 are estimated to be greater than $ 875M, noted in Table 8.2.

The closure cost for Candidate 22 is estimated to be greater than $ 175M, noted in Table 8.3.

**Table 8.1 Initial Capital Costs**

| COST RANGE (M$) | INITIAL CAPITAL COSTS | | | |
|---|---|---|---|---|
| | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
| < 100 | X | | | |
| 100 - 124 | | | X | |
| 125 - 149 | | | | X |
| 150 - 174 | | | | |
| 175 - 200 | | X | | |
| > 200 | | | | |

**Table 8.2 Sustaining Capital and Operating Costs**

| COST RANGE (M$) | SUSTAINING CAPITAL AND OPERATING COSTS | | | |
|---|---|---|---|---|
| | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
| < 175 | | | | |
| 175 - 349 | X | | X | |
| 350 - 524 | | | | |
| 525 - 699 | | | | |
| 700 - 875 | | | | |
| > 875 | | X | | X |

**Table 8.3 Closure Costs**

| COST RANGE (M$) | CLOSURE COSTS | | | |
|---|---|---|---|---|
| | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
| < 25 | | | | |
| 25 - 49 | X | | | |
| 50 - 74 | | | X | |
| 75 - 99 | | | | |
| 100 - 125 | | X | | |
| > 125 | | | | X |

## 9 – SUMMARY

Three tailings storage technologies were considered in the alternatives assessment study: thickened slurry tailings, ultra-thickened (paste) tailings, and filtered tailings. The assessment includes these three tailings technologies and an evaluation of alternative site locations while considering water balance implications. The alternatives assessment contemplates saturated storage of PAG and NAG3 waste rock to achieve chemical stability. Saturated storage of waste rock requires the construction of a submergence facility using water retaining dams regardless of tailings disposal technology. The study also includes options for comparison that consider subaerial, unsaturated storage of these waste rock types in mine waste piles not requiring mining dams. Storage in this latter manner will not prevent the onset of acidic drainage conditions, but rather will rely on collection and treatment to manage the environmental risks associated with these options.

Concepts for management of mine waste were developed based on topographical maps of the project area, utilizing the alternative tailings storage technologies. The candidate sites are interspersed within an area of approximately 35 km by 30 km, and were roughly bounded by the Blackwater River to the south, the Nechako Reservoir to the north, Tatelkuz Lake to the east, and Entiako Provincial Park to the west. The tailings technology applied at each candidate site was chosen based on site specific constraints and professional judgement. Some candidate sites considered multiple tailings technologies, if appropriate, and others only considered a single technology. A total of twenty-three (23) candidates were developed.

A set of criteria was developed based on environmental site constraints to evaluate the group of candidates. The process of evaluating the candidates at this level was referred to as preliminary screening (pre-screening). The goal of pre-screening was to remove those candidates with obvious deficiencies. Ten (10) candidates were removed in the pre-screening process and thirteen (13) candidates were carried forward into a high level risk assessment.

The purpose of the high level risk assessment was to compare the relative risks of development for similar candidates and select the best candidates for a more detailed multiple accounts analysis. Candidates were separated by tailings technology to prevent risk assessment bias from removing all candidates of a single technology. The hazards applying to each candidate were based in specific engineering and environmental issues which will pose the greatest risks to development. Each candidate was evaluated against reasonably similar hazards to create a meaningful comparison of relative risk. The hazards were arranged in three categories: safety, environment, and technical execution. Four candidates (4) were selected from the high level risk assessment and carried forward into a multiple accounts analysis.

A summary of the technical information related to each of the four (4) candidates considered in the multiple accounts analysis was provided. The information includes a general description of the mine development concept, indicators of physical stability, and technical aspects including containment design, construction requirements, water management, operational execution, and closure considerations. The results of the multiple accounts analysis is reported by ERM in a separate report.

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## 11 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared:

Duke Reimer, EIT
Staff Engineer

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
Dec 11, 2015
D. D. FONTAINE
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Reviewed:

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# APPENDIX A

# GOVERNMENT INFORMATION REQUESTS

(Pages A-1 to A-6)

File: 30200-20/BGOL-10

Reference: 276969

March 19, 2015

**SENT VIA EMAIL**

Tim Bekhuys
Director, Environment and Sustainability
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Dear Mr. Bekhuys:

As you are aware, on January 30, 2015, the Independent Expert Engineering Investigation and Review Panel (Panel) issued its report on the breach of the Mount Polley tailings facility (Report). The Panel's Report included several findings and recommendations to enhance safety and prevent the future failure of tailings dams. The Panel findings and recommendations addressed both existing tailings facilities, as well as newly proposed facilities.

The Government has accepted all of the recommendations and indicated that they will be implemented. The Ministry of Energy and Mines will be establishing a process to consider implementation, and has advised that it will take at least a year to consider the results of ongoing investigations and complete a review of the Health, Safety and Reclamation Code for Mines in British Columbia.

The Environmental Assessment Office (EAO) has been working closely with the Ministry of Energy and Mines and Ministry of Environment to identify appropriate considerations of the Panel Report at the environmental assessment level. Based on this collaboration, EAO is setting out the following requirements to enable EAO to evaluate tailings management options and efforts to mitigate risks and potential impacts. This will help to ensure that mine proponents are preparing for new regulations and policies, which may be more prescriptive, but will generally be consistent with the approach set out below.

…2

Specifically, in order to ensure that environmental assessments (EA) on mining projects in British Columbia appropriately consider the implications of the Panel findings and recommendations, I am requiring that proposed mining projects that have new proposed tailings dams provide the following information:

> Proponents must provide a description and an assessment of alternative means of undertaking the proposed project with respect to options for tailings management that considers technology, siting and water balance.
>
> The assessment must present and compare best practices and best available technologies for tailings management for the project, along with options for managing water balance to enhance safety and reduce the risk (likelihood and consequence) of a tailings dam failure during all phases of mine life (construction, operations, closure, post-closure). The assessment must present and compare technically and economically viable engineering solutions that are available to adequately address site conditions.
>
> The assessment must provide a clear and transparent evaluation of the factors that supported the selection of the most suitable option. Factors that will be taken into consideration in the evaluation include safety, technical and financial aspects, and implications for environmental, health, social, heritage and economic values. The assessment must consider these factors in relation to tailings management options in both the short and long-term context. Life cycle cost assumptions (construction, operations, closure, post-closure) must be included in the analysis of options.

While EAO recognizes that the selection of project design rests with the proponent, the requirements outlined in this letter are to ensure that proponents have:

- considered other options that can address the potential for adverse effects on the factors noted above;
- for the project design option selected, considered the potential risks and implications of that option, and have a technically and economically feasible plan to address the potential risks and implications; and
- provided a clear and transparent rationale for the selected option(s).

…3

Moving forward, further information and analysis of Panel recommendations will be dealt with through a variety of other agencies and initiatives. These include the regulatory review of mining projects at the *Mines Act* permitting stage, through policy development and regulation review (such as the review of the Health Safety and Reclamation Code recently announced by the Honourable Bill Bennett, Minister of Energy and Mines, and through initiatives by other agencies such as the Canadian Dam Association, various mining industry associations and the BC Association of Professional Engineers and Geoscientists. EAO will advise you if any of this future work results in a change to these requirements.

I anticipate that the alternative means assessment also may be of interest to Aboriginal Groups potentially affected by the proposed Project. I encourage proponents to include any information in their assessments regarding potential implications of the options for Aboriginal Interests (asserted or established Aboriginal rights, including title and treaty rights). This will enable proactive and timely discussions with Aboriginal Groups in the EA for your project.

The proposed Blackwater Gold Project (Blackwater) is in the Pre-Application Stage of the EA, the Application Information Requirements (AIR) have been issued and an Application has been submitted under section 16 of the *Environmental Assessment Act* (Act). However, the evaluation is not yet complete.

If the Application is not accepted for review, pursuant to Section 13 of the Act, I am ordering that the AIR be amended with the language specified above. The sufficiency of the information provided will be considered when the Application is re-submitted for evaluation under Section 16 of the Act, as a part of the overall evaluation of the Application.

If the Application is accepted for review, pursuant to Section 13 of the Act, I am ordering that you provide the above noted information during Application Review. Timeline extensions or suspensions will be considered if necessary to ensure there is adequate time to receive and assess the information provided. Please provide to Ms. Shelley Murphy, Executive Project Director, an estimate of the amount of time that will be required to provide the required information so that EAO can consider the implications for the review period.

I recognize that this will require proponents to undertake additional assessments and may be more work than you had expected for the EA. It is important that EAs allow for sufficient time for the Report findings and recommendations to be adequately addressed at an EA level, and that this be considered for all proposed mines with new tailings dams going forward.

…4

Ms. Murphy will work with you to address questions you may have about the expectations for alternative means assessments

Sincerely,



Doug Caul
Associate Deputy Minister

cc: Shelley Murphy, Executive Project Director, Environmental Assessment Office

Canadian Environmental Assessment Agency
Agence canadienne d'évaluation environnementale

PO Box 10114
701 West Georgia Street
Suite 410
Vancouver, British Columbia
V7Y 1C6

Boite postale 10114
701 rue Georgia ouest
Bureau 410
Vancouver (Colombie-Britannique)
V7Y 1C6

June 3, 2015

Tim Bekhuys
Director, Environment and Sustainability
New Gold Inc.
555 Burrard Street, Suite 1800
Vancouver B.C. V7X 1M9

Dear Mr. Bekhuys:

**Subject: Federal Requirements Related to the Mount Polley Independent Expert Engineering Investigation and Review Panel Report**

The Canadian Environmental Assessment Agency (the Agency) has considered the additional information requirements issued by the British Columbia Environmental Assessment Office (EAO) on March 19, 2015 for the Blackwater Gold Project (the Project), in follow-up to the recommendations of the Mount Polley Independent Expert Engineering Investigation and Review Panel Report released on January 30, 2015. The Agency also reviewed New Gold Inc.'s (the proponent) proposed approach submitted on April 17, 2015 to respond to the additional information required by the EAO.

The Agency issued the Environmental Impact Statement (EIS) Guidelines for the preparation of an EIS under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), on February 19, 2013. The EIS Guidelines direct the proponent to provide an assessment of alternative means of carrying out the Project that are technically and economically feasible, including the environmental effects of those alternative means. Tailings disposal was a project component identified for the alternative means analysis.

To date, the proponent has submitted to the Agency a draft EIS which includes an assessment of alternative means of undertaking the proposed project, and an "Assessment of Alternatives for the Blackwater Gold Project Tailings Storage Facility" to meet the requirements for a *Metal Mining and Effluent Regulations* Schedule 2 amendment. The additional information required by the EAO would also contribute to the Agency's analysis of the potential effects of alternative means and potential accidents and malfunctions.

.../2

In the proponent's additional tailings management alternatives assessment, the Agency requests that environmental effects, as defined in section 5 of CEAA 2012, be included as factors to be considered in the assessment of the preferred option. In addition, if the alternatives assessment results in any changes to potential effects to Valued Components related to section 5 environmental effects, or to safeguards proposed to protect against the occurrence of accidents or malfunctions, the Agency expects that this information will be presented.

Should you have any questions about the above, please do not hesitate to contact me at *christal.nieman@ceaa-acee.gc.ca* or 604-666-2005.

Sincerely,



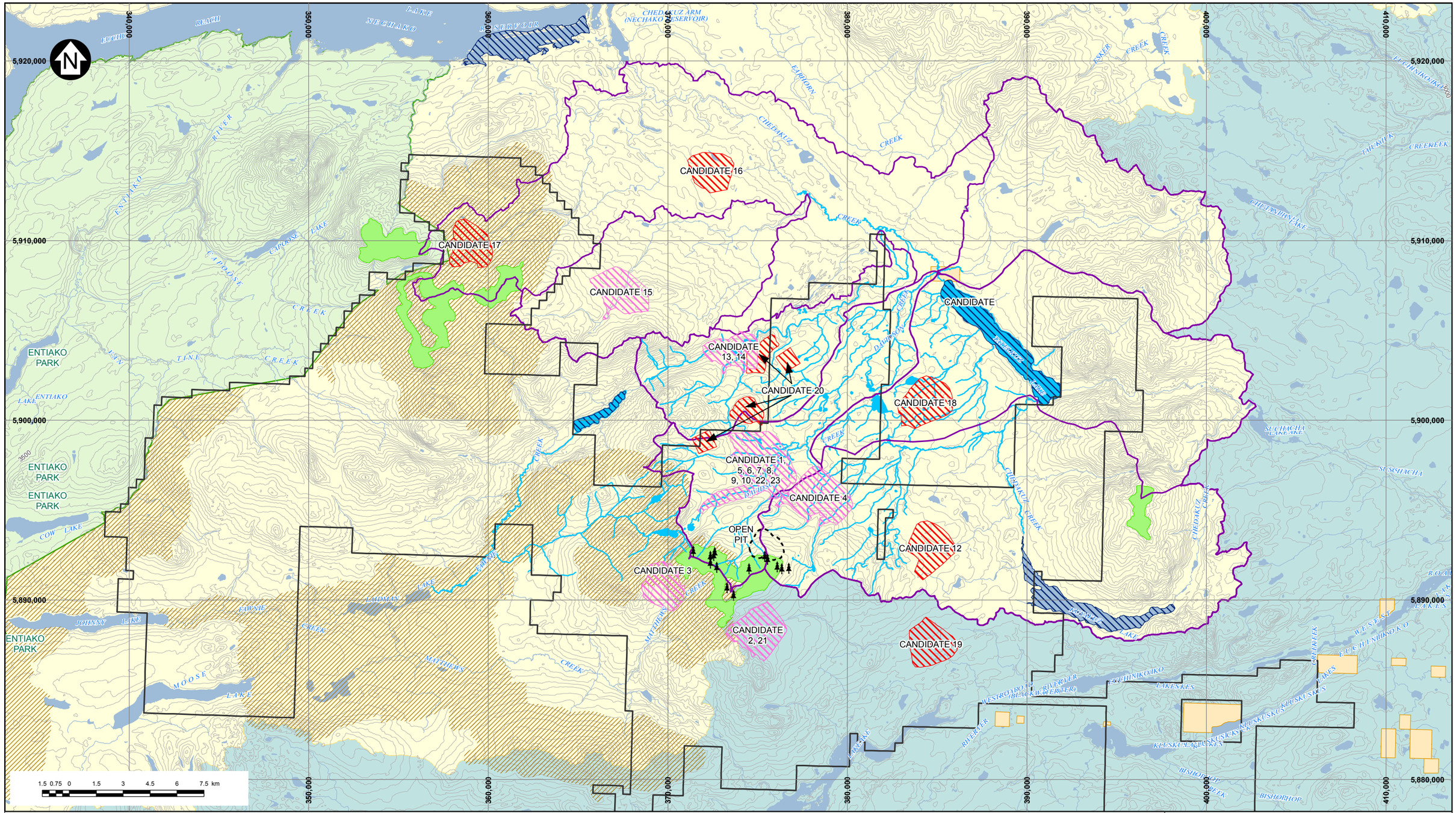
Christal Nieman
Project Manager

c.c.: Shelley Murphy, BC Environmental Assessment Office

# APPENDIX B

## FULL SIZE CANDIDATE MAPS

(Pages B-1 to B-2)




**LEGEND:**

- CONTOUR (100 ft)
- RIVER
- LAKE
- PROJECT CATCHMENT
- NECHAKO RIVER CATCHMENT
- BLACKWATER RIVER CATCHMENT
- MINERAL CLAIM OUTLINE
- OPEN PIT

**CANDIDATES**

- FILTERED TAILINGS
- SLURRY TAILINGS
- SUBAQUEOUS TAILINGS

**SITE CONSTRAINTS**

- WHITEBARK PINE OBSERVATION
- KNOWN OR PRESUMED FISH BEARING STREAM
- KNOWN FISH BEARING LAKE
- ENGELMANN SPRUCE - SUBALPINE FIR MOIST VERY COLD PARKLAND
- PARK OR PROTECTED AREA
- FIRST NATIONS RESERVE
- UNGULATE WINTER RANGE

**NOTES:**

1. BASE MAP: BC TRIM AND CANADA NTS MAPPING, ERM RESCAN ENVIRONMENTAL MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:200,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. AREAS IDENTIFIED WITH MULTIPLE CANDIDATES MAY INCLUDE BOTH SLURRY AND FILTERED TAILINGS ALTERNATIVES.
5. SUBAQUEOUS TAILINGS STORAGE IN A LAKE / COMBINATION OF LAKES IS IDENTIFIED AS CANDIDATE 11.

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
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NEW GOLD INC.

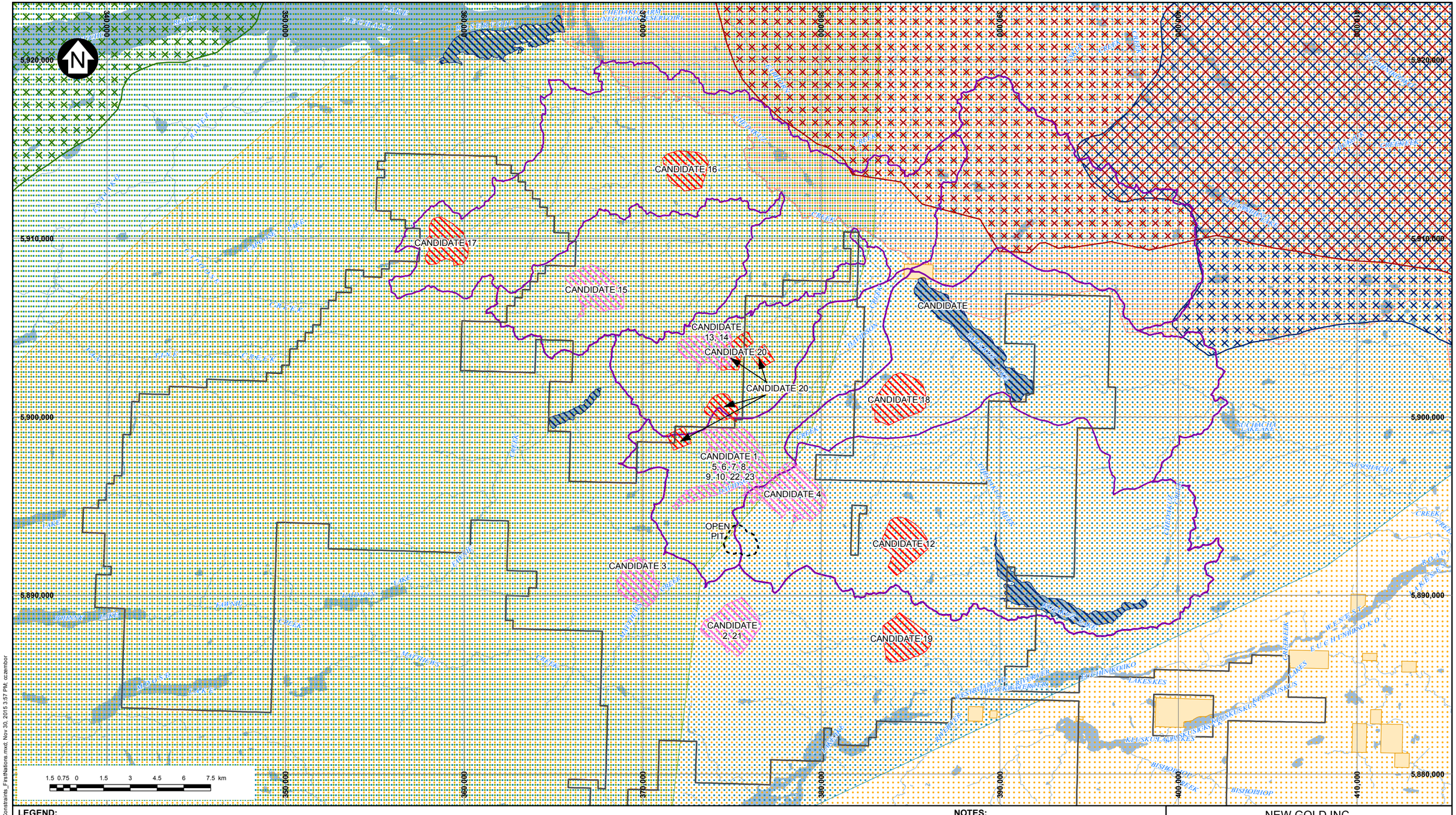
BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE MAP**
**SITE CONSTRAINTS**

Knight Piésold CONSULTING

PIA NO. VA101-457/15 | REF NO. 1

**FIGURE B.1** | REV 0




**LEGEND:**

- RIVER
- LAKE
- FIRST NATIONS RESERVE
- PROJECT CATCHMENT
- MINERAL CLAIM OUTLINE
- OPEN PIT

**CANDIDATES**

- FILTERED TAILINGS
- SLURRY TAILINGS
- SUBAQUEOUS TAILINGS

**STATEMENT OF INTENT**

- CARRIER SEKANI TRIBAL COUNCIL
- CHESLATTA CARRIER NATION
- NAZKO FIRST NATION

**TRADITIONAL TERRITORY**

- LHOOSK'UZ DENE
- SKIN TYEE
- ULKATCHO
- SAIKUZ

**NOTES:**

1. BASE MAP: BC TRIM AND CANADA NTS MAPPING, ERM RESCAN ENVIRONMENTAL MAPPING.
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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE MAP**
**ABORIGINAL TERRITORY INTERACTIONS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE B.2** | REV 0



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# APPENDIX C

## INDIVIDUAL CANDIDATE MAPS

(Pages C-1 to C-23)




**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:40,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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BLACKWATER GOLD PROJECT

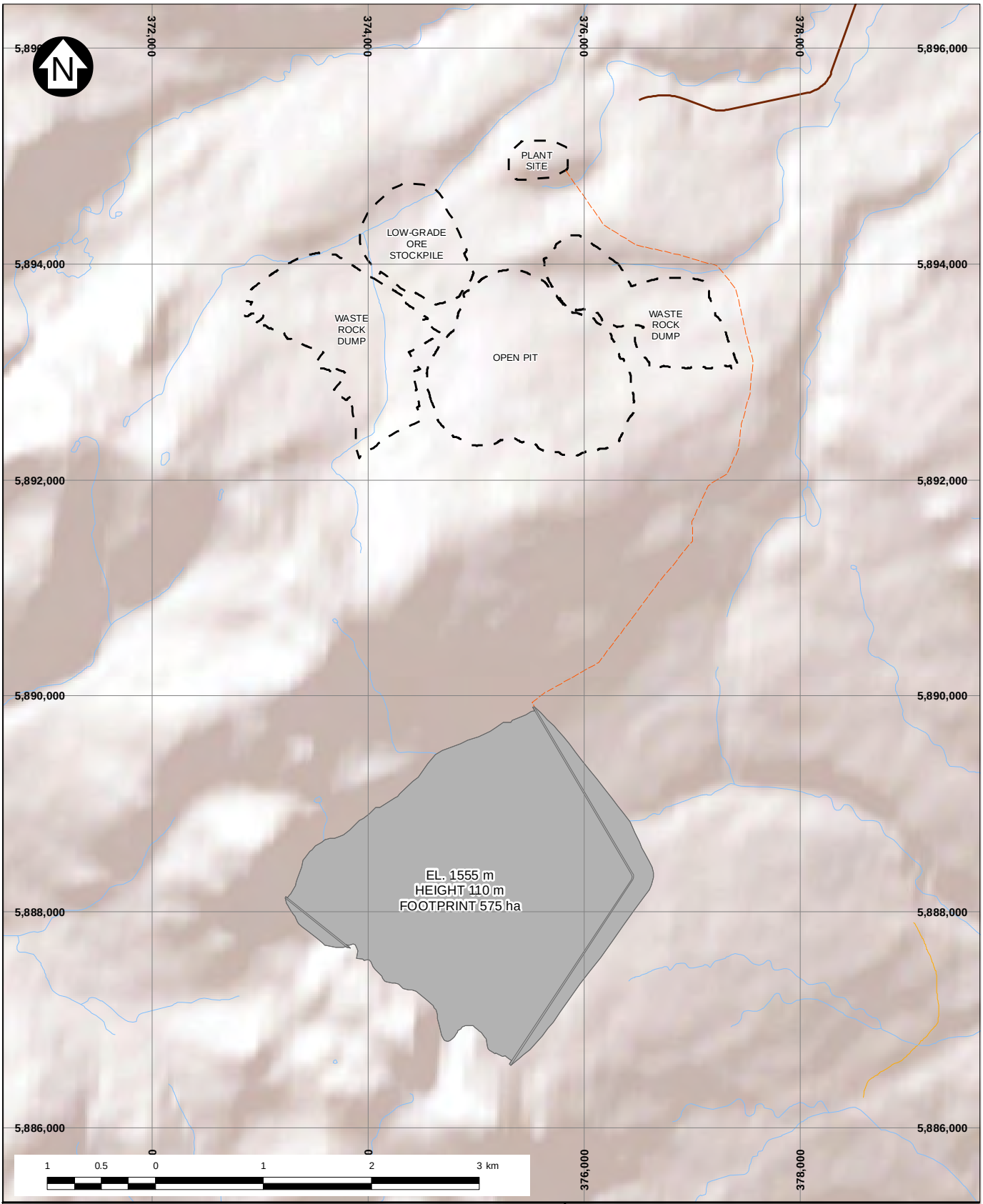
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 1 - SLURRY TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-1** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

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BLACKWATER GOLD PROJECT

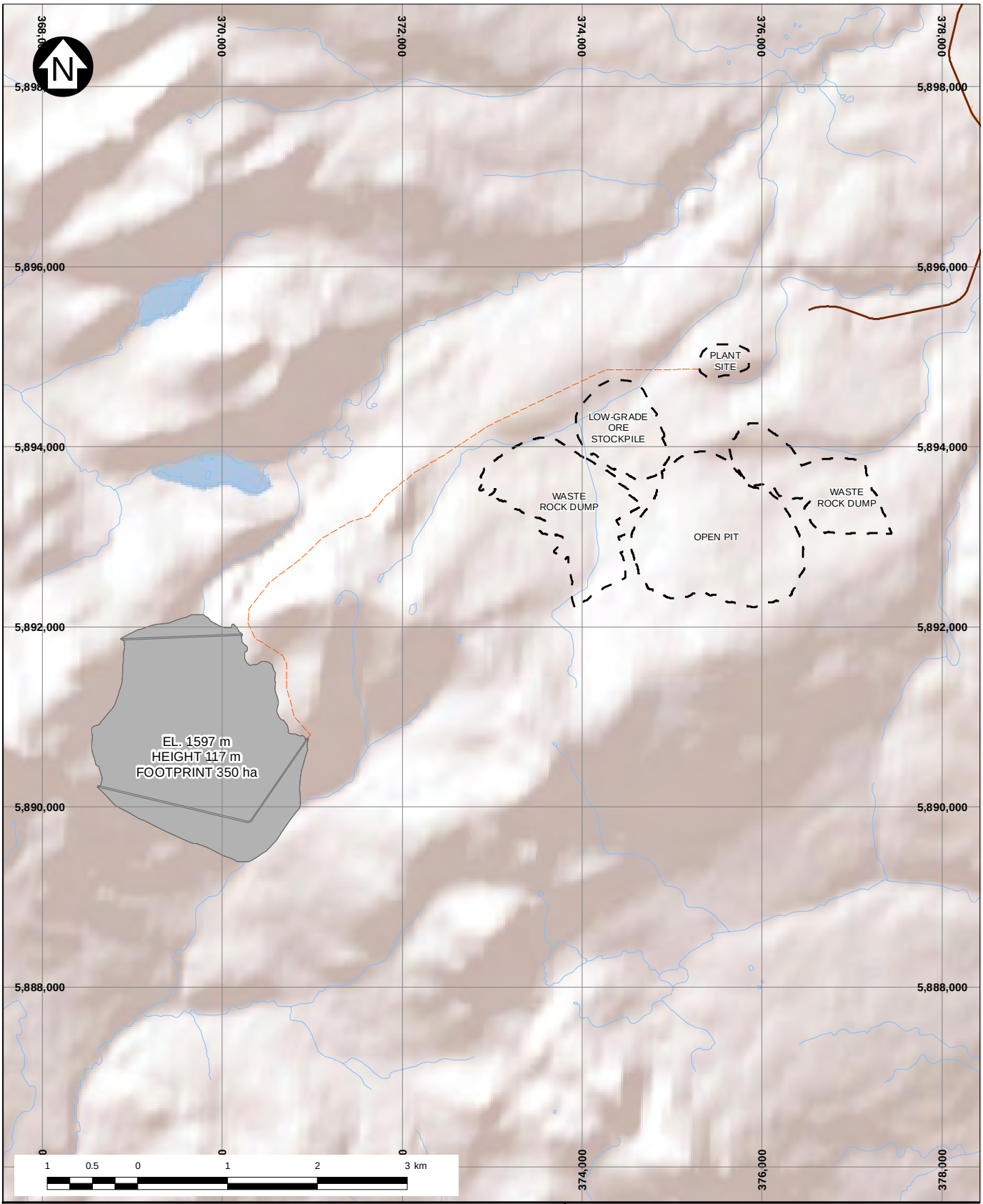
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 2 - SLURRY TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-2** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

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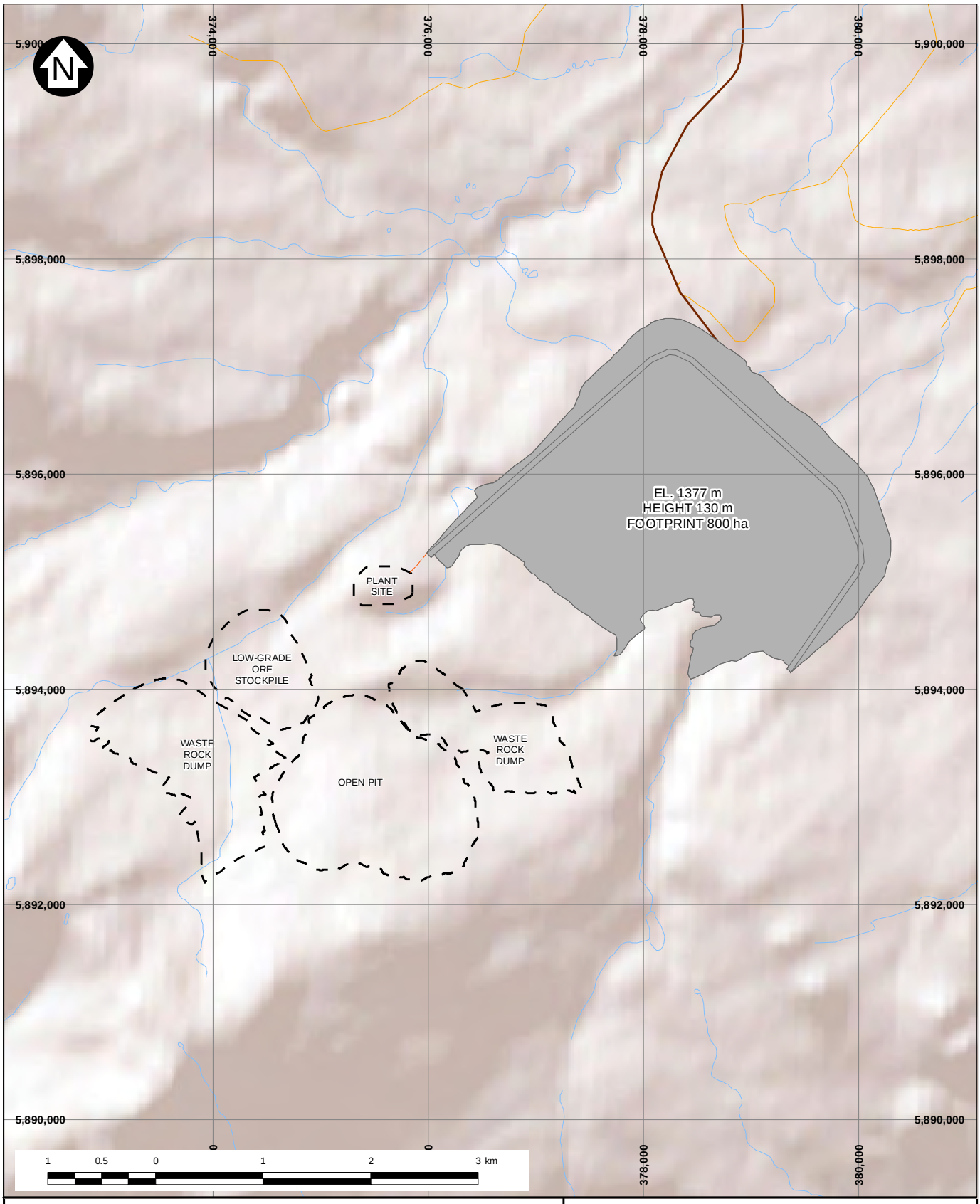
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 3 - SLURRY TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-3** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

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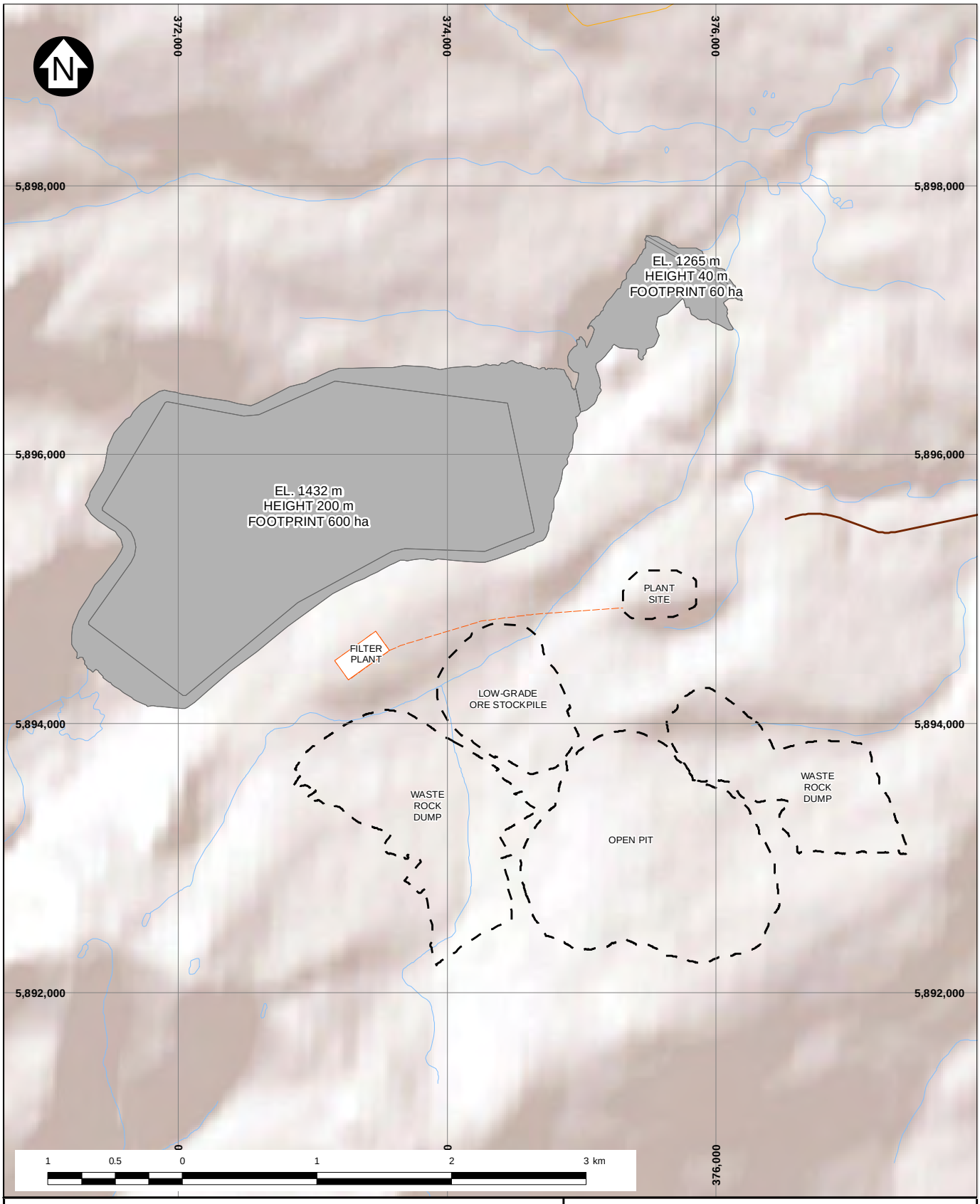
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 4 - SLURRY TAILINGS**

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**FIGURE C-4** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

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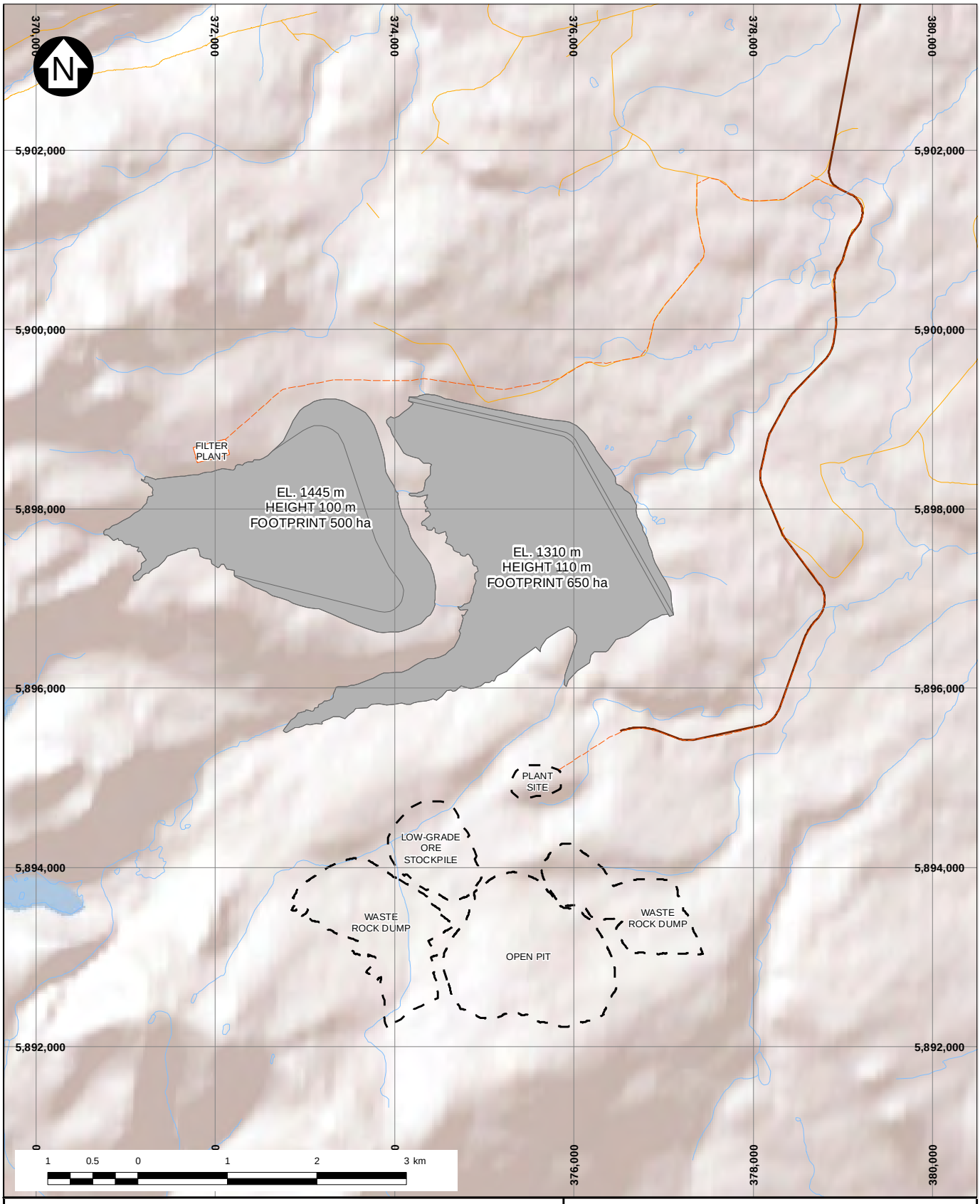
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 5 - FILTERED TAILINGS**

Knight Piésold CONSULTING

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**FIGURE C-5** REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

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3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:60,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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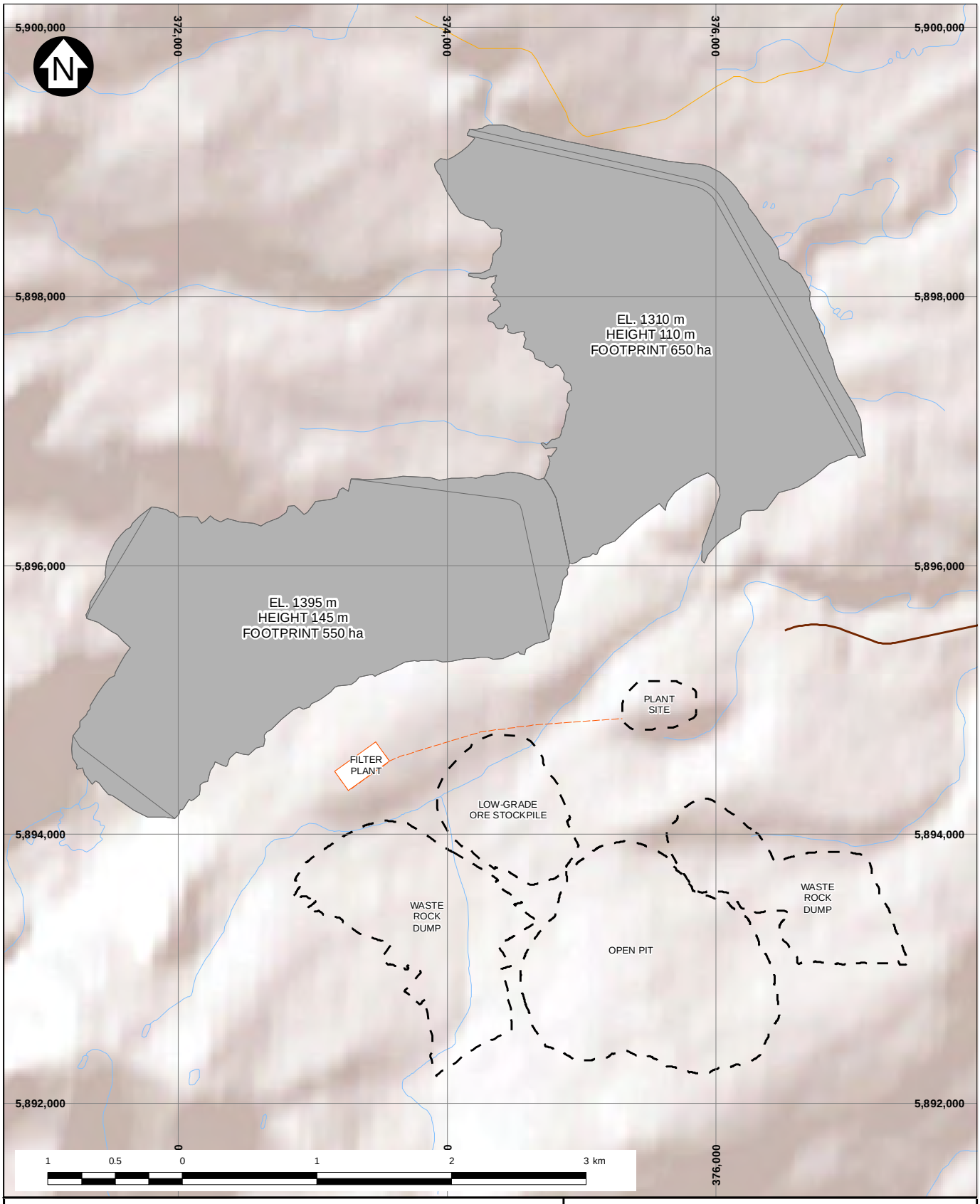
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 6 - FILTERED TAILINGS**

Knight Piésold CONSULTING

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**FIGURE C-6** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

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2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:40,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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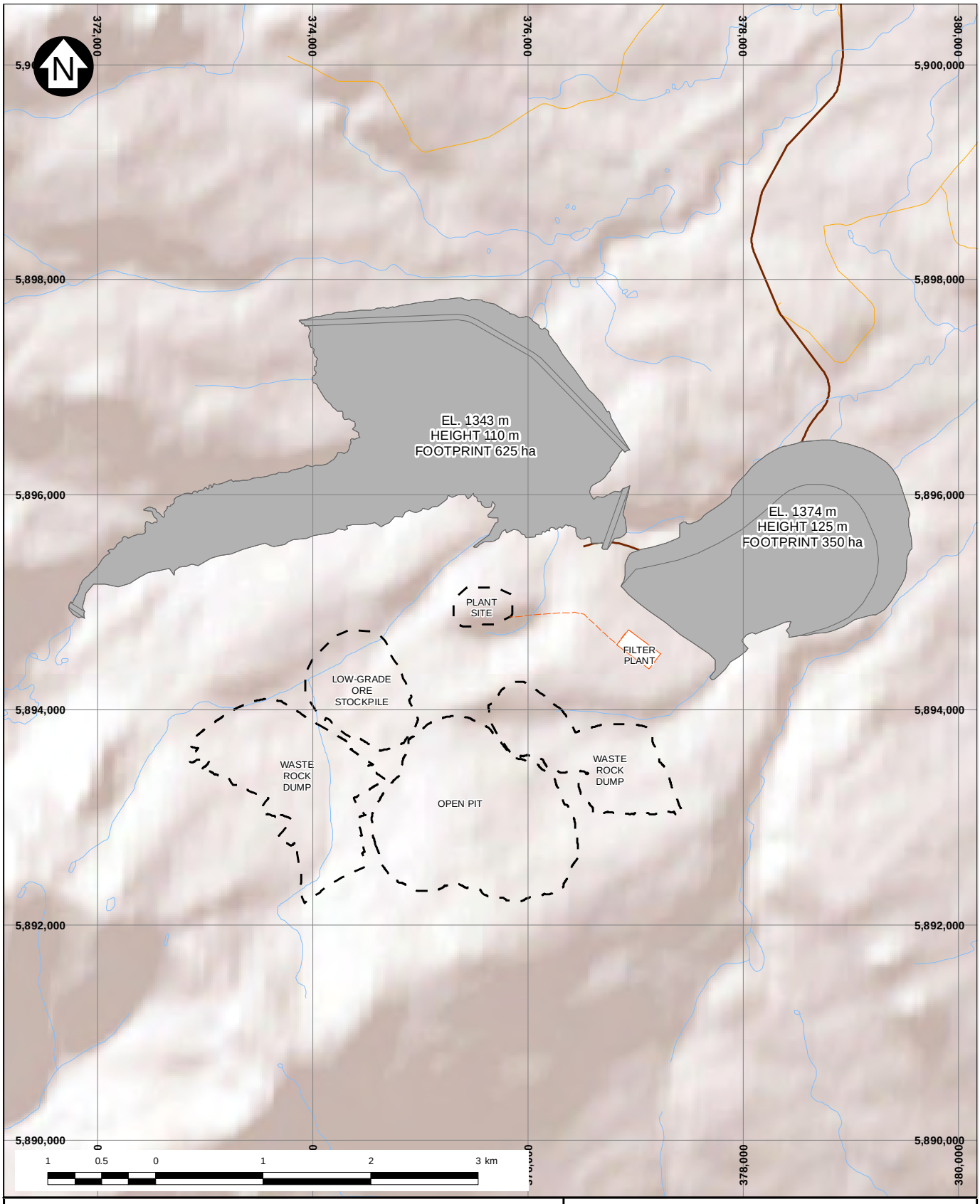
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 7 - FILTERED TAILINGS**

Knight Piésold CONSULTING

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**FIGURE C-7** REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

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2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:50,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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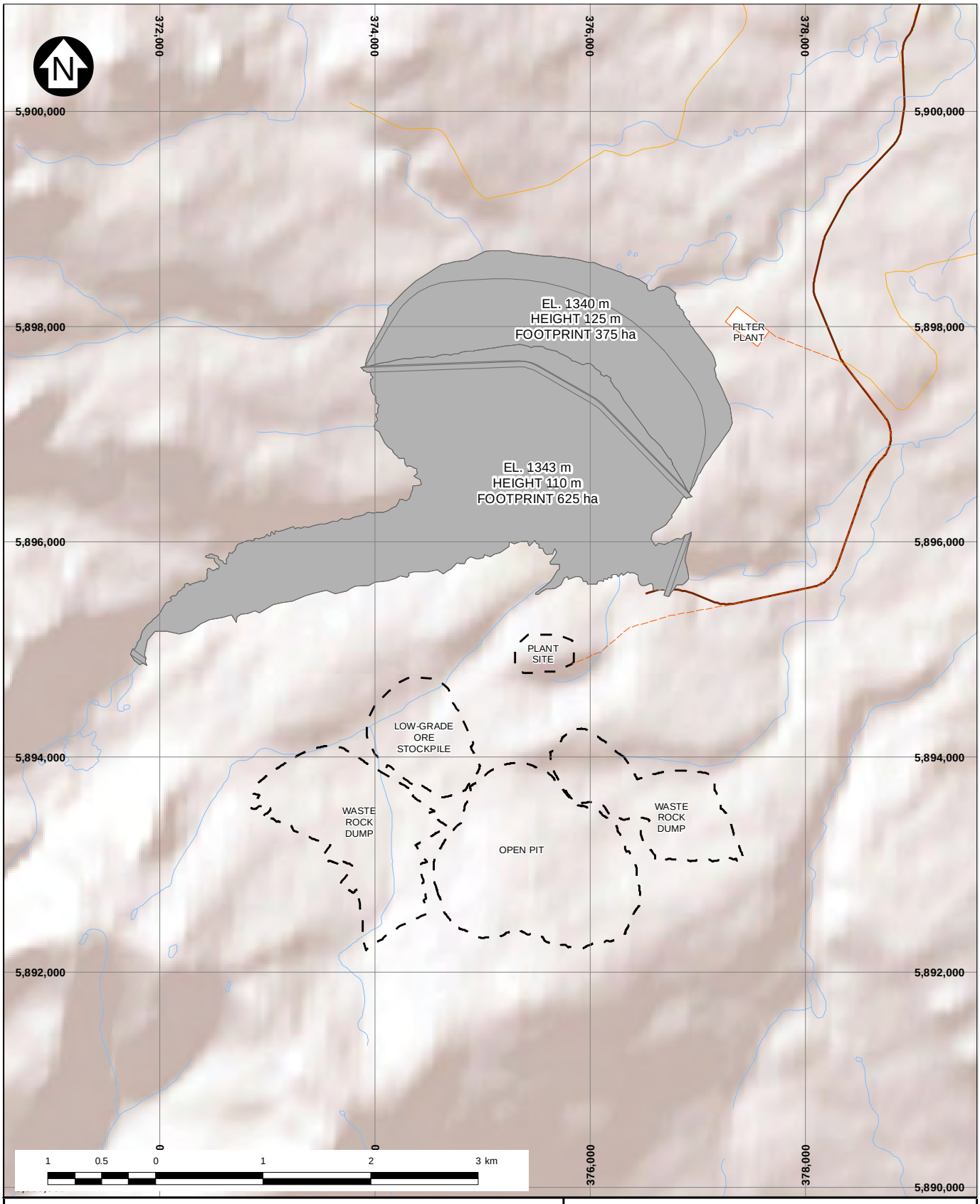
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 8 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-8** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

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| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | CAC | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 9 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-9** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
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| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | CAC | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 10 - PASTE TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-10** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

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3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:140,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

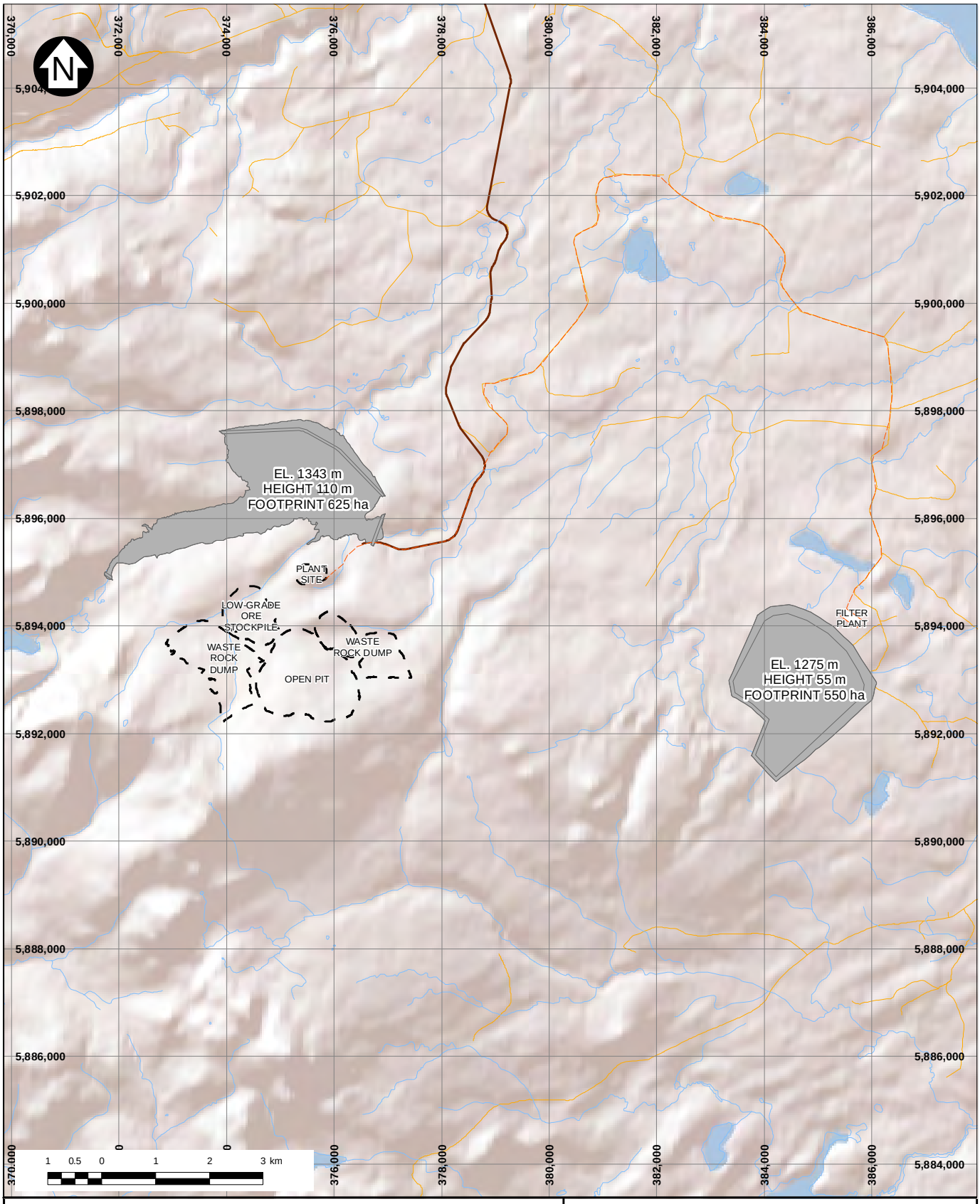
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 11 - SLURRY TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-11** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:100,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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NEW GOLD INC.

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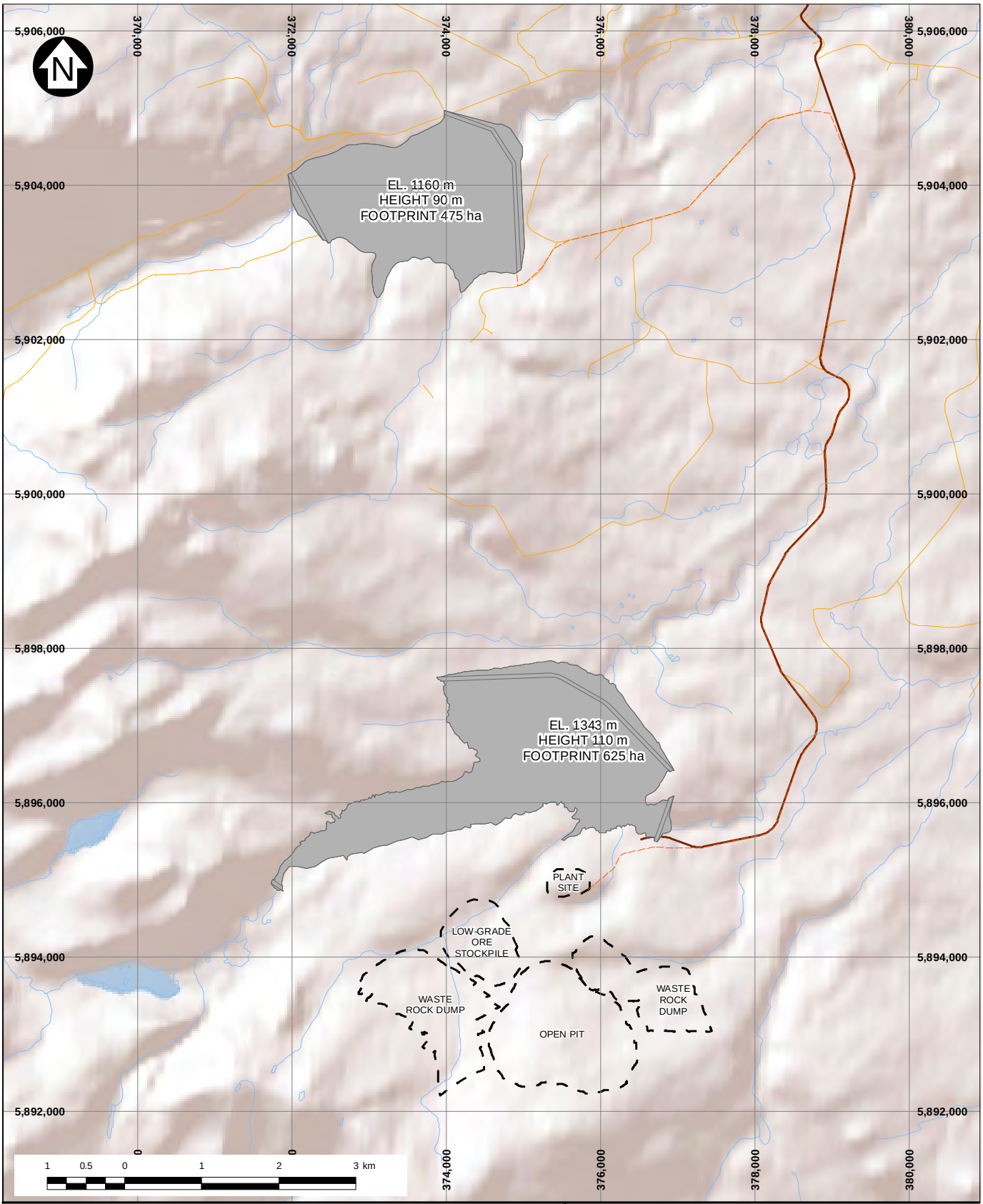
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 12 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-12** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:70,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

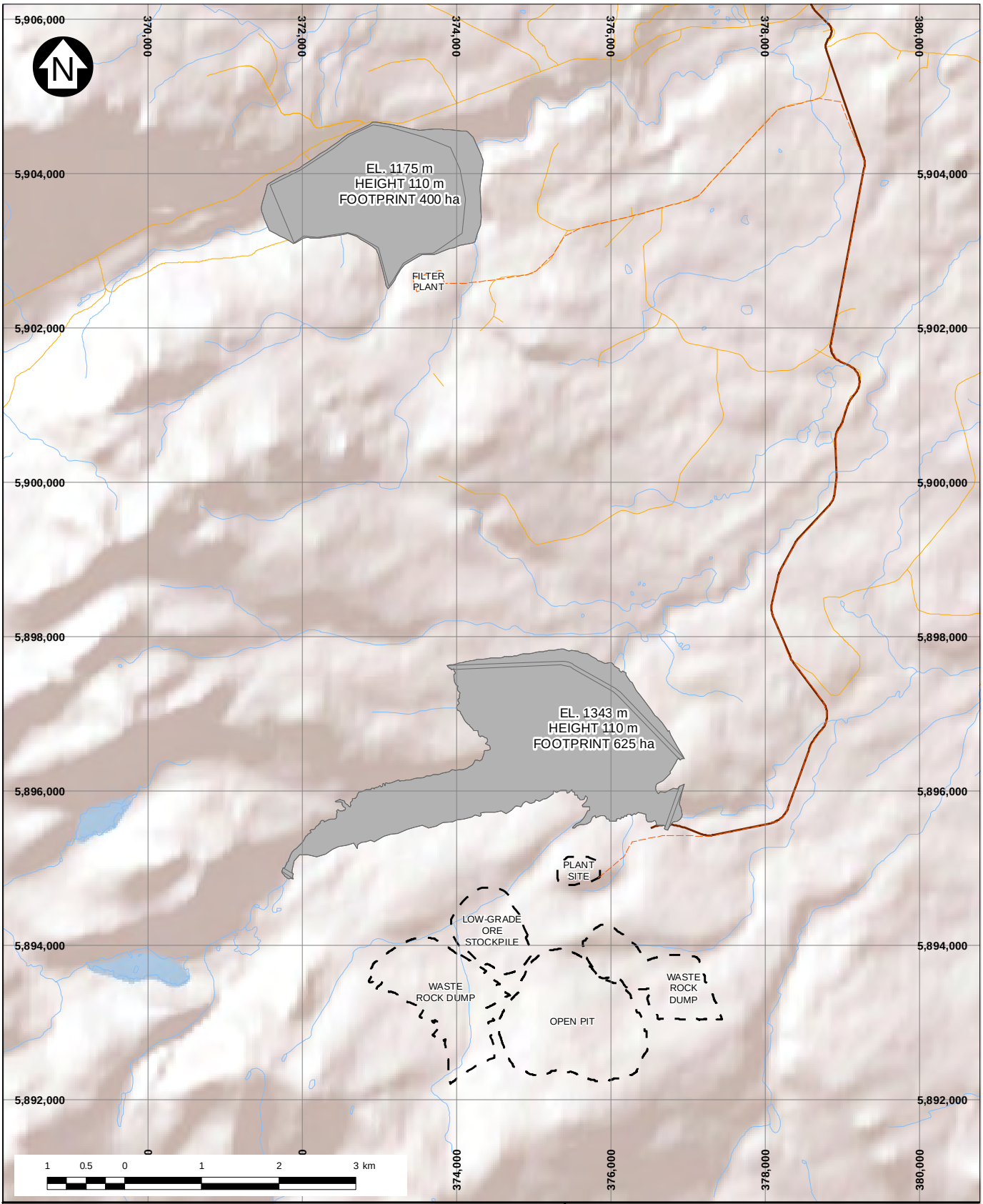
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 13 - SLURRY TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-13** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:70,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

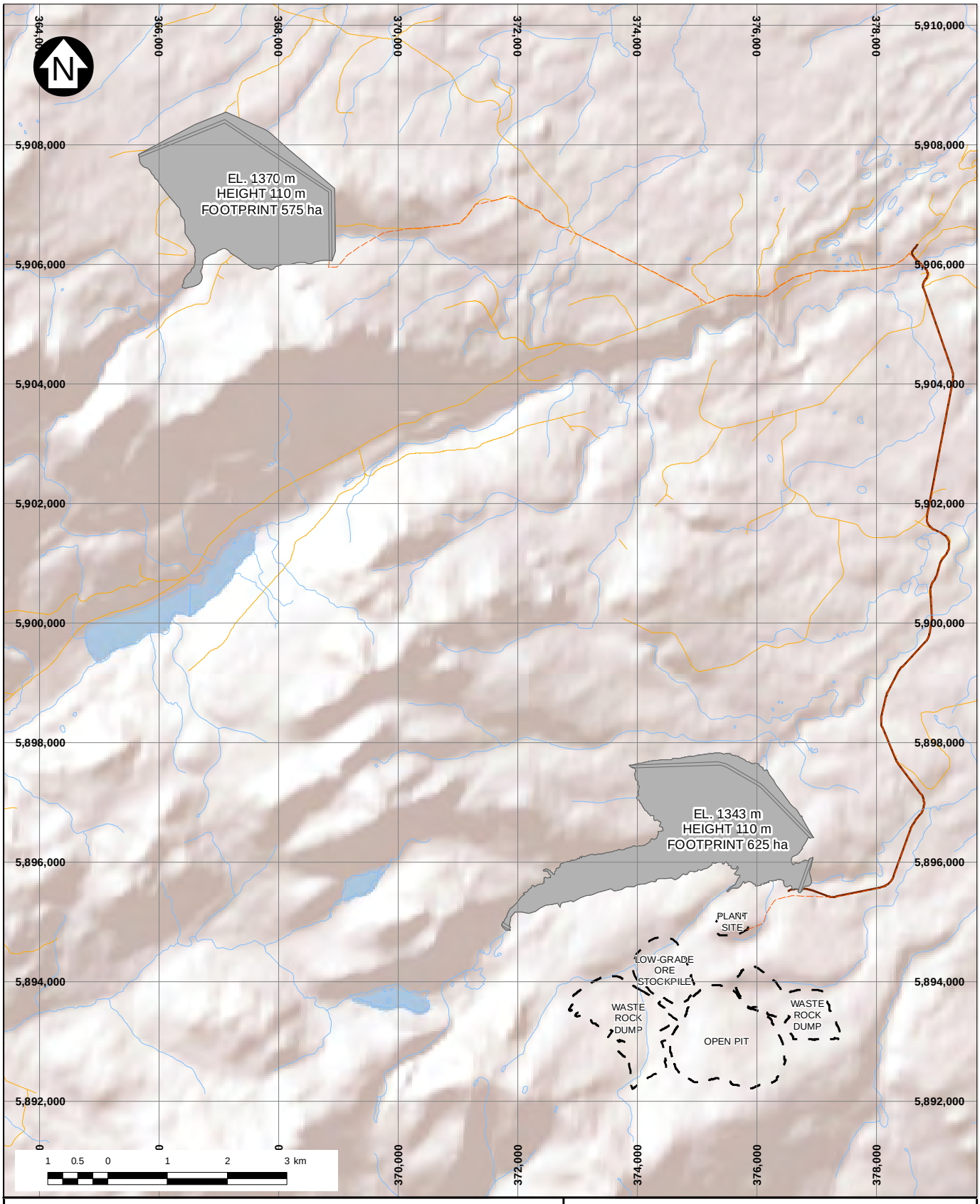
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 14 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-14** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:90,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

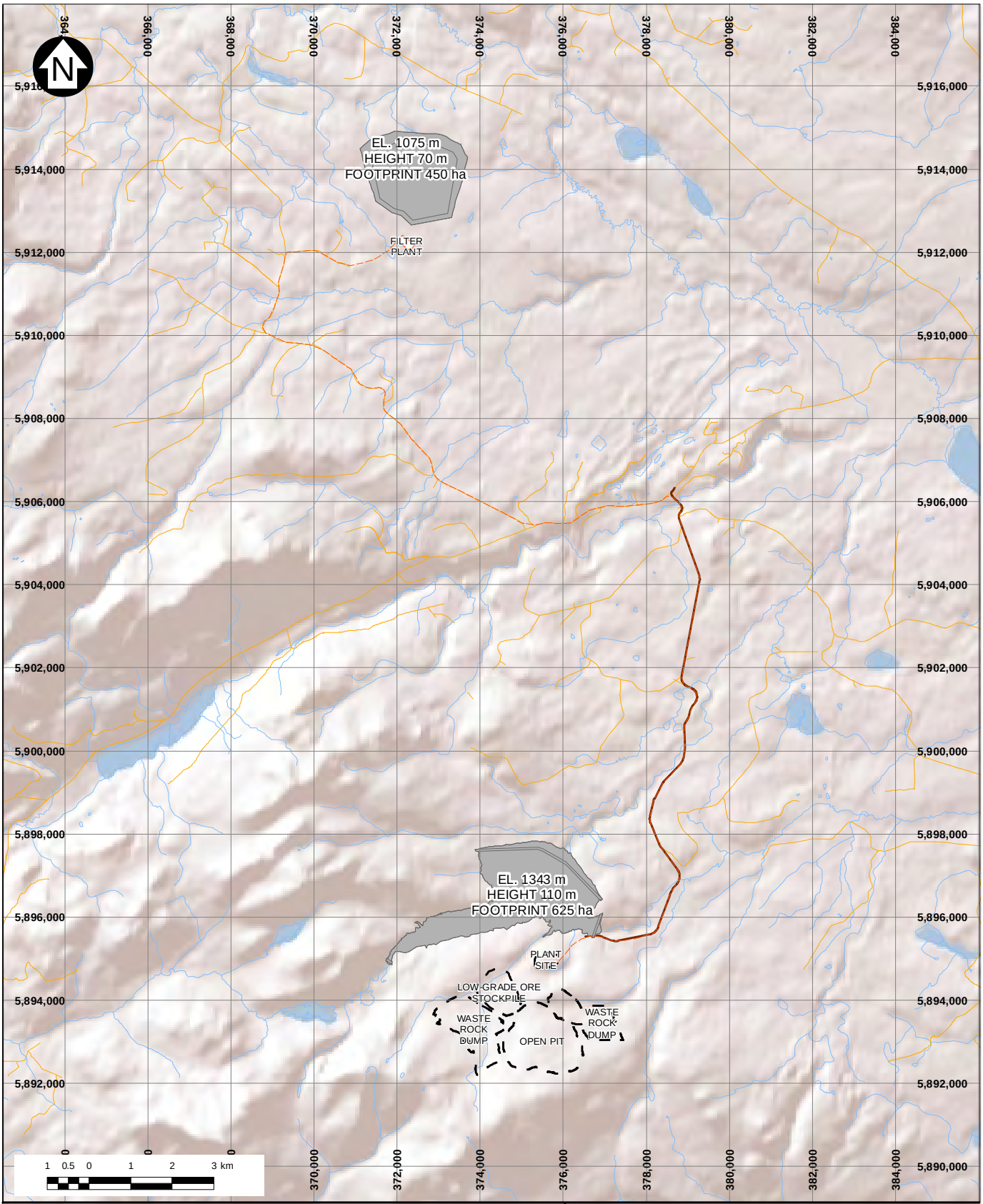
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 15 - SLURRY TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-15** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:130,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

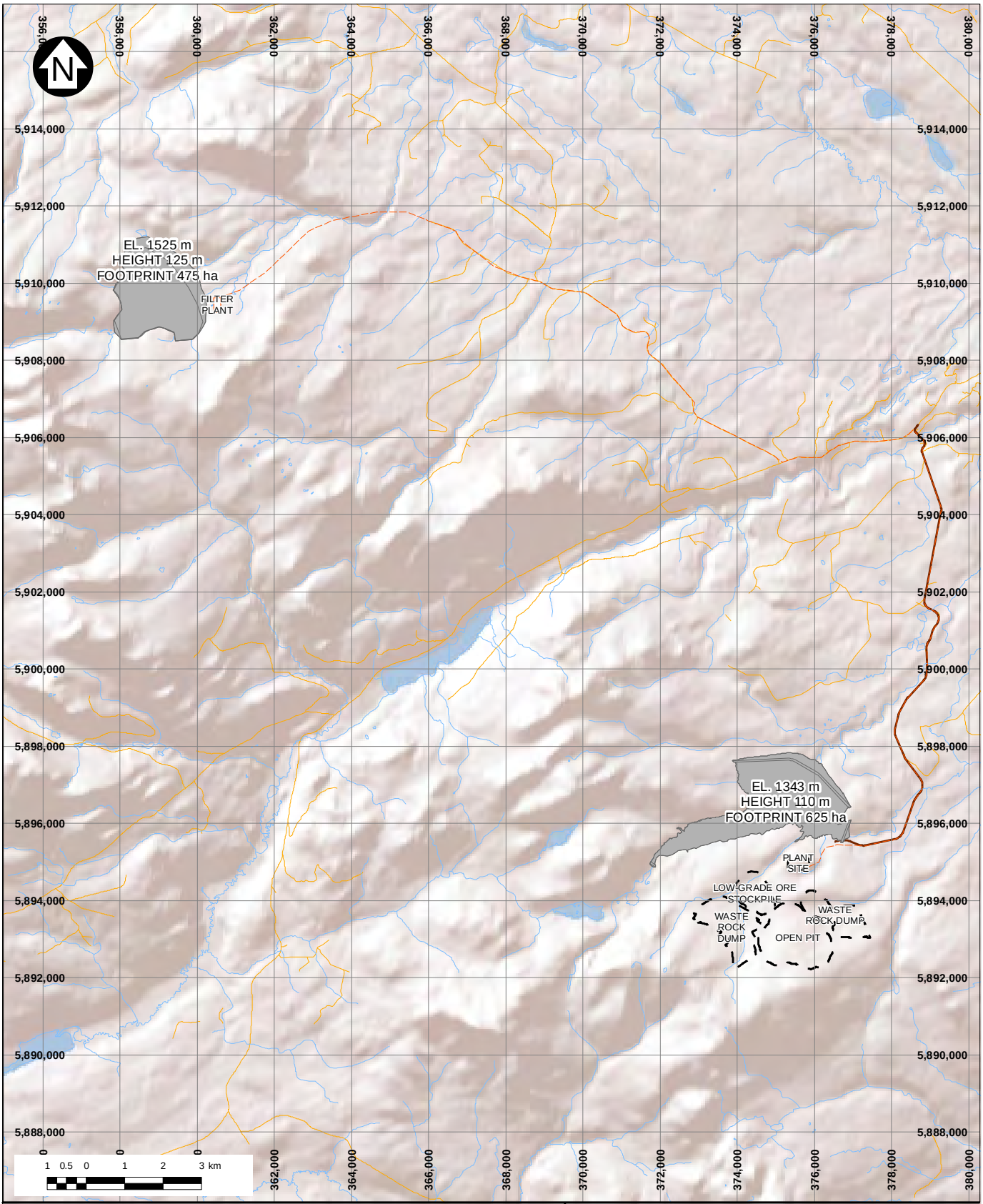
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 16 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-16** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:140,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

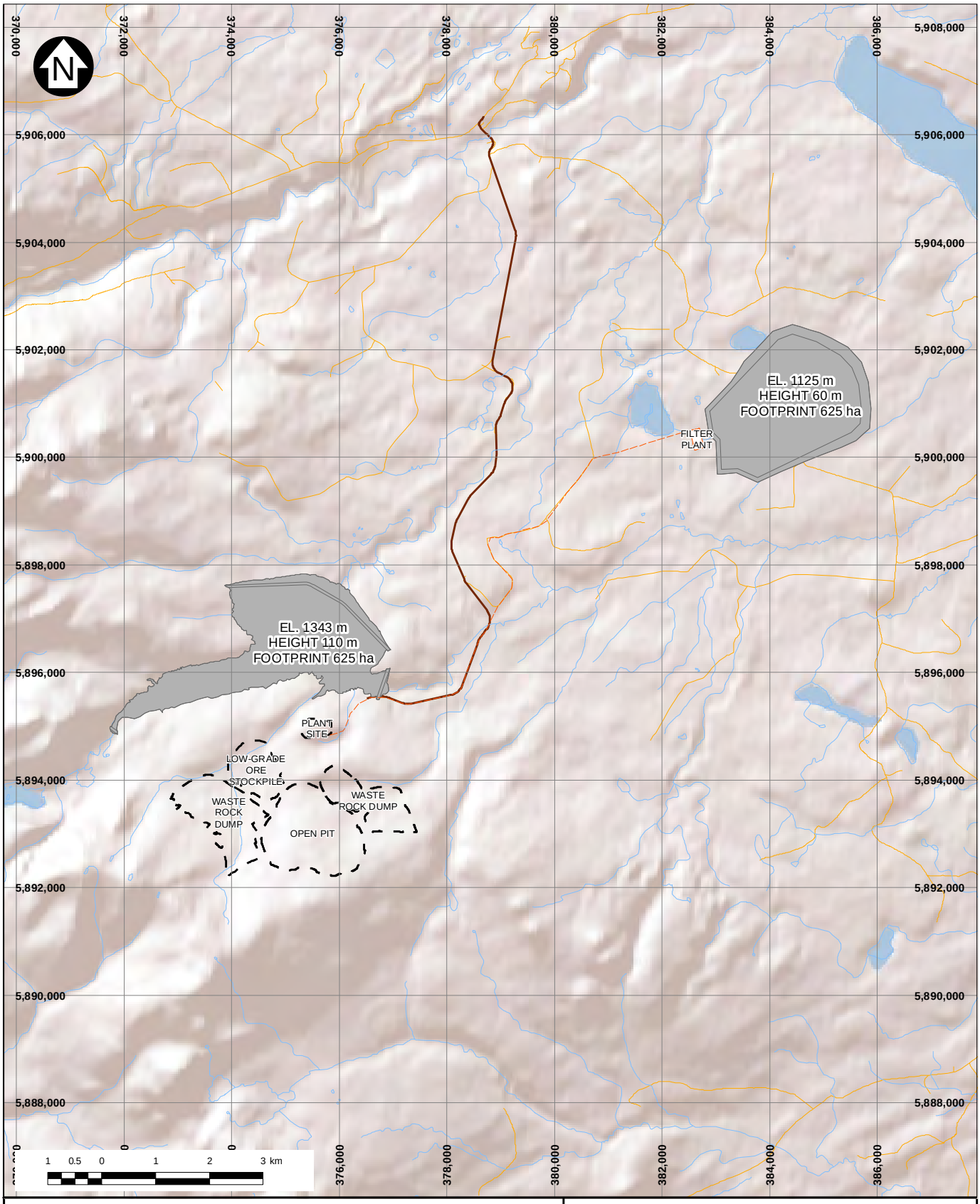
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 17 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-17** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:100,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | CAC | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

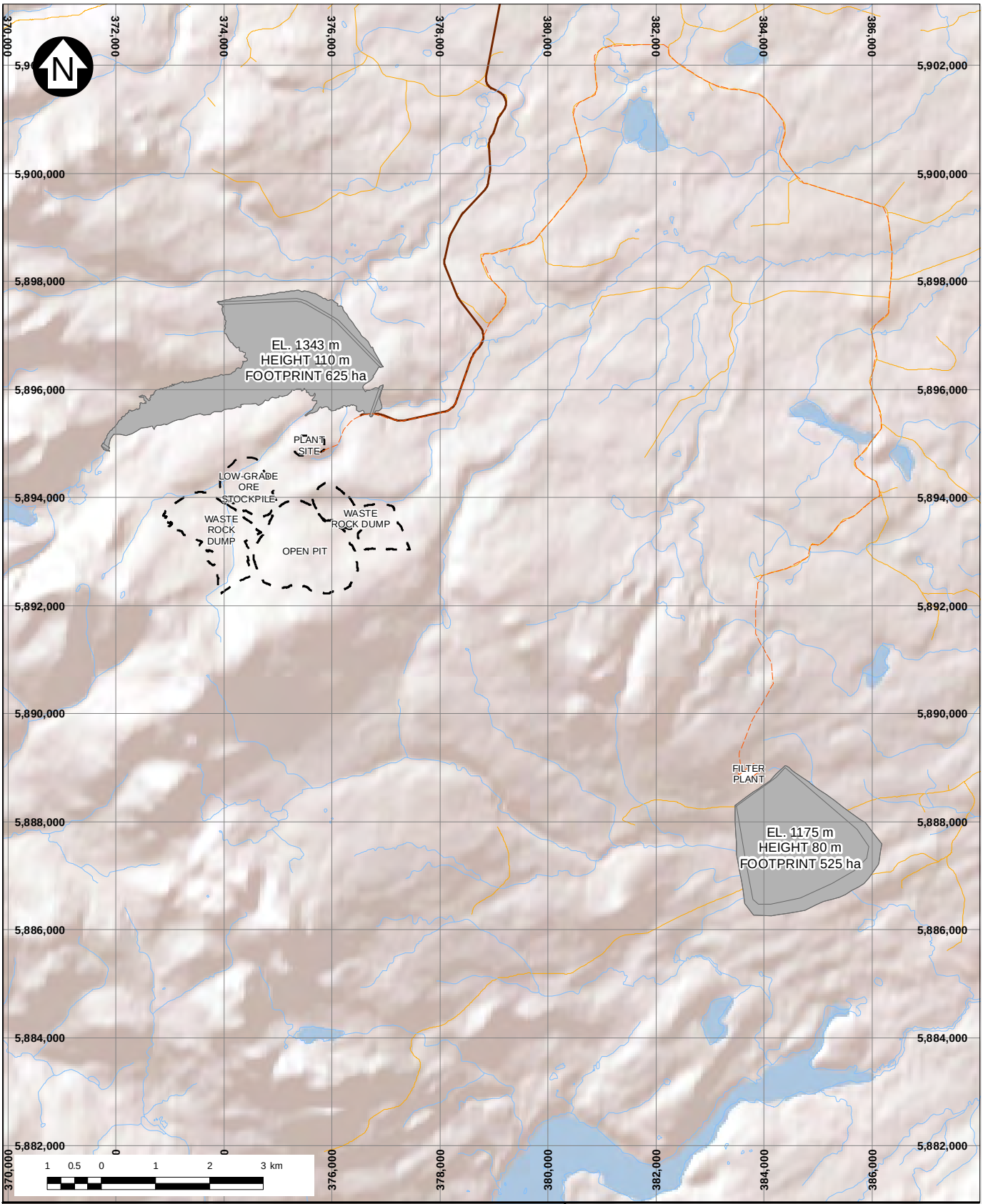
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 18 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-18** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:100,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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NEW GOLD INC.

BLACKWATER GOLD PROJECT

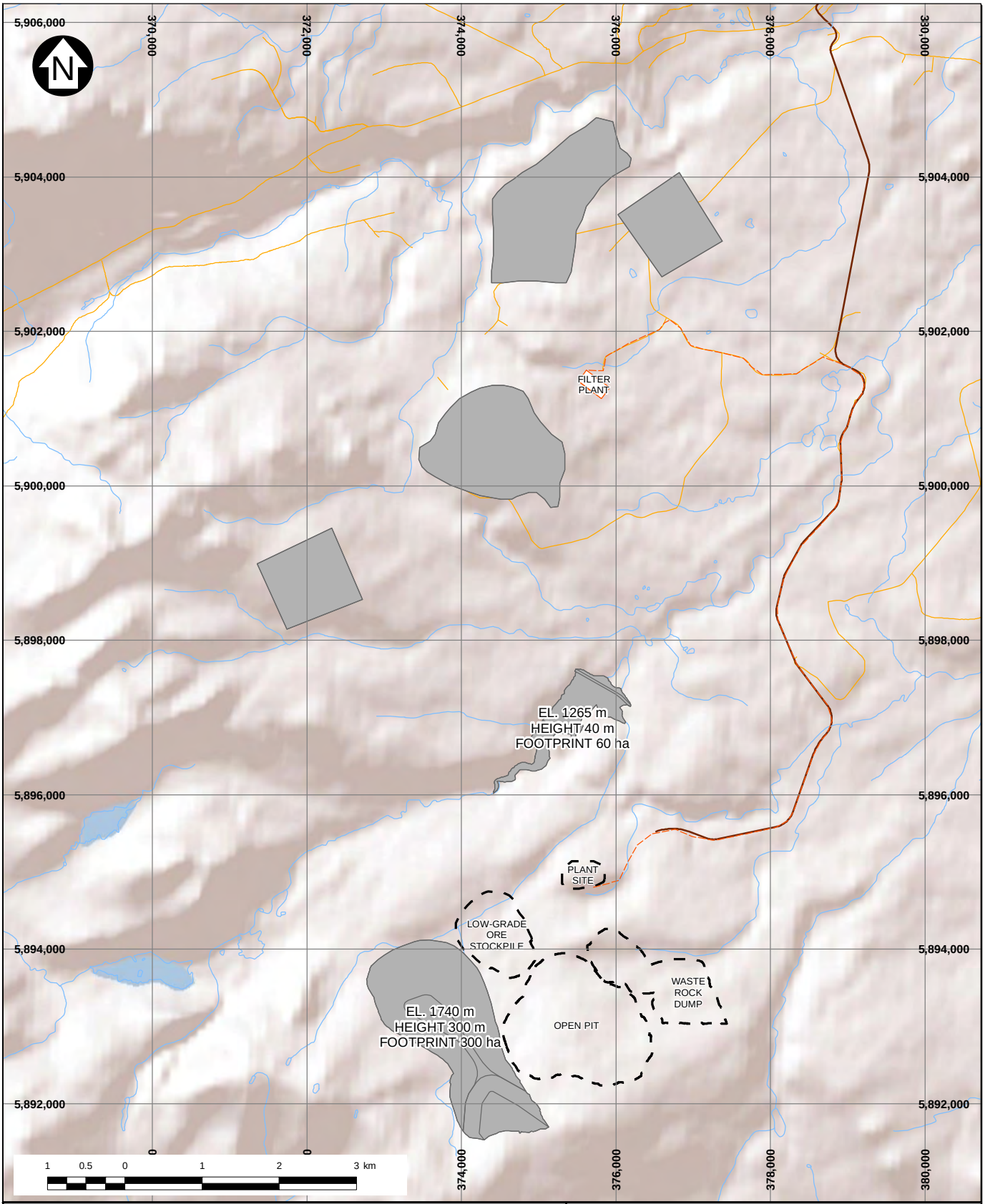
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 19 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-19** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:70,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | CAC | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

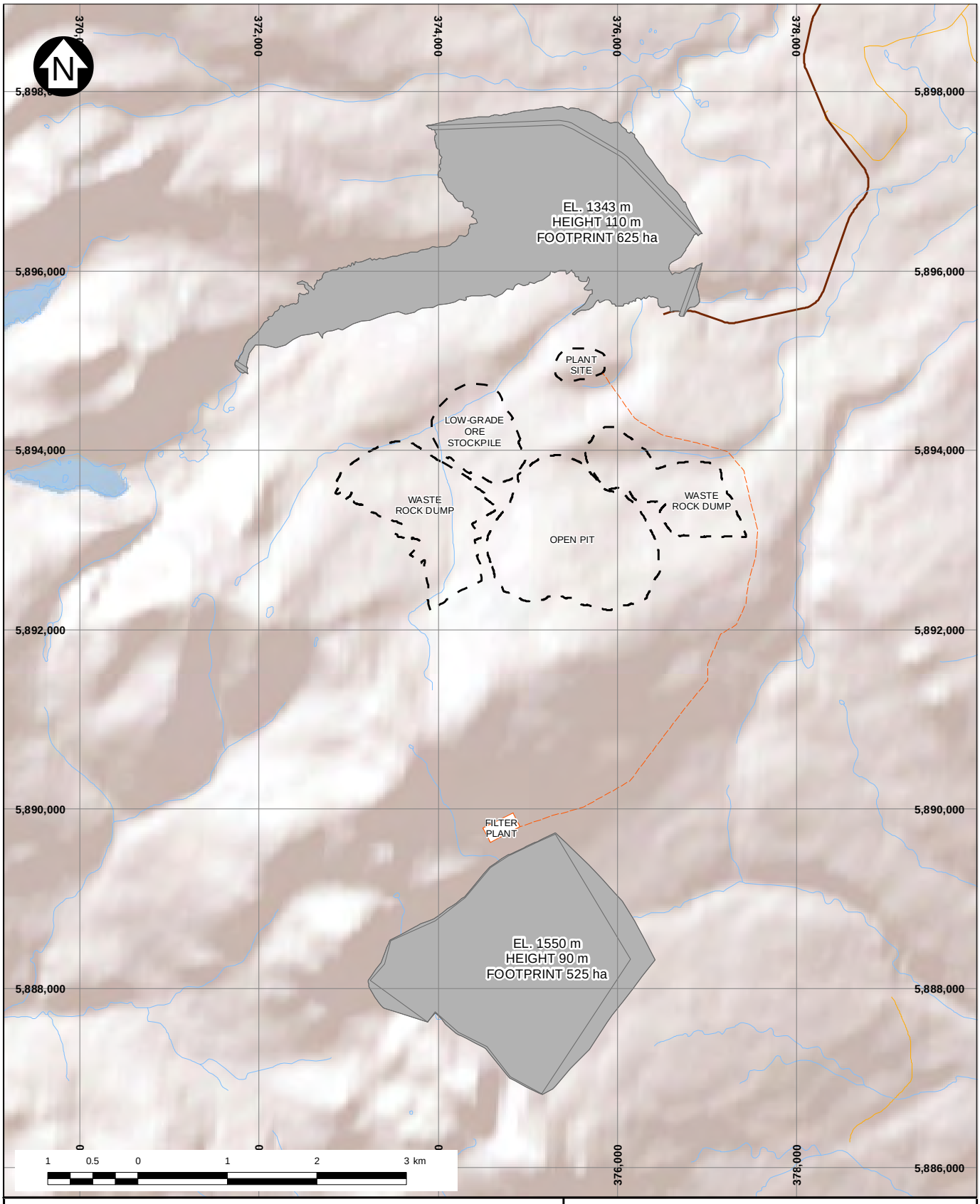
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 20 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-20** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:60,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

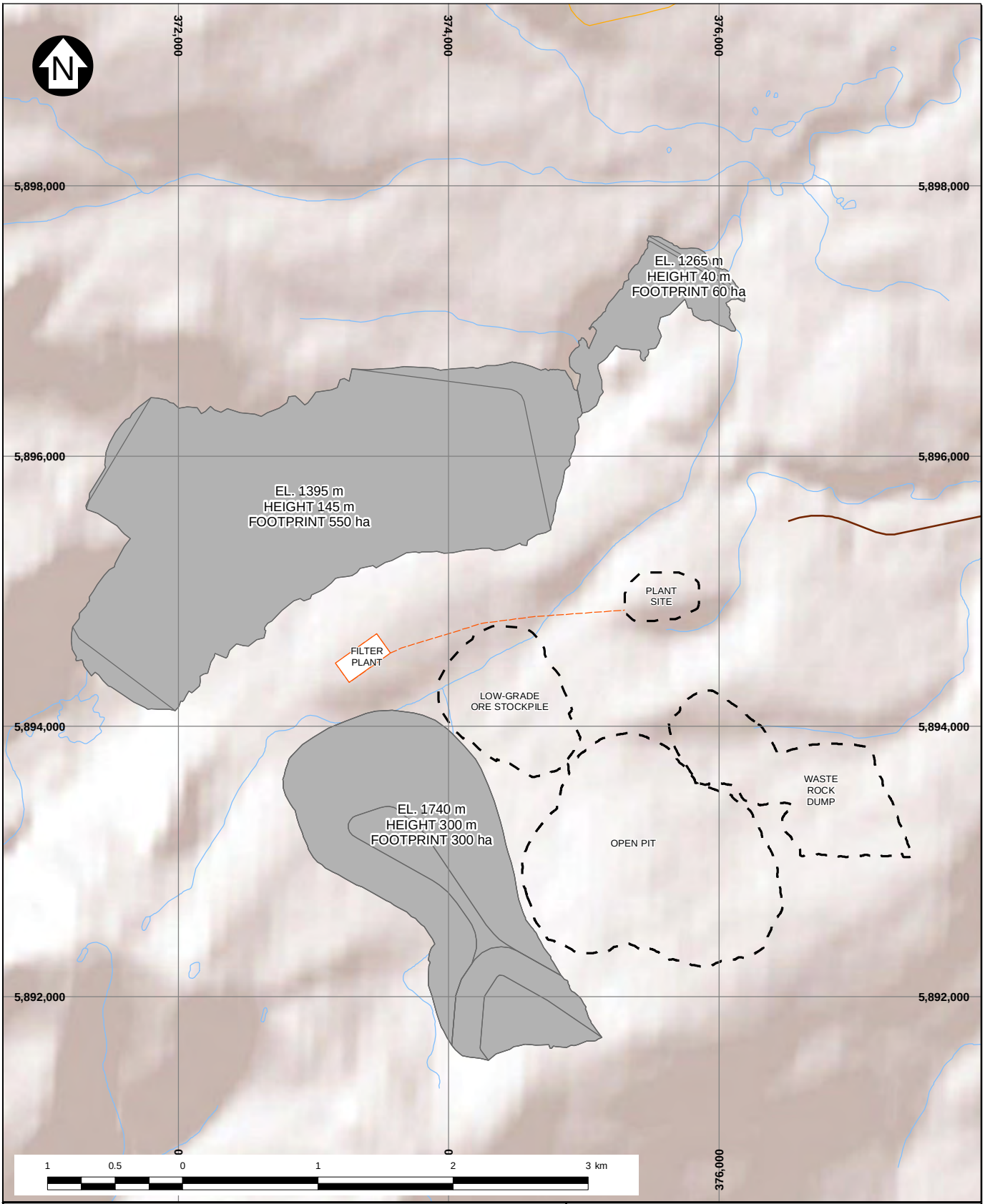
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 21 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-21** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:40,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

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| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | CAC | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

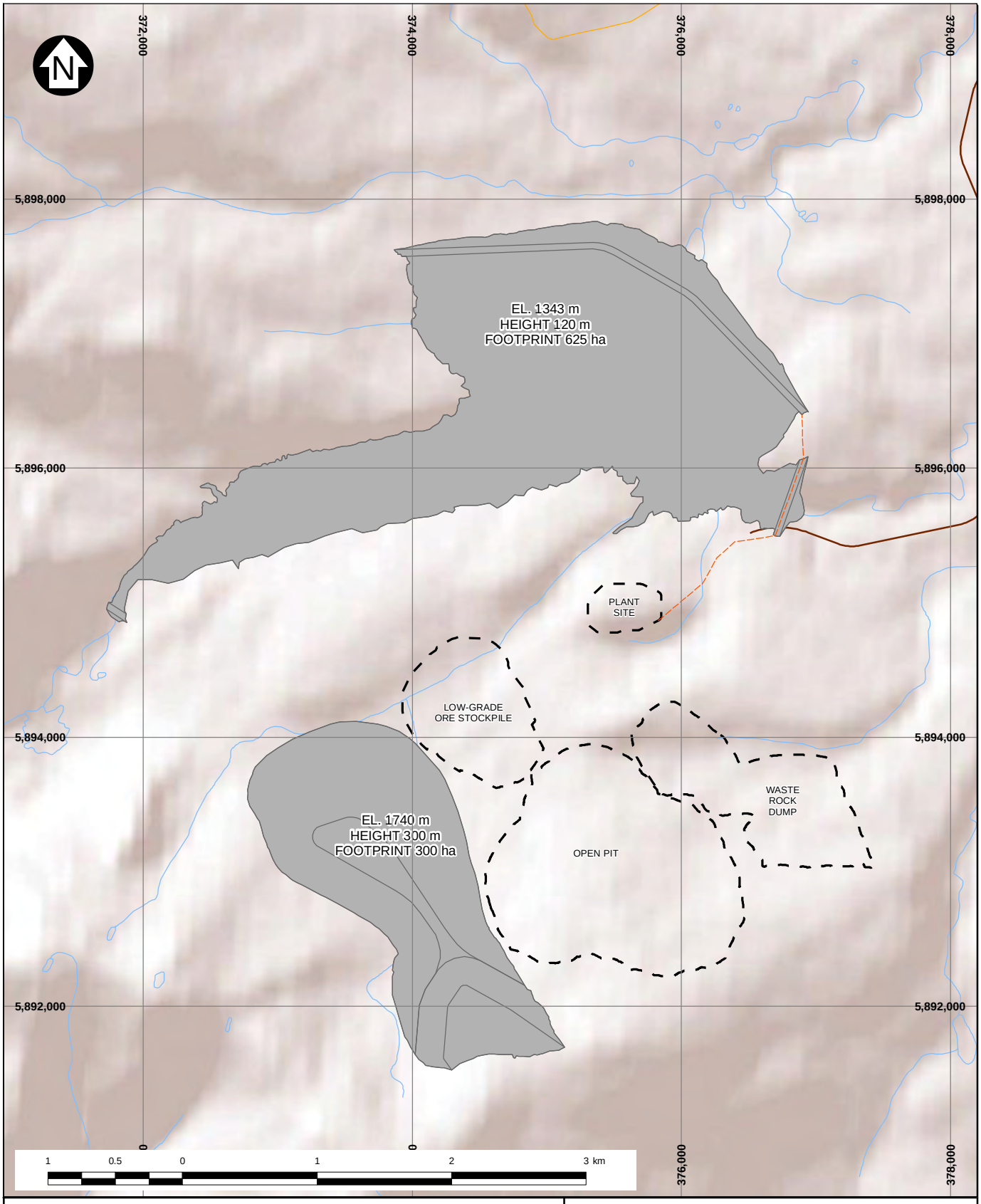
**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 22 - FILTERED TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-22** | REV 0

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**LEGEND:**

- CREEK
- FORESTRY ROAD
- PROPOSED MINE ACCESS ROAD
- TAILINGS PIPELINE
- FILTER PLANT
- CANDIDATE
- MINE SITE FACILITIES

**NOTES:**

1. BASE MAP: ESRI ARCGIS SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:40,000 WHEN PRINTED ON 8.5x11 (LETTER) PAPER.

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 23 - SLURRY TAILINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

**FIGURE C-23** | REV 0

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# APPENDIX D

## HIGH LEVEL RISK ASSESSMENT RATINGS

(Pages D-1 to D-6)

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# TABLE D-1

## NEW GOLD INC.
## BLACKWATER GOLD PROJECT

## ALTERNATIVE TECHNOLOGY OPTIONS STUDY
## HIGH LEVEL RISK ASSESSMENT

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| CANDIDATE SUMMARY | | | | | HAZARDS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SAFETY | | | ENVIRONMENT | | | TECHNICAL | | |
| | | | | | Failure of containment of mine waste disposal systems. | | | Loss of effluent due to failure of collection and/or treatment systems during operations and closure. | | | Application of complex technology resulting in inability to meet design criteria. | | |
| Ref. No. | Location Descriptor | | Storage Technology | | Hazard | Likelihood | Consequence | Hazard | Likelihood | Consequence | Hazard | Likelihood | Consequence |
| | Tailings | PAG Waste Rock | Tailings | PAG Waste Rock | | | | | | | | | |
| 1 | Upper Davidson Creek | Upper Davidson Creek | Slurry | Submerged | Dam breach of co-disposed slurry tailings and waste rock facility generating flood wave impacting Davidson Creek and downstream. | Very Rare | Catastrophic | Loss of effluent from seepage control pond downstream of tailings storage facility. | Unlikely | Minor | Failure of tailings and PAG waste rock distribution and placement resulting in difficulty in facility development. | Likely | Insignificant |
| | | | | | | 1 | 5 | | 2 | 2 | | 4 | 1 |
| 4 | Upper Creek 661 | Upper Creek 661 | Slurry | Submerged | Dam breach of co-disposed slurry tailings and waste rock facility generating flood wave impacting Creek 661 and downstream. | Very Rare | Catastrophic | Loss of effluent from multiple seepage control ponds downstream of tailings storage facility. | Possible | Minor | Failure of tailings and PAG waste rock distribution and placement resulting in difficulty in facility development. | Likely | Minor |
| | | | | | | 1 | 5 | | 3 | 2 | | 4 | 2 |
| 5 | Upper Davidson Creek | Upper Davidson Creek | Filtered | Stockpiled | Slumping of co-disposed filtered tailings and waste rock storage facility overtops downstream water storage facility impacting Davidson Creek and downstream. | Unlikely | Major | Loss of ML/ARD runoff from filtered tailings and PAG waste rock co-disposal stack resulting from inadequate storage and/or treatment system capacity. | Unlikely | Moderate | Failure of tailings and PAG waste rock distribution and placement resulting in difficulty in facility development. | Likely | Major |
| | | | | | | 2 | 4 | | 2 | 3 | | 4 | 4 |
| 6 | Upper Davidson Creek | Upper Davidson Creek | Filtered | Submerged | Dam breach of subaqueous PAG waste rock facility generatign flood wave impacting Davidson Creek and downstream. | Unlikely | Catastrophic | Loss of ML/ARD runoff from filtered tailings resulting from inadequate storage and/or treatment system capacity. | Unlikely | Moderate | Failure of tailings distribution and placement resulting in difficulty in facility development. | Likely | Moderate |
| | | | | | | 2 | 5 | | 2 | 3 | | 4 | 3 |
| 7 | Upper Davidson Creek | Upper Davidson Creek | Filtered | Submerged | Dam breach of subaqueous PAG waste rock facility generating flood wave impacting Davidson Creek and downstream. | Unlikely | Catastrophic | Loss of ML/ARD runoff from filtered tailings resulting from inadequate storage and/or treatment system capacity. | Unlikely | Minor | Failure of tailings distribution and placement resulting in difficulty in facility development. | Likely | Moderate |
| | | | | | | 2 | 5 | | 2 | 2 | | 4 | 3 |
| 10 | Upper Davidson Creek | Upper Davidson Creek | Paste | Submerged | Dam breach of co-disposed ultra-thickened tailings and PAG waste rock facility generating flood wave impacting Davidson Creek and downstream. | Unlikely | Catastrophic | Loss of effluent from seepage collection pond dowstream of tailings storage facility. | Unlikely | Minor | Failure to achieve target tailings thickening leading to increased pond size. | Likely | Minor |
| | | | | | | 2 | 5 | | 2 | 2 | | 4 | 2 |
| 12 | West of Kuyakuz | Upper Davidson Creek | Filtered | Submerged | Dam breach of subaqueous PAG waste rock facility generating flood wave impacting Davidson Creek and downstream. | Unlikely | Catastrophic | Loss of tailings due to pipeline breakage. | Possible | Moderate | Failure of tailings distribution and placement resulting in difficulty in facility development. | Likely | Moderate |
| | | | | | | 2 | 5 | | 3 | 3 | | 4 | 3 |
| 13 | Turtle Creek | Upper Davidson Creek | Slurry | Submerged | Dam breach of slurry tailings facility generating flood wave impacting Turtle Creek and downstream. | Unlikely | Catastrophic | Loss of tailings due to pipeline breakage. | Possible | Moderate | Failure of tailings and PAG waste rock distribution and placement resulting in difficulty in facility development. | Likely | Insignificant |
| | | | | | | 2 | 5 | | 3 | 3 | | 4 | 1 |
| 14 | Turtle Creek | Upper Davidson Creek | Filtered | Submerged | Dam breach of submerged PAG waste rock facility generating flood wave impacting Davidson Creek and downstream. | Unlikely | Catastrophic | Loss of tailings due to pipeline breakage. | Possible | Moderate | Failure of tailings distribution and placement resulting in difficulty in facility development. | Likely | Moderate |
| | | | | | | 2 | 5 | | 3 | 3 | | 4 | 3 |
| 15 | North of Turtle Creek | Upper Davidson Creek | Slurry | Submerged | Dam breach of submerged PAG waste rock facility generating flood wave impacting Davidson Creek and downstream. | Unlikely | Catastrophic | Loss of tailings due to pipeline breakage. | Likely | Moderate | Failure of tailings distribution and placement resulting in difficulty in facility development. | Likely | Insignificant |
| | | | | | | 2 | 5 | | 4 | 3 | | 4 | 1 |
| 16 | Lower Chedakuz Creek | Upper Davidson Creek | Filtered | Submerged | Dam breach of submerged PAG waste rock facility generating flood wave impacting Davidson Creek and downstream. | Unlikely | Catastrophic | Loss of tailings due to pipeline breakage. | Likely | Moderate | Failure of tailings distribution and placement resulting in difficulty in facility development. | Likely | Moderate |
| | | | | | | 2 | 5 | | 4 | 3 | | 4 | 3 |
| 22 | Davidson Creek - PAG O/L | Upper Davidson Creek | Filtered | Stockpiled | Slumping of filtered tailings storage facility resulting in overtopping of water storage facility impacting Davidson Creek and downstream. | Unlikely | Major | Loss of ML/ARD runoff from filtered tailings and PAG waste rock resulting from inadequate storage and/or treatment system capacity. | Unlikely | Moderate | Failure of tailings distribution and placement resulting in difficulty in facility development. | Likely | Moderate |
| | | | | | | 2 | 4 | | 2 | 3 | | 4 | 3 |
| 23 | Davidson Creek - PAG O/L | Upper Davidson Creek | Slurry | Stockpiled | Dam breach of slurry tailings facility generating flood wave impacting Davidson Creek and downstream. | Very Rare | Catastrophic | Loss of ML/ARD runoff from PAG waste rock resulting from inadequate storage and/or treatment system capacity. | Possible | Moderate | Failure of tailings distribution and placement resulting in difficulty in facility development. | Likely | Insignificant |
| | | | | | | 1 | 5 | | 3 | 3 | | 4 | 1 |

M:\1\01\00457\15\A\Data\Task 400 - Additional Scope\[20151021_High Level Risk Assessment - Bar Chart_dbr.xlsx]Table D-1

**NOTES:**
1. REFERENCE NUMBERING CORRESPONDS TO PRE-SCREENING CANDIDATE LIST.

| REV. | DATE | DESCRIPTION | PREP'D | REV'D |
|---|---|---|---|---|
| 0 | 27NOV15 | ISSUED FOR REPORT | DBR | DDF |

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**TABLE D-2**

**NEW GOLD INC.**
**BLACKWATER GOLD PROJECT**

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**HIGH LEVEL RISK ASSESSMENT - SCORING SUMMARY**

Print Nov/27/15 10:36:50

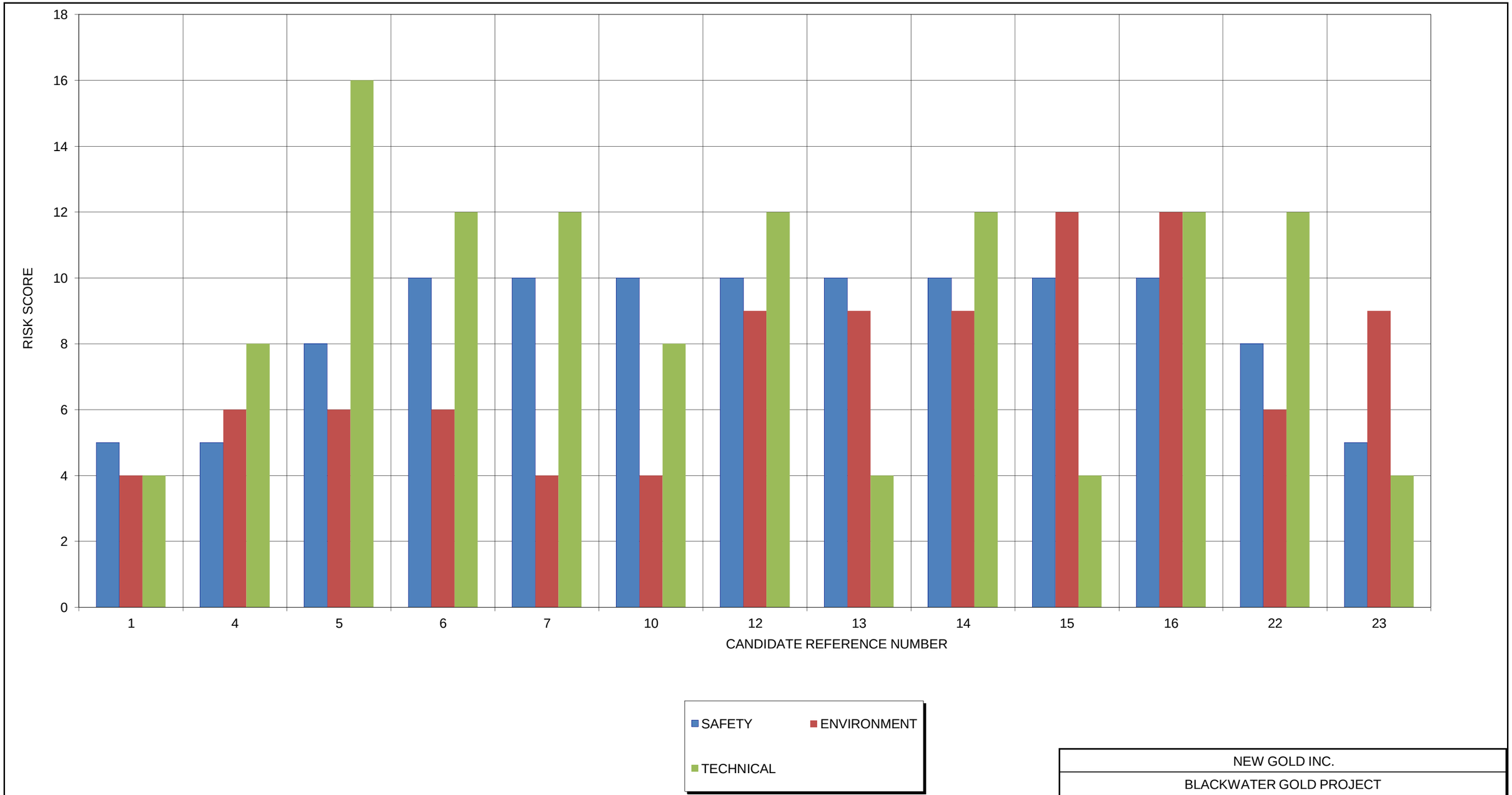
| CANDIDATE SUMMARY | RISK SCORE | | | TOTAL SCORE |
|---|---|---|---|---|
| | SAFETY | ENVIRONMENT | TECHNICAL | |
| Ref. No. | Score | Score | Score | |
| 1 | 5 | 4 | 4 | **13** |
| 4 | 5 | 6 | 8 | **19** |
| 5 | 8 | 6 | 16 | **30** |
| 6 | 10 | 6 | 12 | **28** |
| 7 | 10 | 4 | 12 | **26** |
| 10 | 10 | 4 | 8 | **22** |
| 12 | 10 | 9 | 12 | **31** |
| 13 | 10 | 9 | 4 | **23** |
| 14 | 10 | 9 | 12 | **31** |
| 15 | 10 | 12 | 4 | **26** |
| 16 | 10 | 12 | 12 | **34** |
| 22 | 8 | 6 | 12 | **26** |
| 23 | 5 | 9 | 4 | **18** |

M:\1\01\00457\15\A\Data\Task 400 - Additional Scope\[20151021_High Level Risk Assessment - Bar Chart_dbr.xlsx]Table D-2

**NOTES:**

1. RISK SCORE IS MULTIPLICATION OF LIKELIHOOD SCORE AND CONSEQUENCE SCORE.
2. TOTAL SCORE IS SUM OF SAFETY, ENVIRONMENT, TECHNICAL EXECUTION SCORES.

| REV | DATE | DESCRIPTION | PREP'D | REV'D |
|---|---|---|---|---|
| 0 | 27NOV'15 | ISSUED FOR REPORT | DBR | DDF |




| REV | DATE | DESCRIPTION | PREP'D | REV'D |
|---|---|---|---|---|
| 0 | 27NOV'15 | ISSUED FOR REPORT | DBR | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**HIGH LEVEL RISK ASSESSMENT**
**CANDIDATE RATING SUMMARY**

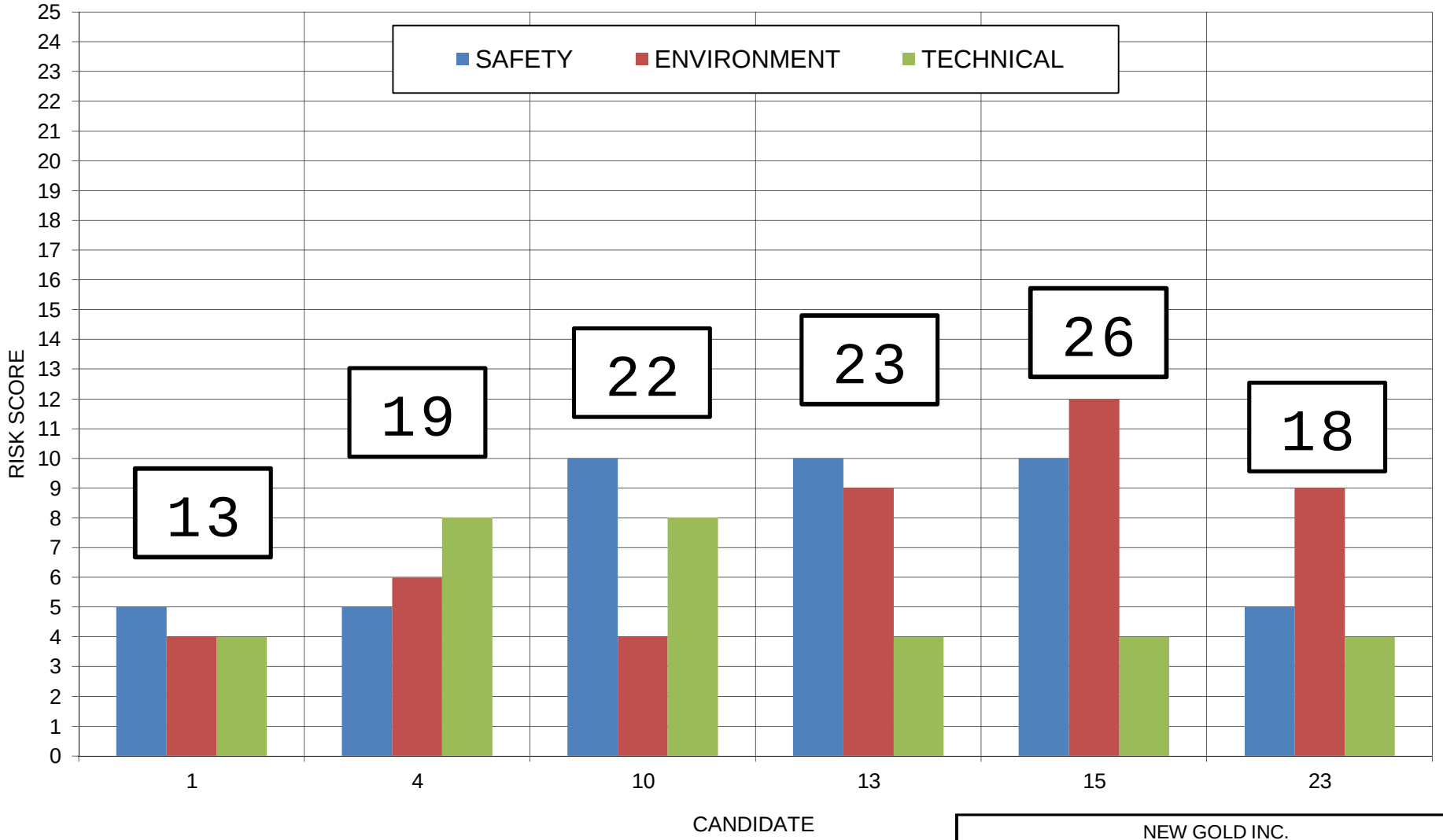
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P/A NO. VA101-457/15

REF. NO. 1

**FIGURE D-1**

REV 0




**NOTES:**
1. THE ULTRA-THICKENED ALTERNATIVE (CANDIDATE 10) WAS COMPARED WITH OTHER THICKENED SLURRY ALTERNATIVES FOR THIS COMPARISON.

| REV | DATE | DESCRIPTION | PREP'D | REV'D |
|---|---|---|---|---|
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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**HIGH LEVEL RISK ASSESSMENT**
**SLURRY TAILINGS CANDIDATE RANKINGS**

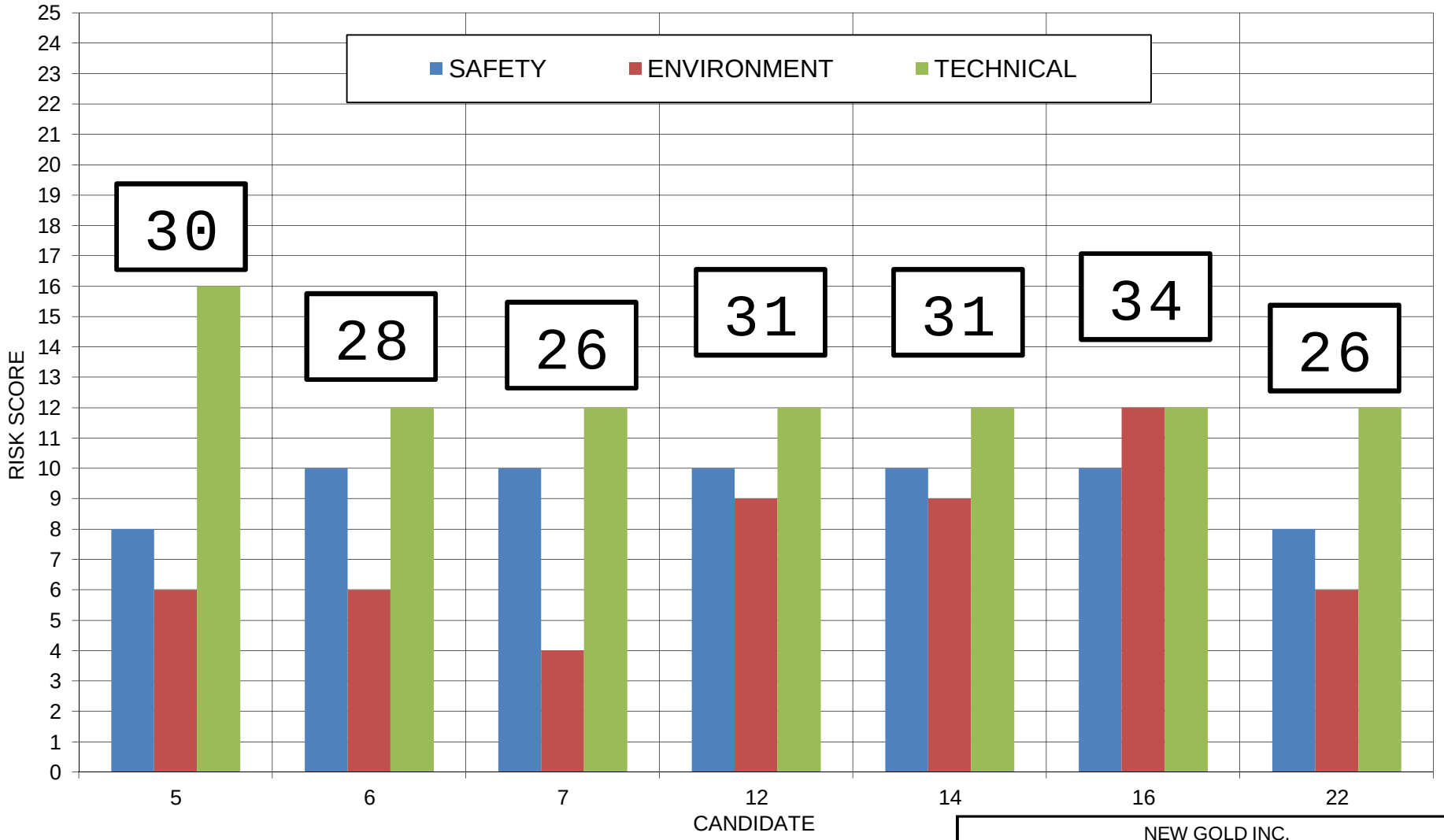
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P/A NO. VA101-457/15

REF. NO. 1

**FIGURE D-2**

REV 0




| REV | DATE | DESCRIPTION | PREP'D | REV'D |
|---|---|---|---|---|
| 0 | 27NOV'15 | ISSUED FOR REPORT | DBR | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**HIGH LEVEL RISK ASSESSMENT**
**FILTERED TAILINGS CANDIDATE RANKINGS**

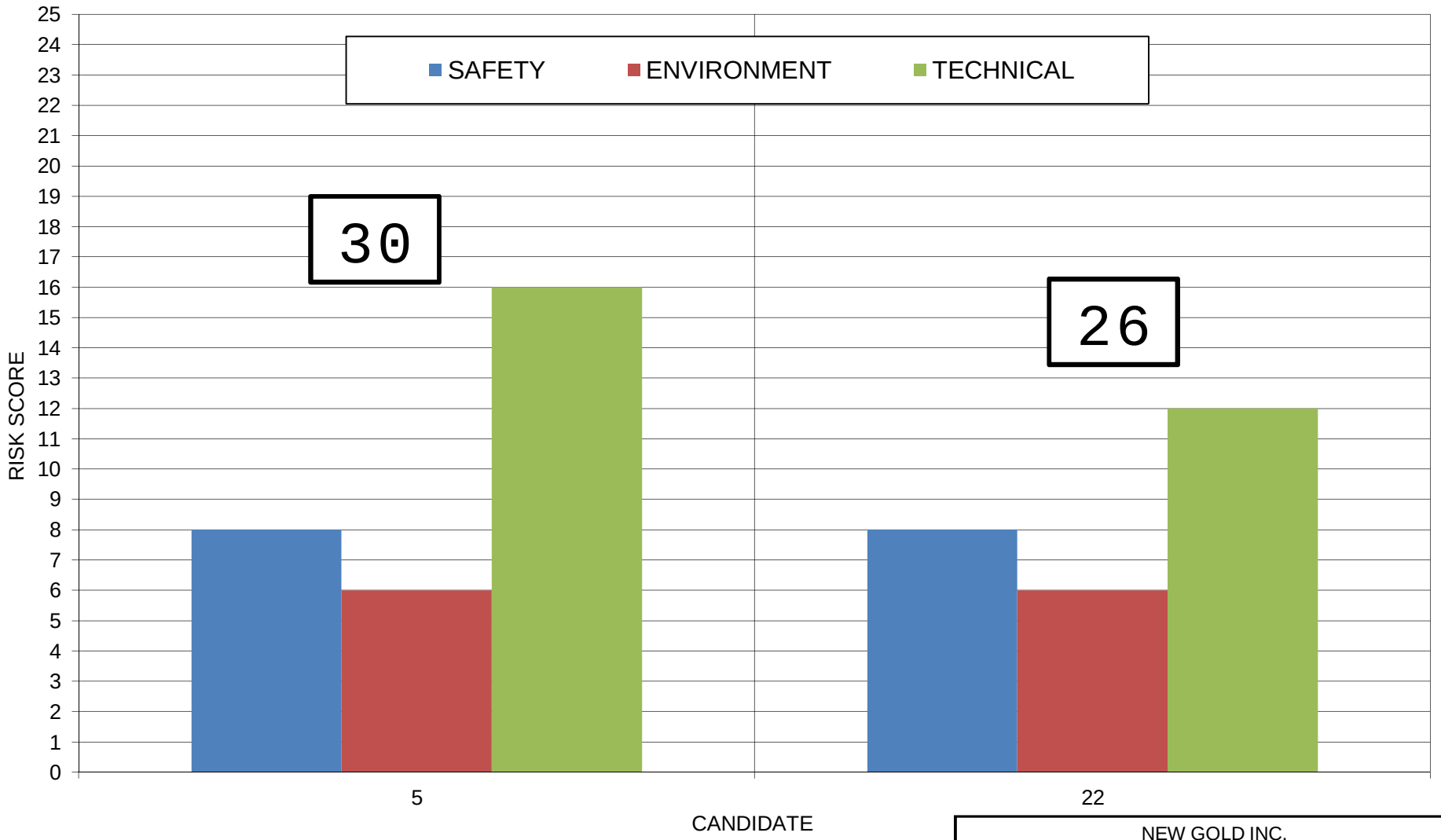
Knight Piésold CONSULTING

P/A NO. VA101-457/15

REF. NO. 1

**FIGURE D-3**

REV 0




| REV | DATE | DESCRIPTION | PREP'D | REV'D |
|---|---|---|---|---|
| 0 | 27NOV'15 | ISSUED FOR REPORT | DBR | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**HIGH LEVEL RISK ASSESSMENT**
**PHYSICAL STABILITY CANDIDATE RANKINGS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15

REF. NO. 1

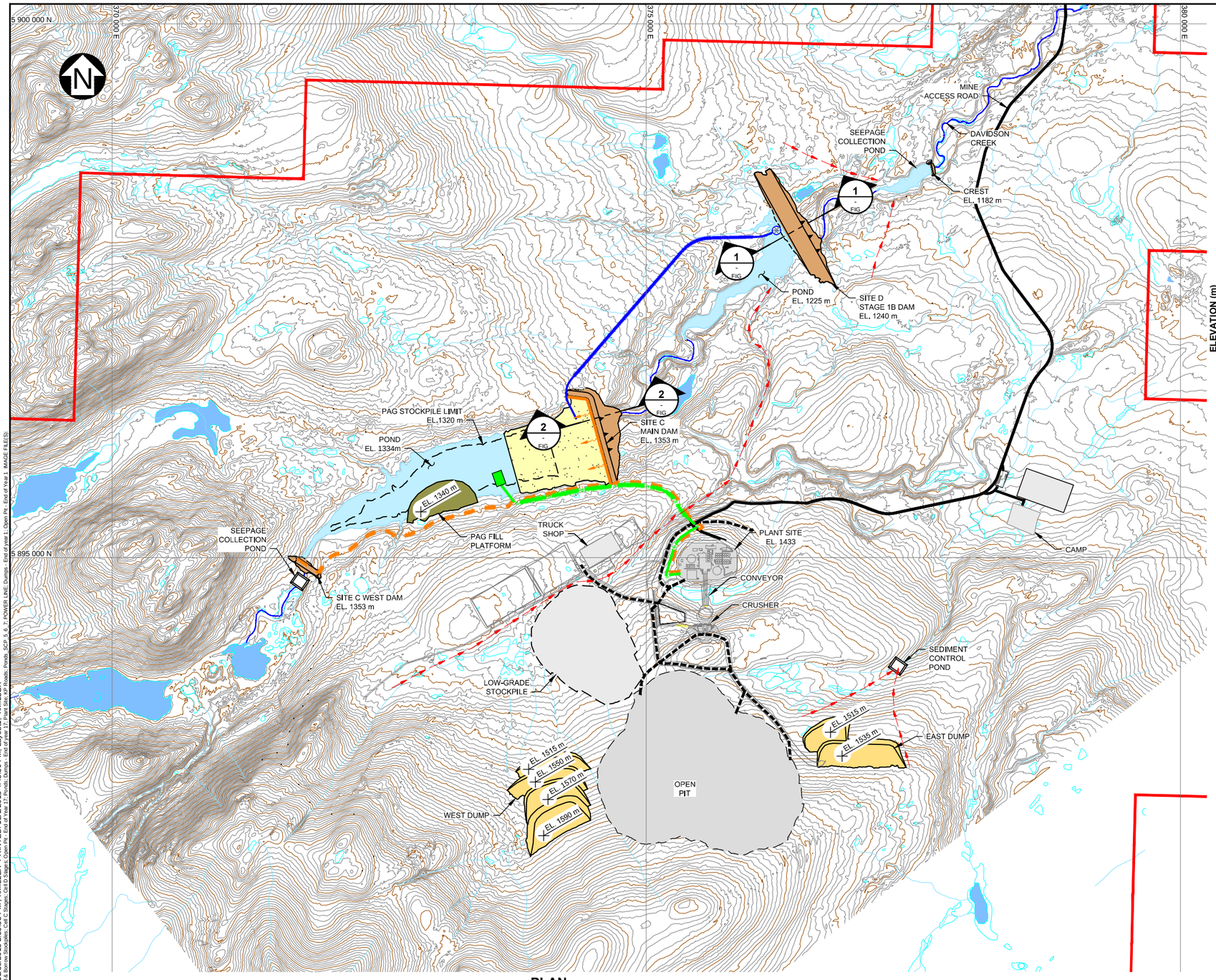
**FIGURE D-4**

REV 0

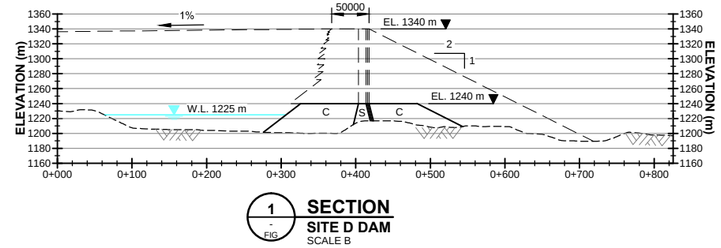
# APPENDIX E

## MULTIPLE ACCOUNTS ANALYSIS - STARTER AND ULTIMATE CONFIGURATIONS

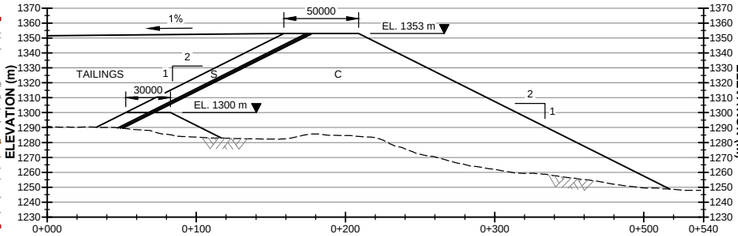
(Pages E-1 to E-8)




**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




**1 - FIG — SECTION**
**SITE D DAM**
SCALE B




**2 - FIG — SECTION**
**SITE C DAM**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- NAG WASTE ROCK
- PAG WASTE ROCK
- LOW-GRADE ORE
- RECLAIM SYSTEM
- PUMPSTATION

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- PIPELINE SERVICE ROAD
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY (CLOSURE ONLY)
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD 83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

**FOR INFORMATION ONLY**

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 1 - SLURRY TAILINGS**
**STARTER ARRANGEMENT**

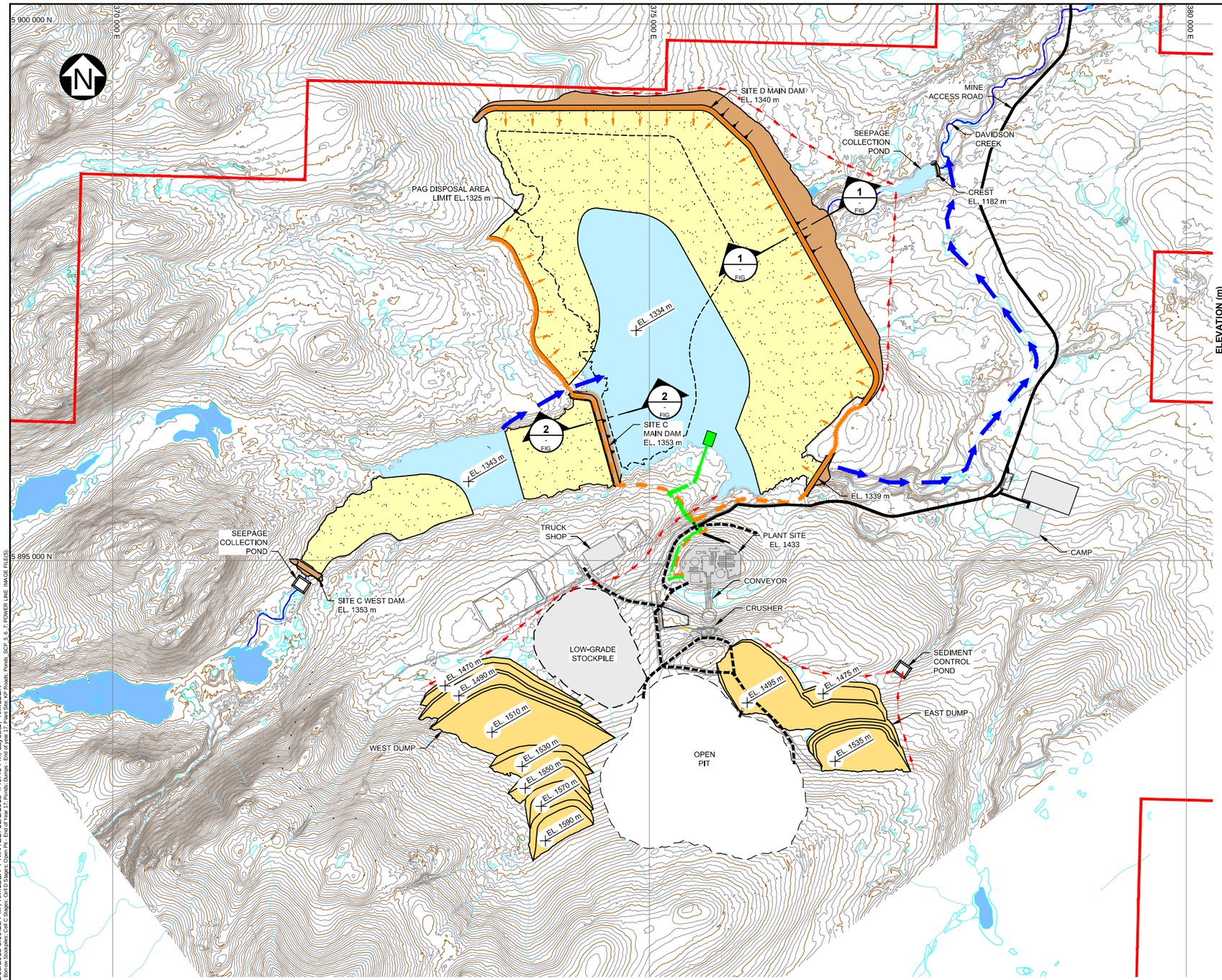
Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

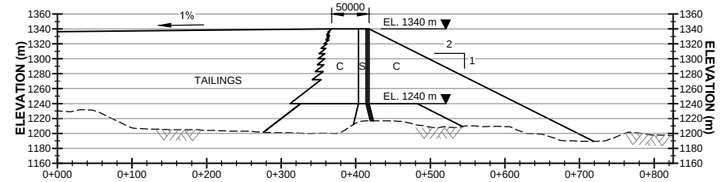
**FIGURE E-1** | REV 0



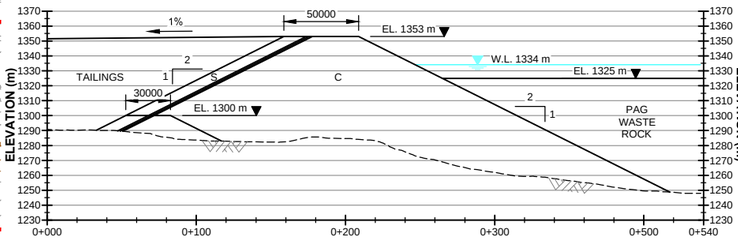
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**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




**1 - FIG SECTION**
**SITE D DAM**
SCALE B




**2 - FIG SECTION**
**SITE C DAM**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY (CLOSURE ONLY)
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD 83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

**FOR INFORMATION ONLY**

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 1 - SLURRY TAILINGS**
**FINAL ARRANGEMENT**

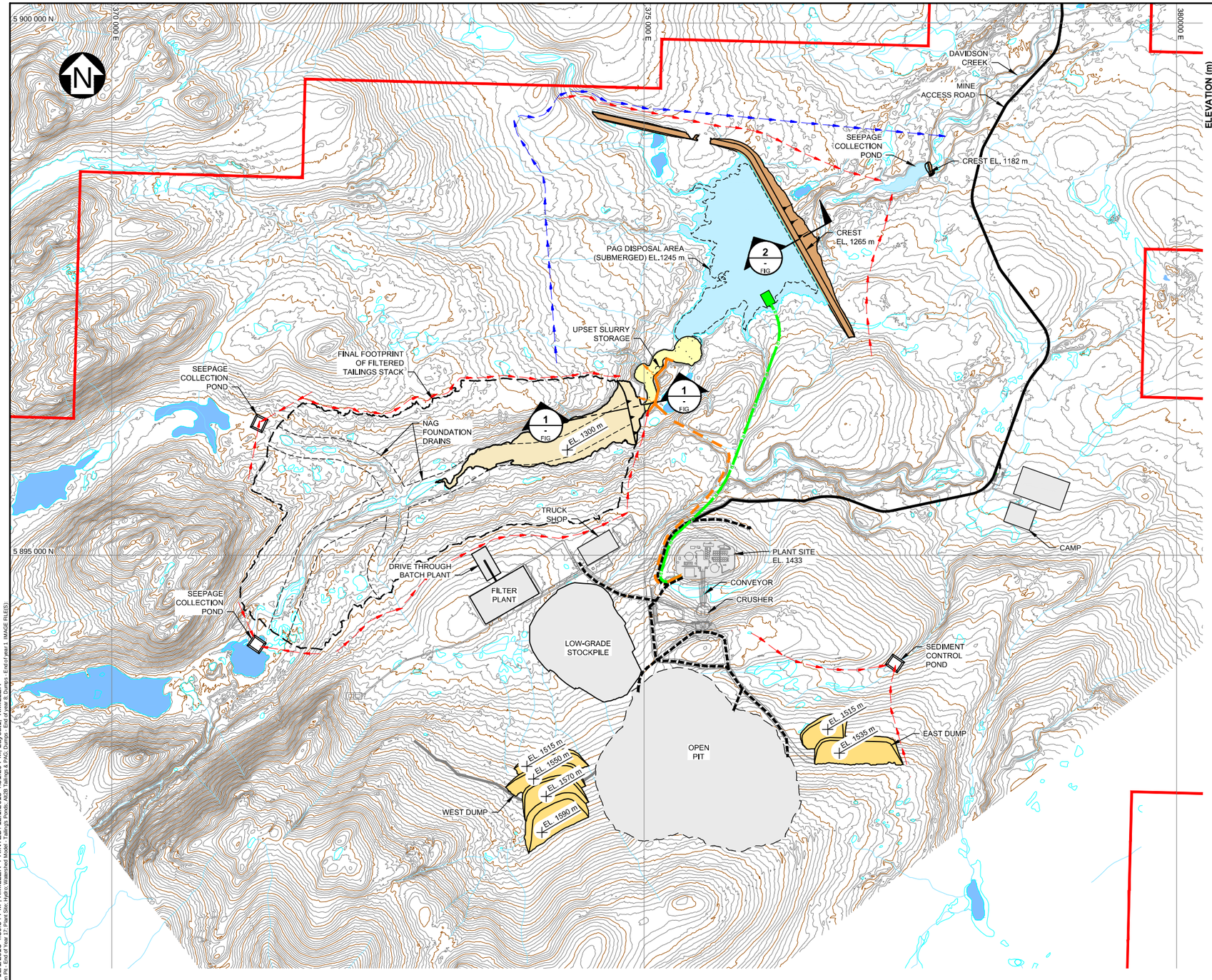
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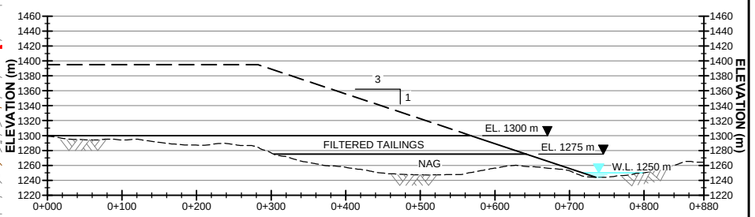
P/A NO. VA101-457/15 | REF NO. 1

**FIGURE E-2** | REV 0

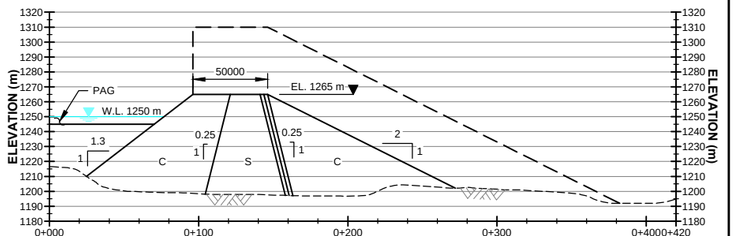


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1 FIG **SECTION**
**FILTERED TAILINGS STACK**
SCALE B




2 FIG **SECTION**
**PAG STORAGE DAM**
SCALE C

**LEGEND:**

- SLURRY TAILINGS
- MINE WATER
- FRESH WATER
- EMBANKMENT
- FILTERED TAILINGS
- NAG WASTE ROCK
- RECLAIM SYSTEM
- PUMPSTATION

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- SPILLWAY (CLOSURE ONLY)
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TAILINGS PIPELINE
- SLURRY TAILINGS DISCHARGE

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

**FOR INFORMATION ONLY**

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY CANDIDATE 7 - FILTERED TAILINGS PAG - UW STARTER ARRANGEMENT**

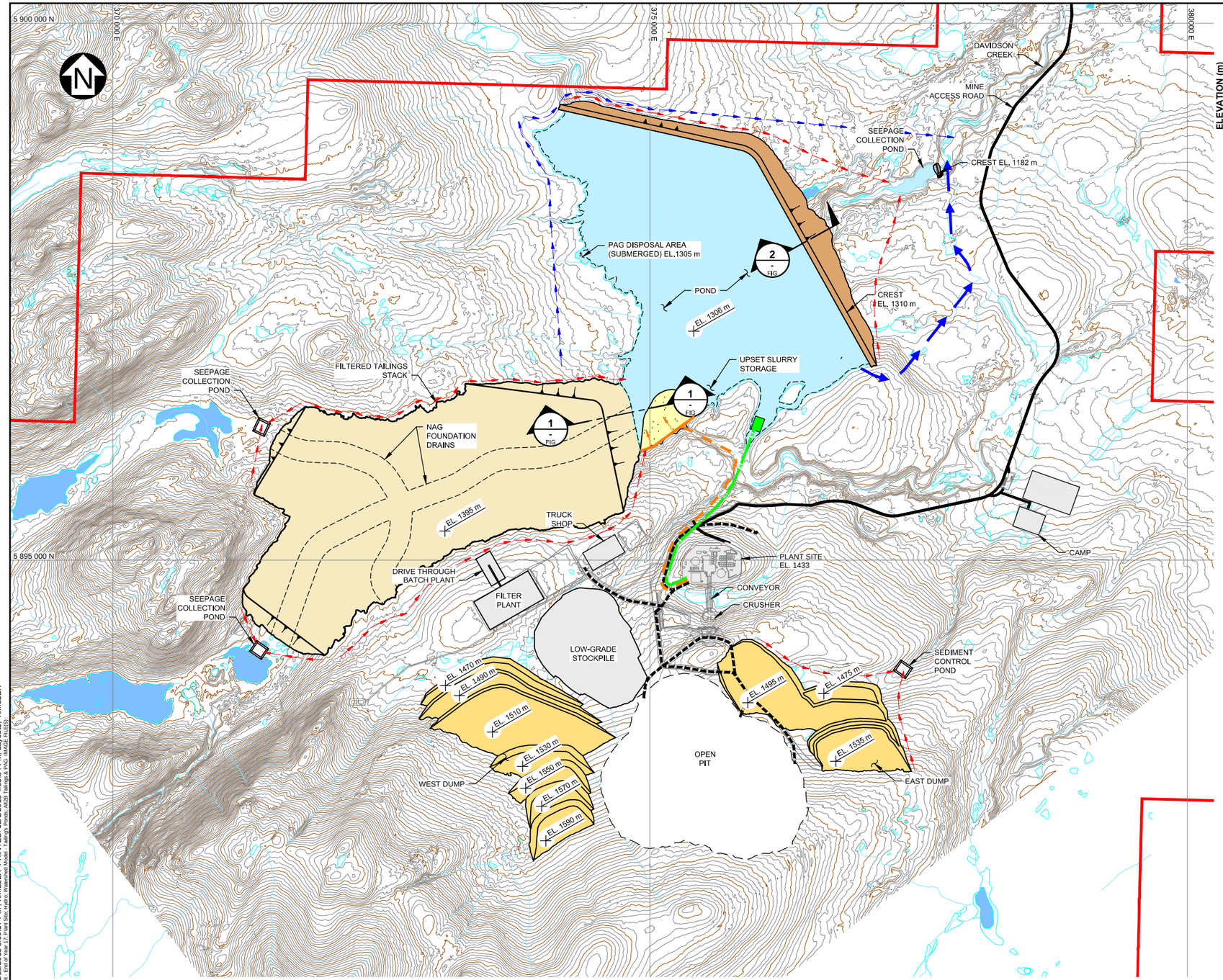
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P/A NO. VA101-457/15 | REF NO. 1

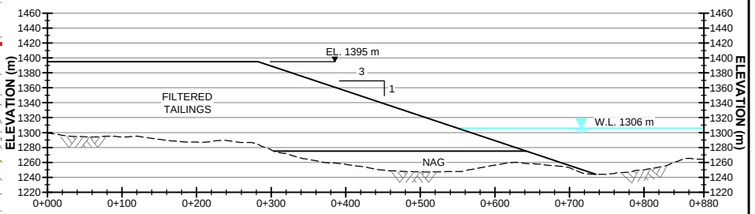
**FIGURE E-3** | REV 0



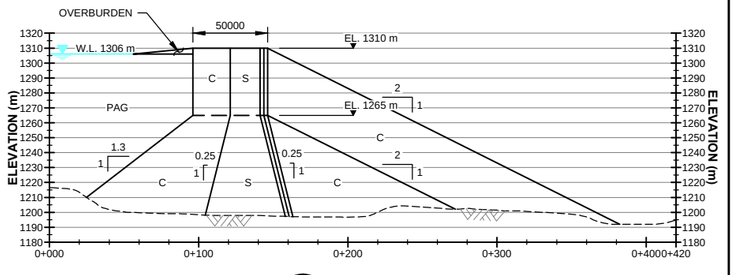
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**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




**1 FIG — SECTION**
**FILTERED TAILINGS STACK**
SCALE B




**2 FIG — SECTION**
**PAG STORAGE DAM**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- FILTERED TAILINGS
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY (CLOSURE ONLY)
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

**FOR INFORMATION ONLY**

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 7 - FILTERED TAILINGS PAG-UW**
**FINAL ARRANGEMENT**

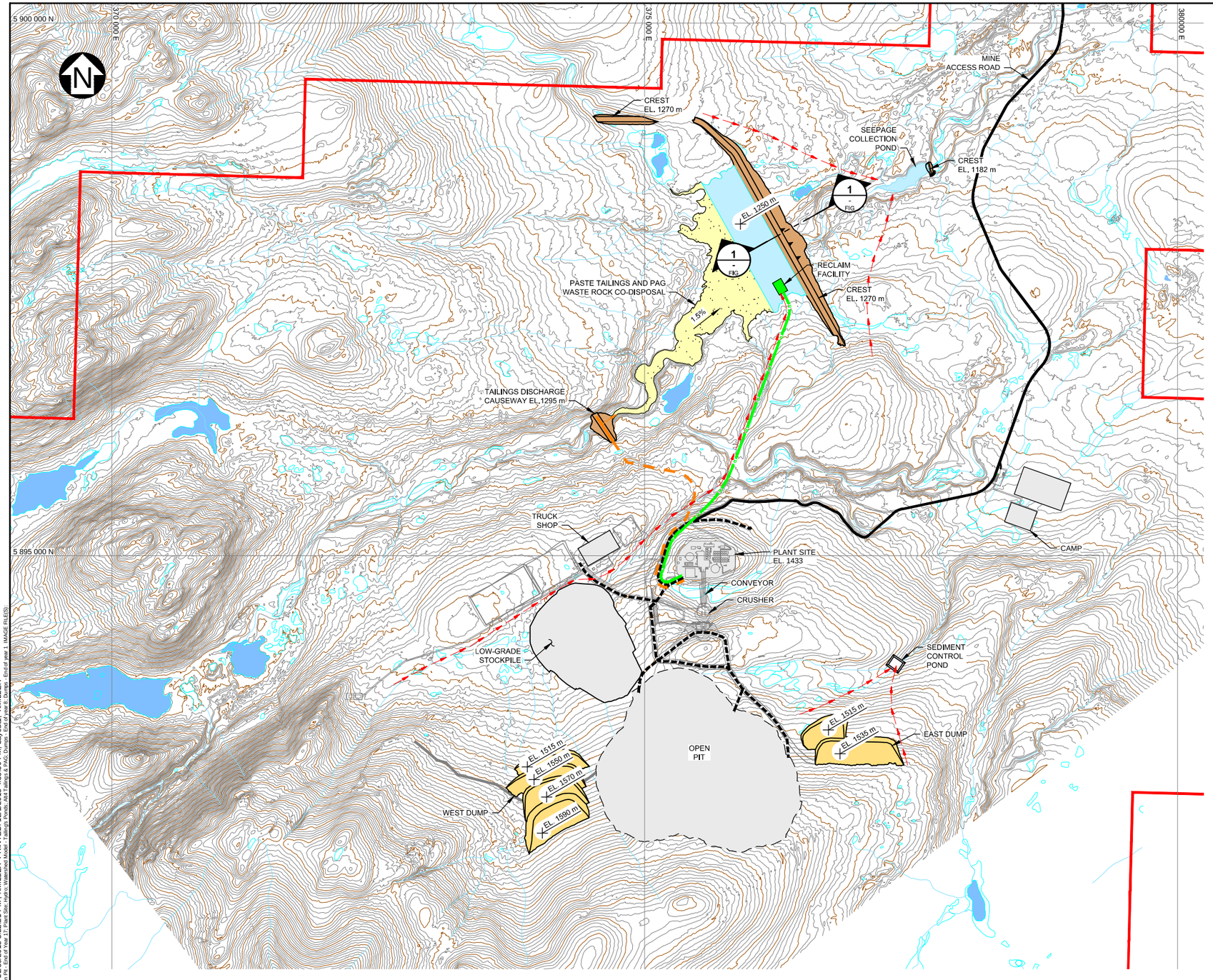
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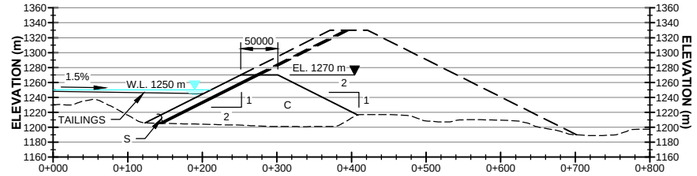
P/A NO. VA101-457/15 | REF NO. 1

**FIGURE E-4** | REV 0



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1 - FIG **SECTION**
**THICKENED TAILINGS DAM**
SCALE B

**LEGEND:**

- SLURRY TAILINGS
- MINE WATER
- FRESH WATER
- EMBANKMENT
- PAG WASTE ROCK
- NAG WASTE ROCK
- RECLAIM SYSTEM
- PUMPSTATION

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- SPILLWAY (CLOSURE ONLY)
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TAILINGS PIPELINE
- SLURRY TAILINGS DISCHARGE

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

**FOR INFORMATION ONLY**

SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 10 - PASTE TAILINGS**
**STARTER ARRANGEMENT**

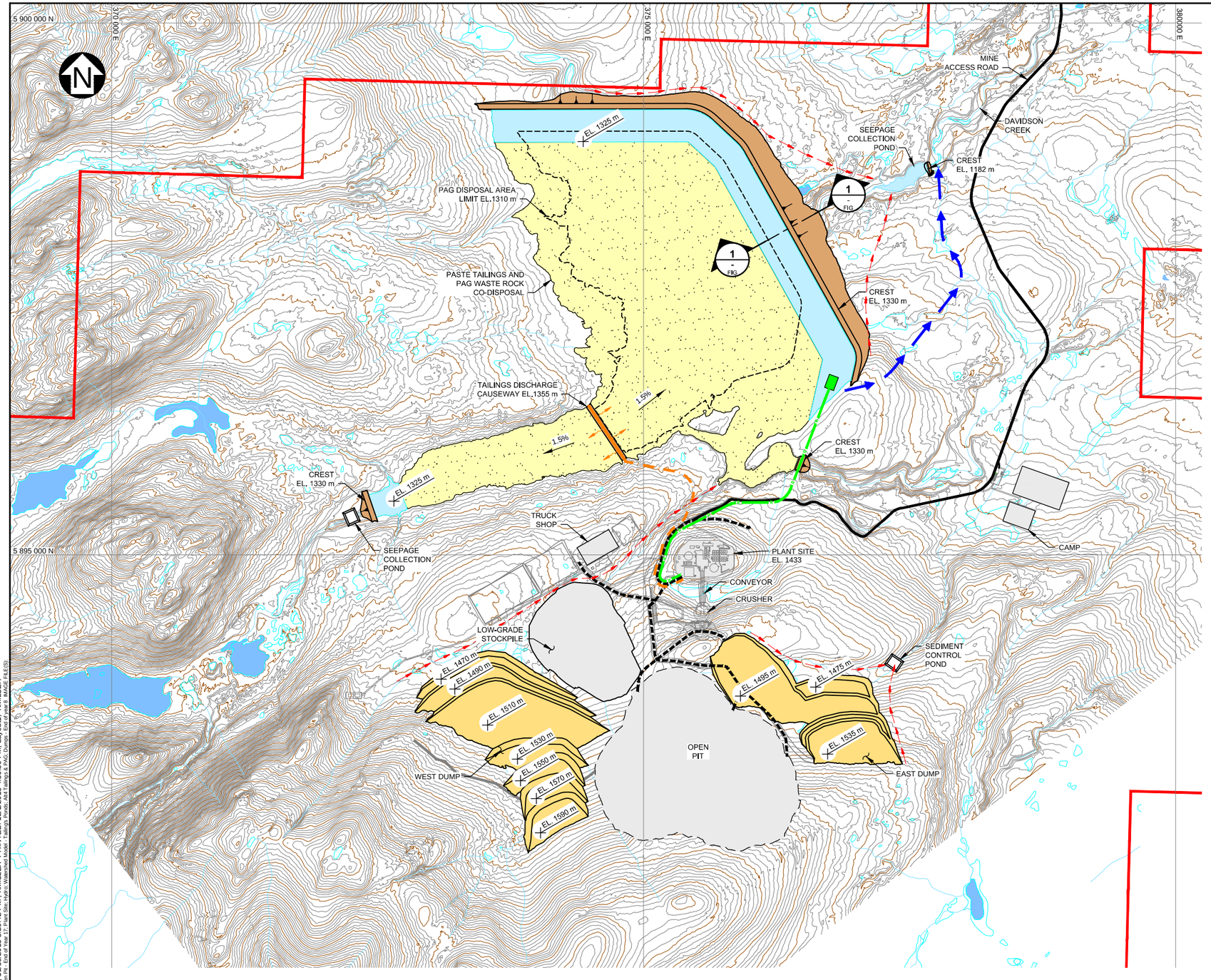
Knight Piésold CONSULTING

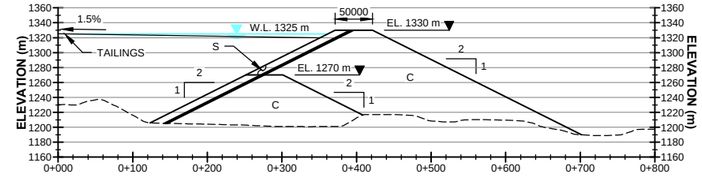
P/A NO. VA101-457/15 | REF NO. 1

**FIGURE E-5** | REV 0



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1 - FIG **SECTION**
**THICKENED TAILINGS DAM**
SCALE B

**LEGEND:**

- SLURRY TAILINGS
- MINE WATER
- FRESH WATER
- EMBANKMENT
- PAG WASTE ROCK
- NAG WASTE ROCK
- RECLAIM SYSTEM
- PUMPSTATION

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- SPILLWAY (CLOSURE ONLY)
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TAILINGS PIPELINE
- SLURRY TAILINGS DISCHARGE

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

**FOR INFORMATION ONLY**

SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 30NOV'15 | ISSUED WITH REPORT | DBR | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 10 - PASTE TAILINGS**
**FINAL ARRANGEMENT**

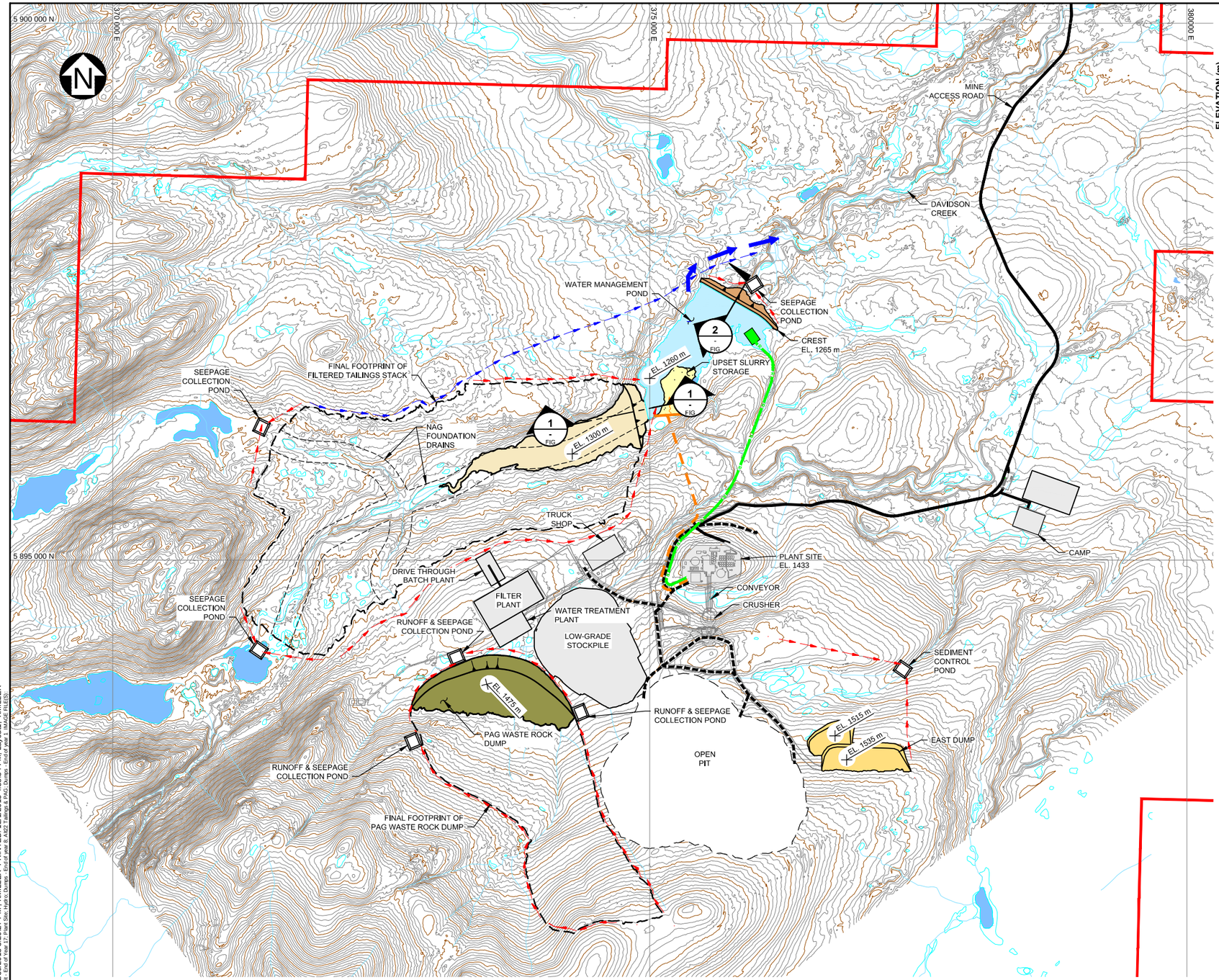
Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 1

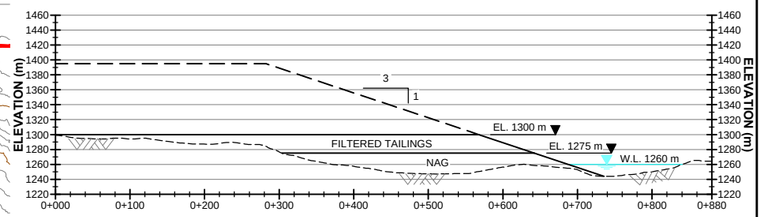
**FIGURE E-6** | REV 0



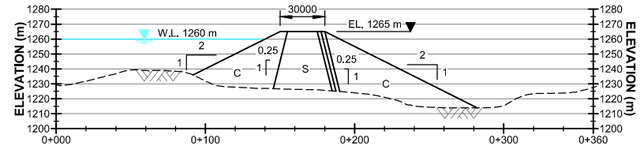
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**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




**1 FIG - SECTION**
**FILTERED TAILINGS STACK**
SCALE B




**2 FIG - SECTION**
**WATER MANAGEMENT POND**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- FILTERED TAILINGS
- PAG WASTE ROCK
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
4. PAG WASTE ROCK DUMP DESIGNED TO KEEP FOOTPRINT OUT OF UNGULATE WINTER RANGE.

**FOR INFORMATION ONLY**

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

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BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 22 - FILTERED TAILINGS PAG-OL STARTER ARRANGEMENT**

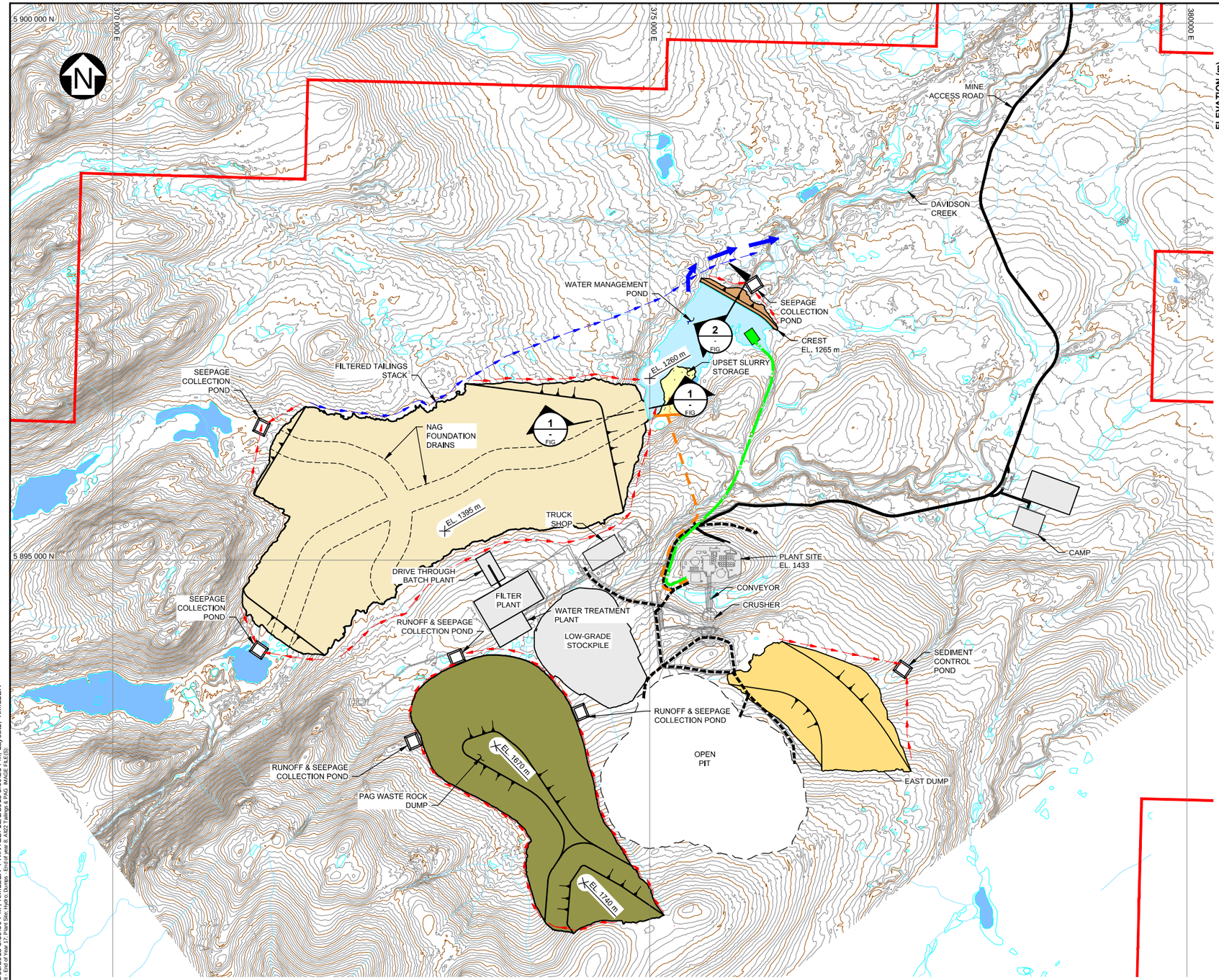
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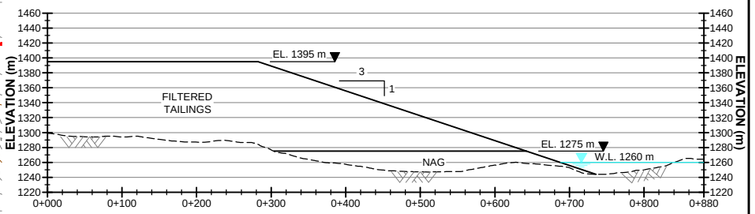
**FIGURE E-7** REV 0



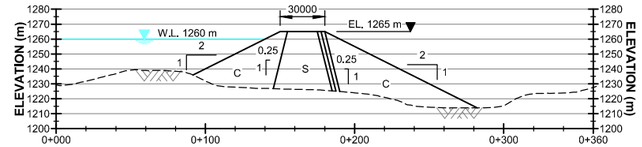
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**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




**1 FIG — SECTION**
**FILTERED TAILINGS STACK**
SCALE B




**2 FIG — SECTION**
**WATER MANAGEMENT POND**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- FILTERED TAILINGS
- PAG WASTE ROCK
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
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**NOTES:**

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4. PAG WASTE ROCK DUMP DESIGNED TO KEEP FOOTPRINT OUT OF UNGULATE WINTER RANGE.

**FOR INFORMATION ONLY**

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**ALTERNATIVE TECHNOLOGY OPTIONS STUDY**
**CANDIDATE 22 - FILTERED TAILINGS PAG-OL**
**FINAL ARRANGEMENT**

Knight Piésold CONSULTING

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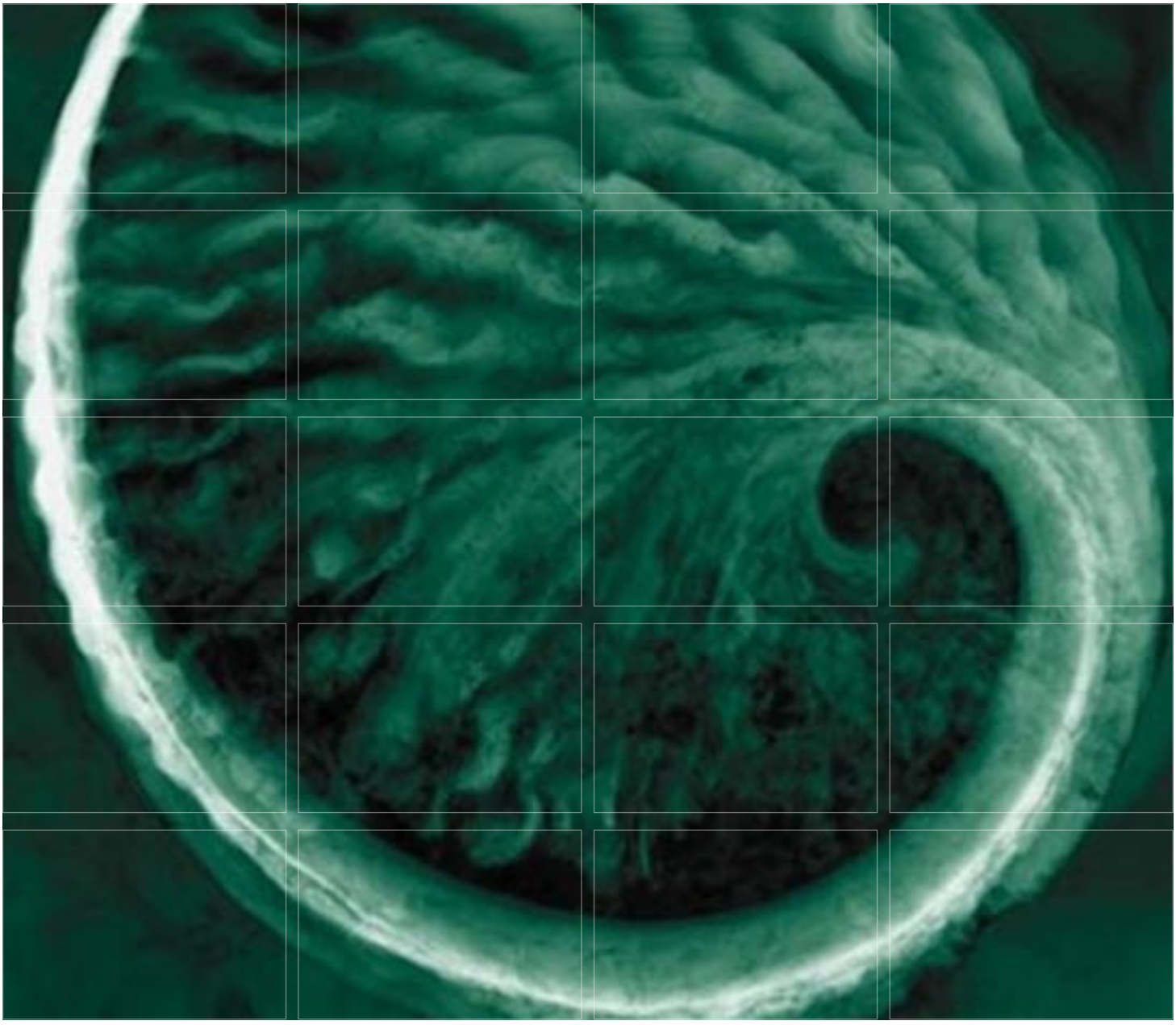
**FIGURE E-8** REV 0



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# *Appendix E*

*Multiple Accounts Analysis*



*Prepared for:*

newgold

BLACKWATER GOLD PROJECT

# Multiple Accounts Analysis

November 2015

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**New Gold Inc.**

# BLACKWATER GOLD PROJECT
# Multiple Accounts Analysis

**November 2015**

Project #0289076-0009

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Citation:
ERM. 2015. *Blackwater Gold Project: Multiple Accounts Analysis* Prepared for New Gold Inc. by ERM Consultants Canada Ltd.: Vancouver, British Columbia.

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# EXECUTIVE SUMMARY

New Gold completed this report for the Blackwater Gold Project (Project) in response to a request from the British Columbia (BC) Environmental Assessment Office (EAO; March 19, 2015) that all mining proponents consider the implementation of Best Available Technology (BAT) and Best Available Practices (BAP) identified by the Mount Polley Independent Investigation Review Panel (the Panel).

In a letter dated June 3, 2015, the Canadian Environmental Assessment Agency requested that environmental effects, as defined in section 5 of the *Canadian Environmental Assessment Act, 2012*, be included as factors to be considered in the assessment of the preferred option.

To identify BAT and BAP for the Project, New Gold conducted a comprehensive assessment of tailings and potentially acid generating/metal leaching (PAG/ML) waste rock management alternatives. Tailings and PAG/ML waste rock management must be considered in an integrated manner for the Project due to the geochemical reactivity of the majority of the waste rock (445 million tonnes [Mt] of PAG/ML waste rock out of 685 Mt total). Both conventional and customized risk assessment methods as well as Environment Canada's (EC; 2011) *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* (*Guidelines*) have been modified to emphasize the importance of physical stability in the assessment and used to screen and assess the candidate alternatives.

This report summarizes one step of this evaluation process, the multiple accounts analysis (MAA). This MAA was used to determine Project BAT from a short-list of feasible Project candidates for mine waste disposal and management. The short-list was developed after a pre-screening (fatal-flaw) assessment, and a high level risk assessment (HLRA). The short-listed candidates evaluated in this assessment were the lowest risk options for each of the following tailings technology: thickened slurry, paste, and filtered (dry stack). Additionally, the candidate with the best overall physical stability/safety was evaluated. These candidates are:

Four candidates, all located primarily within the Davidson Creek catchment were selected from the HLRA for further assessment:

- Candidate 1 – thickened slurry tailings with submerged PAG/ML waste rock;
- Candidate 7 – 'dry stack' (filtered) tailings with submerged PAG/ML waste rock;
- Candidate 10 – paste tailings with submerged PAG/ML waste rock; and
- Candidate 22 – 'dry stack' (filtered) tailings with PAG/ML waste rock on land.

The MAA used to determine Project BAT used the following steps:

- **Step A – alternative characterization**; entails the thorough characterization of a short-list of feasible alternatives, termed 'candidates'in this report;

- **Step B – multiple accounts ledger**; entails the development of a ledger that seeks to differentiate among candidates and provides the basis for scoring and weighting of criteria as described in Step C;
- **Step C – value-based decision process**; entails taking the list of accounts, sub-accounts, and indicators and assessing the combined impacts for each of the candidates under review; and
- **Step D – sensitivity analysis**; This process is specifically tailored to be transparent and to the extent practicable, eliminate bias and subjectivity.

The MAA characterized, compared and ranked the 4 candidates' impacts and interactions with physical stability, technical, environmental, human environment, and Project stability accounts. These accounts are largely a reflection of the Guidelines; however, they are reflective of the EAO' requirements.

The MAA determined that thickened slurry tailings with submerged PAG/ML waste rock (Candidate 1), was the best overall candidate and therefore is BAT for the Project. Candidate 1 scored the highest in the technical, environmental, human environment, and Project economics accounts, and scored second overall for physical stability. Candidate 22 scored the highest in the physical stability account, primarily because this candidate did not involve storing submerged mine waste behind a dam. However, Candidate 22 scored much lower than Candidate 1 for all other accounts primarily because it does not involve submerging waste. Candidate 1 was second best in the physical stability account. Additionally, Candidate 1 scored better than any other candidates when the Project economics account was not considered, which demonstrates that cost is not a determining factor in the evaluation.

Candidate 1 scored highest for technical criteria because it involves efficient seepage control; the overall foundation conditions for long term waste containment and geotechnical stability; no operational discharge of surface water; a manageable water balance and submergence of all PAG/ML material to minimize metal leaching and prevent acid rock drainage (ML/ARD) with minimal long-term monitoring and maintenance. Candidate 1 scored the highest in the environmental account because wetted mine waste minimizes dust emissions; produces the least volume of seepage because the pond is not adjacent to the dam; and has the best water quality because all reactive waste is submerged. Candidate 1 was the best alternative for the human environment account because its reduced dust emissions and better water quality minimizes potential health effects from consumption of harvested resources.

# BLACKWATER GOLD PROJECT
# Multiple Accounts Analysis

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# GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

| | |
|---|---|
| **AA** | Alternatives assessment |
| **AIA** | Archaeological impact assessment |
| **Application** | Application for an Environmental Assessment Certificate |
| **ARD** | Acid rock drainage |
| **BAP** | Best available practices |
| **BAT** | Best available technology |
| **BC** | British Columbia |
| **BCFWG** | British Columbia Guidelines for the Protection of Fresh Water Aquatic Life |
| **BC MOE** | British Columbia Ministry of Environment |
| **bgs** | Below ground surface |
| **Bt** | Metric billion tonnes |
| **CCTC** | Carrier-Chilcotin Tribal Council |
| **CDA** | Canadian Dam Association |
| **CDC** | Conservation Data Centre (BC) |
| **CEAA 2012** | *Canadian Environmental Assessment, 2012* |
| **COSEWIC** | Committee on the Status of Endangered Wildlife in Canada |
| **CMT** | Culturally modified tree |
| **COPC** | Contaminant of Potential Concern |
| **CRA** | Commercial, recreational, Aboriginal |
| **CSTC** | Carrier Sekani Tribal Council |
| **CULRTP** | Current use of lands and resources for traditional purposes |
| **EA** | Environmental Assessment |
| **EAO** | Environmental Assessment Office |
| **EC** | Environment Canada |
| **EIS** | Environmenal Impact Statement |
| ***Guidelines*** | *Guidelines for the Assessment of Alternatives for Mine Waste Disposal*, published by Environment Canada (2011) |

| | |
|---|---|
| **FSR** | Forest Service Road |
| **ha** | Hectare or 10,000 $m^2$ |
| **HLRA** | High level Risk Assessment |
| **IDF** | Inflow Design Flood |
| **IR** | Indian Reserve |
| **km** | Kilometre(s) |
| **LDN** | Lhoosk'uz Dene Nation |
| **LPS** | Low-permeability subgrade |
| **MAA** | Multiple Accounts Analysis |
| **m** | Metre(s) |
| **masl** | Metres above sea level |
| **MAL** | Multiple Accounts Ledger |
| **ML** | Metal leaching |
| **$Mm^3$** | Million cubic metres |
| **MNBC** | Métis Nation British Columbia |
| **NAG** | Non-acid generating |
| **NWFN** | Nadleh Whut'en First Nation |
| **New Gold** | New Gold Inc. |
| **NFN** | Nazko First Nation |
| **NP** | Neutralization potential |
| **NPR** | Neutralization potential ratio |
| **NPV** | Net present value |
| **PAD** | permanent alteration to, or destruction of fish habitat, Section 35.2 of the *Fisheries Act* (1985) |
| **PAG** | Potentially acid generating |
| ***Panel Report*** | Report on Mount Polley Tailings Storage Facility Breach by the Independent Expert Engineering Investigation and Review Panel, January 30, 2015 |
| **PGA** | Peak ground acceleration |
| **The Project** | The Blackwater Gold Project |
| **PMF** | Probable maximum flood |
| **ppm** | Parts per million |

| | |
|---|---|
| **SARA** | *Species At Risk Act* (2002b) |
| **SFN** | Saik'uz First Nation |
| **STN** | Skin Tyee Nation |
| **SMU** | Soil mapping unit |
| **StFN** | Stellat'en First Nation |
| **TDS** | Total dissolved solids |
| **TEM** | Terrestrial Ecosystem Mapping |
| **TNG** | Tsilhqot'in National Government |
| **TSF** | Tailing Storage Facility |
| **tpd** | Tonnes per day |
| **UFN** | Ulkatcho First Nation |
| **UWR** | Ungulate Winter Range |
| **VC** | Valued Component |

# 1. INTRODUCTION

## 1.1 PURPOSE OF THE REPORT

This report provides an assessment of alternative means (technology, location, and practices) for storing tailings and potentially acid generating/non-acid generating (PAG/NAG3; metal leaching) waste rock generated during the Blackwater Project (the Project).

This assessment has been undertaken in response to correspondence from the British Colombia (BC) Environmental Assessment Office (EAO) dated March 19, 2015. The EAO requires that environmental assessments (EAs) on mining projects appropriately consider the recommendations of the "Report on Mount Polley Tailings Storage Facility Breach" by the Independent Expert Engineering Investigation and Review Panel (the Panel Report; IEEIRP 2015). For proposed mining projects with new proposed tailings dams, Proponents must provide the following information:

- A description and assessment of alternative means of undertaking the proposed project with respect to options for tailings management that considers technology, siting and water balance.
- A presentation and comparison of best practices and best available technologies for tailing management for the project, along with options for managing water balance to enhance safety and reduce the risk (likelihood and consequence) of tailings dam failure during all phases of mine life (construction, operations, closure and post closure). The assessment must present and compare technically and economically viable engineering solutions that are available to adequately address site conditions.
- Provision of a clear and transparent evaluation of the factors that supported the selection of the most suitable option. Factors that will be taken into consideration in the evaluation include safety, technical and financial aspects, and implications for environmental, health, social, heritage and economic values. The assessment must consider these factors in relation to tailings management options in both the short and long-term context. Life cycle cost assumptions (construction, operations, closure, and post closure) must be included in the analysis of options.

In a letter dated June 03, 2015, the Canadian Environmental Assessment Agency (CEA Agency) requested that environmental effects, as defined in section 5 of the *Canadian Environmental Assessment, 2012* (CEAA 2012), be included as factors to be considered in the assessment of the preferred option.

In response, New Gold has conducted an assessment of alternative sites and management options for tailings and ML/PAG waste rock storage to determine Best Available Technology (BAT) specific to the Project and to identify Best Available Practices (BAP) to reduce residual risk. The Project will produce about 345 million tonnes (Mt) of tailings (the majority are PAG) and 446 Mt of ML/PAG waste rock. Tailings and ML/PAG waste rock management alternatives must be developed and assessed in an integrated manner. Both conventional and customized risk assessment methods as

well as Environment Canada's (EC; 2011) *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* (*Guidelines*) have been modified to emphasize the importance of physical stability in the assessment and used to screen and assess the candidate alternatives. This report summarizes one step of this evaluation process, the multiple accounts analysis (MAA). This MAA was used to determine Project BAT from a short-list of feasible Project candidates for mine waste disposal and management. The short-list was developed after a pre-screening (fatal-flaw) assessment, and a high level risk assessment (HLRA). The short-listed candidates evaluated in this assessment are the lowest risk options for each of the following tailings technology: thickened slurry, paste, and filtered (dry stack). Additionally, the candidate with the best overall physical stability/safety is also evaluated here.

## 1.2 METHODOLOGY

The MAA used for this study has been adapted from the *Guidelines*, and includes the following steps (Figure 1.2-1):

- Step A – alternative characterization;
- Step B – multiple accounts ledger;
- Step C – value-based decision process; and
- Step D – sensitivity analysis.

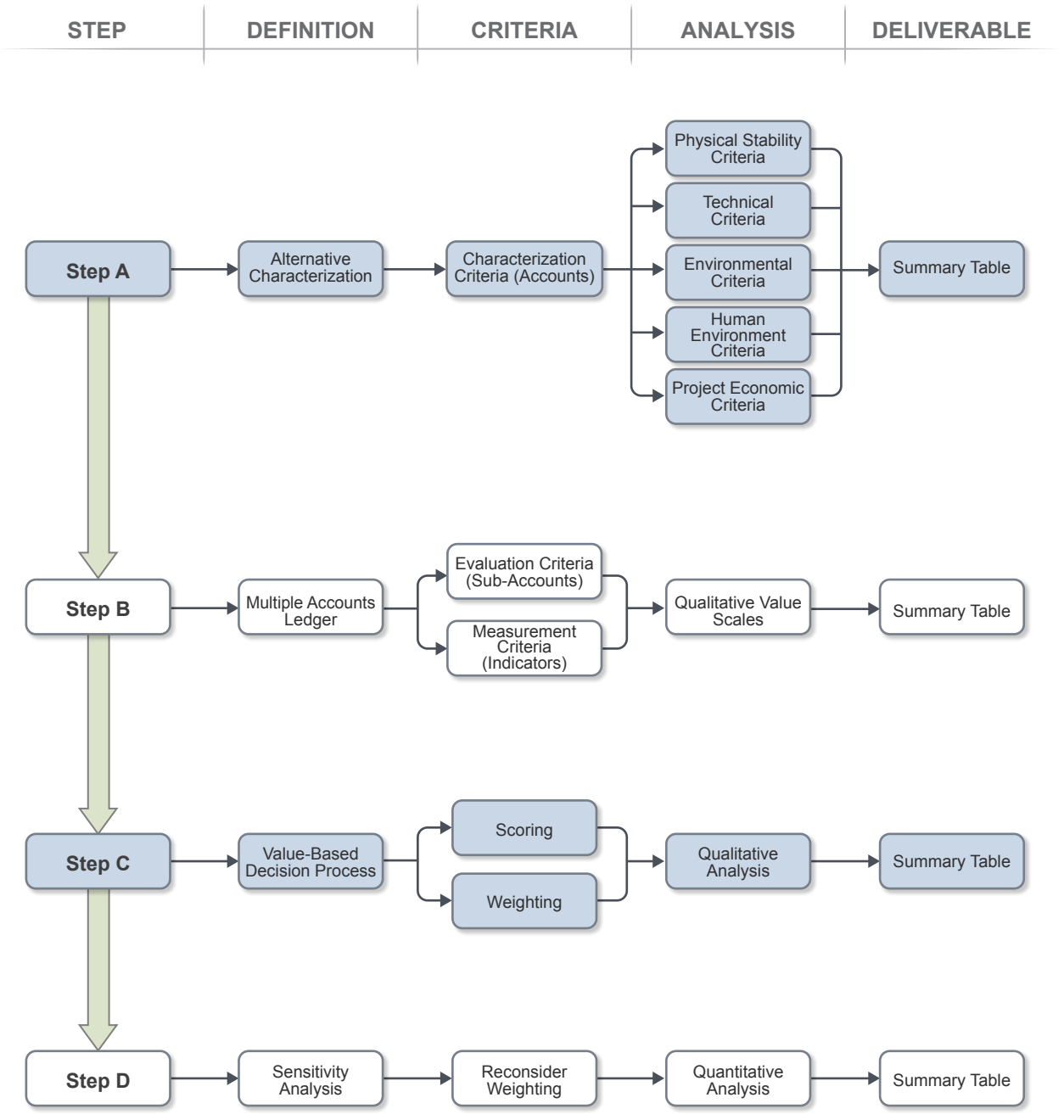
The methodology set out in the *Guidelines* allows for consideration of technical and non-technical information and provides an approach that is transparent and reproducible.

Steps A through D are briefly described below.

- Step A: **Alternatives Characterization** entails the thorough characterization of a short-list of feasible alternatives, termed 'candidates'in this report. Site-specific characterization criteria have been developed for each candidate within five broader categories: physical stability, technical, environmental, human environment (i.e. socio-economic factors), and Project economics. These five categories are known as "accounts." Characterization criteria have been selected to provide a factual, objective basis for comparison among the selected candidates.
- Step B: **Multiple Accounts Ledger** entails the development of a ledger that seeks to differentiate among candidates and provides the basis for scoring and weighting of criteria as described in Step C. Sub-accounts and indicators have been chosen and described based on the characterization criteria presented in Step A. Sub-Accounts are described based on the material impact (i.e., actual or estimated benefit or loss) or comparitive effect associated with the candidates being evaluated. Only those sub-accounts and indicators that differentiate candidates are presented for evaluation. Indicators are a sub-level that often allows sub-accounts to be decomposed to a degree that allows measurability. Like sub-accounts, the indicators have been chosen from the Project's valued environmental components; the *Guidelines*; the recommendations of the Mt. Polley Review Panel and professional judgement. Only those indicators that differentiate candidates are presented for evaluation.

**Figure 1.2-1**

**Blackwater Project:**
**Multiple Account Analysis Methodology**



- Step C: **Value-based Decision Process** entails taking the list of accounts, sub-accounts, and indicators and assessing the combined impacts for each of the candidates under review. All indicators, sub-accounts, and accounts are scored and weighted, and merit ratings for each alternative are quantified. Scoring involves the development of quantitative or qualitative scales for each indicator, such that each indicator can be assigned a rank on the scale. Weighting involves comparing indicators, sub-accounts, and accounts among alternatives by introducing value bias by applying a weighting factor to each indicator, sub-account, or account. Weighting factors allow the ability to assign relative importance from one criterion as compared to another. The default weighting of accounts in the *Guidleines* is technical – 3; environmental – 6; human environment – 3 and project economics – 1.5.
- Step D: **Sensitivity Analysis**. This process is specifically tailored to be transparent and to the extent practicable, eliminate bias and subjectivity. However, any decision making process is subject to bias and subjectivity, and the goal is to manage that bias and subjectivity to the point where an external reviewer would agree that the decision is justifiable and reasonable, irrespective of their own value system. To test the sensitivity of the value-based decision making process, different weightings are assigned to those indicators, sub-accounts, and accounts according to a range of value systems (e.g., equal weighting for all accounts).

# 2. CANDIDATES

Four candidates were identified in the HLRA and are evaluated in this assessment. The candidates are all located within the upper reaches of Davidson Creek watershed and have similar waste storage locations allowing for comparison of the advantages and disadvantages of the different technologies within the same setting. This section provides figures and a brief summary of each candidate; detailed description of the mine development concept, water management, technical execution and mine closure is provided in Section 7 of Appendix 2.

## 2.1 CANDIDATE 1 – THICKENED SLURRY TAILINGS / SUBMERGED PAG/NAG3 ROCK

Candidate 1 is a thickened-slurry tailings alternative located in the upper reaches of the Davidson Creek catchment (ultimate arrangement is presented in Figure 2.1-1). The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The impoundment will be created in a staged manner consisting of two nested TSF sites. The facility was designed to permanently store tailings, PAG/NAG3 waste rock, and operational supernatant pond allowance, and capacity to contain the IDF with additional freeboard for wave run-up. The upper facility (Site C) will be constructed first with two dams to contain the first two years of tailings and waste rock.

A third, larger dam will be constructed downstream to expand the impoundment into the lower facility (Site D) to contain the remaining 15 years of tailings and waste rock. A fourth, smaller saddle dam will be required late in mine life to maintain containment. The impoundment will form a valley fill type arrangement and will be constrained by natural topography to the south and west.

The TSF Site C Main and West Dams will be constructed to elevation 1353 m and TSF Site D Main and Saddle Dam constructed to elevation 1,340 m. Construction of the dams will require a total of 74 $Mm^3$, sourced from pit stripping and external borrow sources. The earth-rockfill dams will be comprised of a core zone, filter zone, transition zone and shell zone. Filter and transition material will be sourced from a nearby aggregate borrow. The majority of the core zone and shell zone material will come from the open pit. The maximum height of the Site D Main Dam will be approximately 140 m.

Process water will be stored on site within the TSF to maintain the saturated condition of the mine waste materials and will be split between two ponds; one within each disposal area. The normal operating pond allowance for each pond will be 10 $Mm^3$. Tailings slurry will be conveyed by gravity in a pipeline to the TSF and the pipeline route will remain within the TSF catchment at all times.

The dam safety hazard classification for the tailings facility is VERY HIGH based on the technical bulletin *Application of Dam Safety Guidelines to Mining Dams* (CDA 2014). These guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the tailings dams.

The following suggested design levels were adopted from the CDA guidelines for Candidate 1 during the operational phase:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF);
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE).

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF;
- EDGM – MCE.

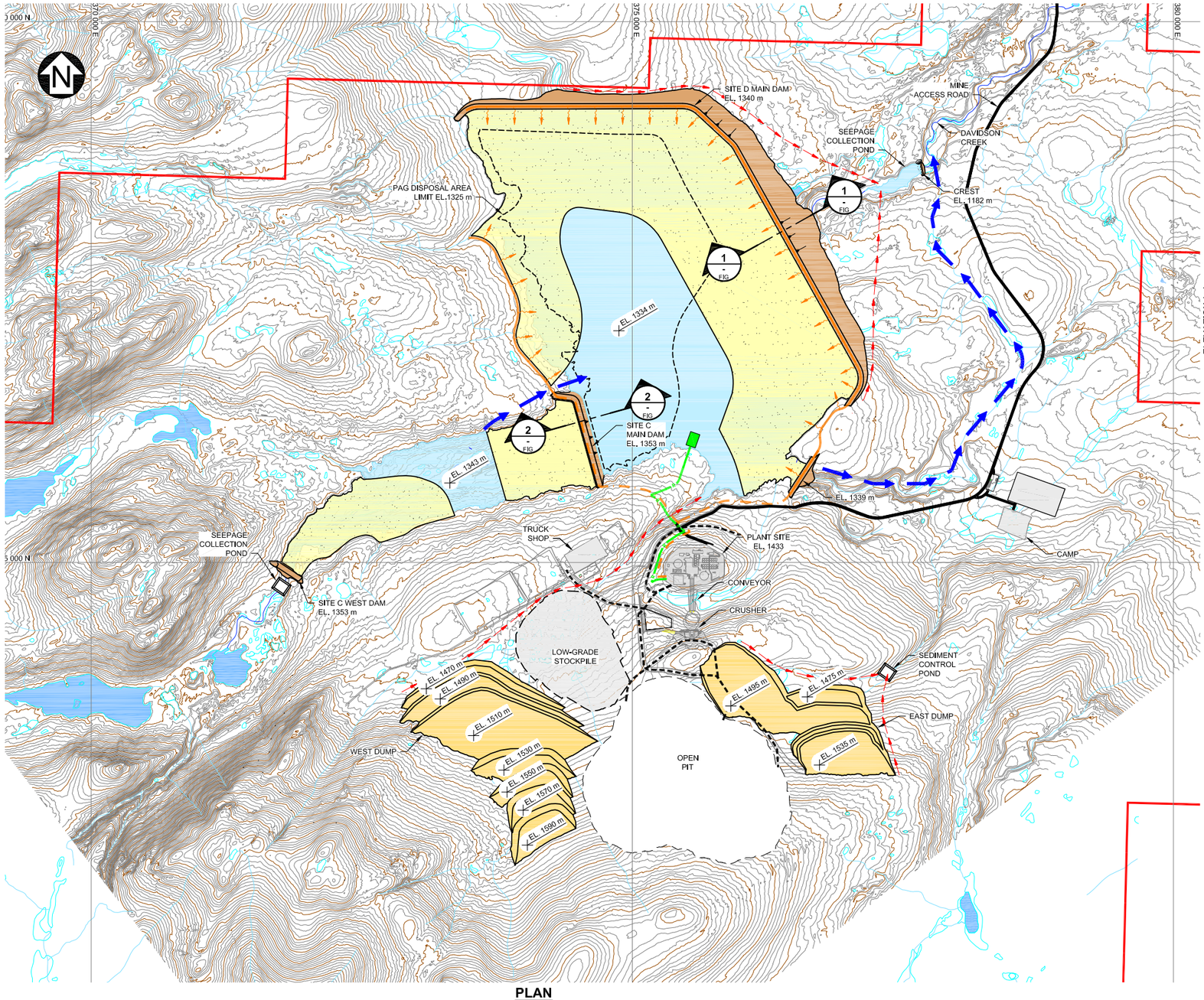
Tailings will be thickened to approximately 50% solids at the process plant and delivered by gravity through a pipeline to either the TSF Site C or Site D. The tailings distribution system includes a fully installed standby pipeline for operational flexibility. Tailings spigots will be located regularly along the dam crests for subaerial discharge of the tailings slurry. The slurry will segregate upon deposition with the coarsest sand particles settling near the discharge spigots and finer sands settling farther down the slope. Even finer silt and clay sized tailings particles will be carried out into the supernatant pond in suspension and will settle over a longer period of time. The segregation of coarser material will facilitate development of extensive tailings beaches providing separation of the containment dams from the supernatant pond. Beach slopes will develop at an approximate grade of 1% away from the discharge point.

The PAG and NAG3 waste rock disposal area will be developed at the same or similar rate of rise as the tailings in the TSF, with the final tailings level several meters higher to provide complete submergence of PAG waste rock. The tailings beach will provide a low permeability transition between the coarse, permeable waste rock in the centre of the TSF and the tailings embankments. The extensive tailings beaches will provide seepage control and are an indicator of dam safety.

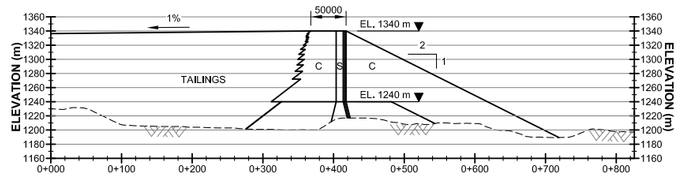
Seepage will be primarily controlled by the low-permeability core zone and cut-off trenches constructed prior to the development of tailings beaches. Seepage passing through the main embankment will be collected in embankment drains and conveyed to a seepage collection pond (Environmental Control Dam; ECD) downstream of the main dam. Seepage will be recycled back to the TSF. Unrecoverable seepage passing the collection and recycle system has the potential to affect one watershed: Davidson Creek.

**Figure 2.1-1**
**Candidate 1 – Slurry Tailings / Submerged PAG Rock Tailings Storage Facility**

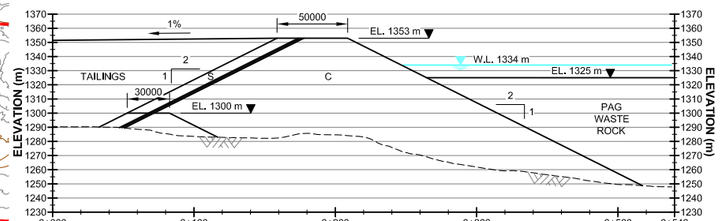
ERM




**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




**SECTION**
**SITE D DAM**
SCALE B




**SECTION**
**SITE C DAM**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY (CLOSURE ONLY)
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD 83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

## 2.2 CANDIDATE 7 – FILTERED TAILINGS / SUBMERGED PAG/NAG3 ROCK

Candidate 7 is a filtered tailings alternative located in the upper reaches of the Davidson Creek catchment (ultimate arrangement is presented in Figure 2.2-1). The filtered tailings will be stacked in a waste pile on land in a heaped valley fill arrangement in a partially saturated condition. A PAG/NAG3 waste rock submergence impoundment will be positioned downstream of the filtered tailings waste pile. The submergence impoundment was design to permanently store PAG/NAG3 waste rock in a saturated condition and contain the process water pond with additional capacity to contain the IDF and freeboard for wave run-up. This impoundment will also manage storm water from the filtered tailings waste pile. The impoundment will be created by constructing a two-sided dam that is progressively expanded over the life of the mine. The impoundment will form a valley fill type arrangement and will be constrained by natural topography to the south and west. PAG/NAG3 waste rock stored in the impoundment will eventually buttress the toe of the filtered tailings waste pile.

The centre of the tailings waste pile site is located 3.5 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filter plant approximately 1 km away as thickened slurry with a gravimetric solids content of 50%. Tailings will be filtered and then transported by conveyer to a truck load out building. Haul trucks will transport the filtered tailings to the stacking location where dozers will be used for placement and grading. A conveyor will be considered for placement in later years once a large working surface has been developed. Two areas of the tailings pile will be developed: a general area where tailings will be placed in 10 m thick platforms with surface grading and compaction to reduce infiltration and maintain trafficability, and a structural area with thinner lift thicknesses and compaction to maintain stability of the stack.

The filtered tailings waste pile will be constructed to elevation 1,395 m with a maximum height of approximately 145 m. The working surface of the pile at ultimate extents will be approximately 550 ha, and the rate of rise of the waste pile will be roughly 9 m per year. The filtered tailings waste pile rises approximately 40 m higher than the TSF Site C facility contemplated in Candidate 1 in the same location. This change will alter the seepage and surface water flow regime such that some of the runoff and seepage may now report to the west of the filtered tailings pile. Two seepage collection ponds will be required on the west side of the filtered tailings pile. The waste pile slopes will be reclaimed concurrent with development; however the working surface of the pile is a large area and will require reclamation at closure.

An assessment of the stability rating for the filtered tailings waste pile was carried out using the waste dump and stockpile stability rating system as described in the interim guidelines provided by the BC Mine Waste Rock Pile Research Committee (BCMWRPRC, 1991). The waste pile was classified as Class III, Moderate Hazard. The submergence impoundment dam will be constructed to elevation 1,310 m.

The dam safety hazard classification for the PAG/NAG3 waste rock submergence impoundment is VERY HIGH (CDA, 2014). The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the containment dams.

The following suggested design levels were adopted from the CDA guidelines for Candidate 7 during the operational phase:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF);
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE).

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF;
- EDGM – MCE.

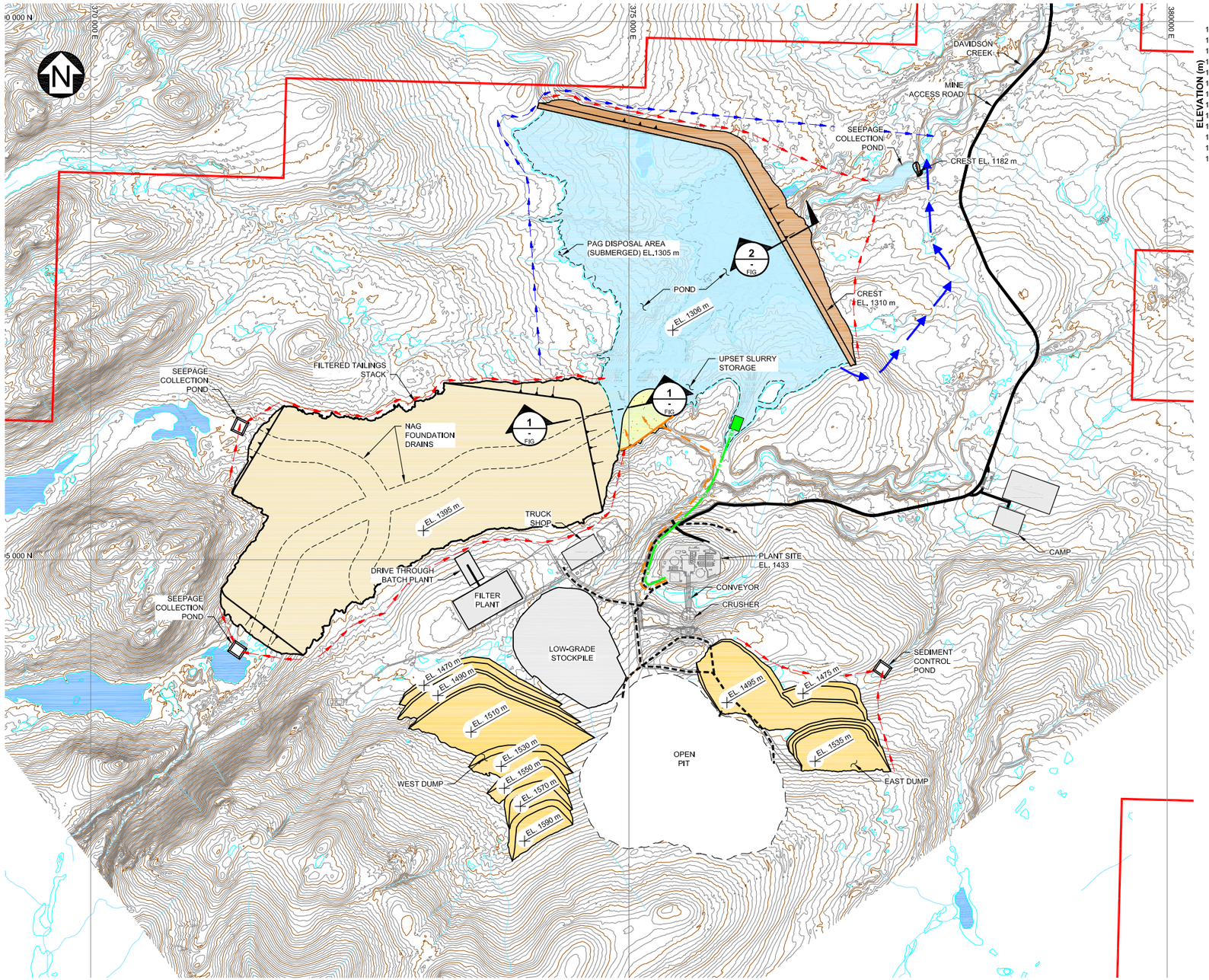
Process water will be stored on site within the submergence impoundment to maintain the saturated condition of the PAG/NAG3 waste rock. The normal operating pond allowance will be 10 $Mm^3$. Process water will be retained by the dam, while maintaining minimum freeboard requirements, and reclaimed for use in the mill. The impoundment will include an 'upset' conditions slurry tailings storage area in the submergence facility for times when the filter plant cannot achieve the required tailings moisture content for placement in the waste pile.

Seepage from the submergence impoundment will be primarily controlled by the low-permeability core zone and cut-off trenches constructed in the containment dam. Seepage passing through the core zone will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main dam. Higher relative seepage rates are expected from the impoundment compared to Candidate 1 because this option lacks a tailings beach, which reduces seepage flows. Seepage will be recycled back to the TSF. Unrecoverable seepage rates to Davidson Creek are not expected to increase substantially and the seepage collection infrastructure in Davidson Creek is robust enough to manage the change.

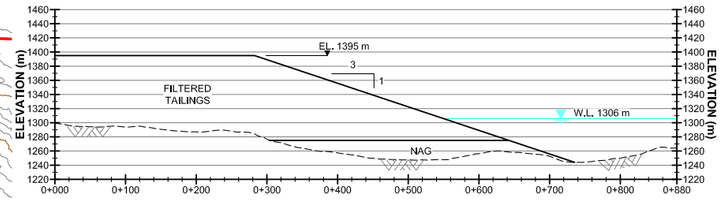
Unrecoverable seepage by-passing the collection and recycle systems for the filter tailings waste pile and PAG/NAG3 submergence impoundment has the potential to affect two watersheds: Davidson Creek and Creek 705.

## 2.3 CANDIDATE 10 – PASTE TAILINGS / SUBMERGED PAG ROCK

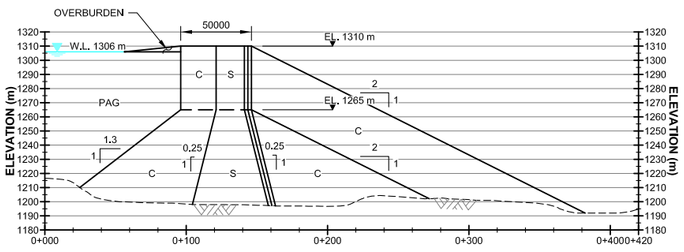
Candidate 10 is an ultra-thickened (paste) tailings alternative located in the upper reaches of the Davidson Creek catchment (ultimate arrangement is presented in Figure 2.3-1). The TSF will permanently store tailings and PAG/NAG3 waste rock in a saturated condition in one impoundment. The facility was designed to contain tailings, PAG/NAG3 waste rock, and the operational supernatant pond allowance, and capacity to contain the IDF with additional freeboard for wave run-up. The impoundment will be created by constructing three dams in the area previously described as Site D. The main dam will be a large two sided dam across Davidson Creek. Two smaller dams will be required on the west side of the impoundment and in a small saddle on the southeast side of the facility to maintain containment.




**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




**1 / FIG – SECTION**
**FILTERED TAILINGS STACK**
SCALE B




**2 / FIG – SECTION**
**PAG STORAGE DAM**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- FILTERED TAILINGS
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY (CLOSURE ONLY)
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

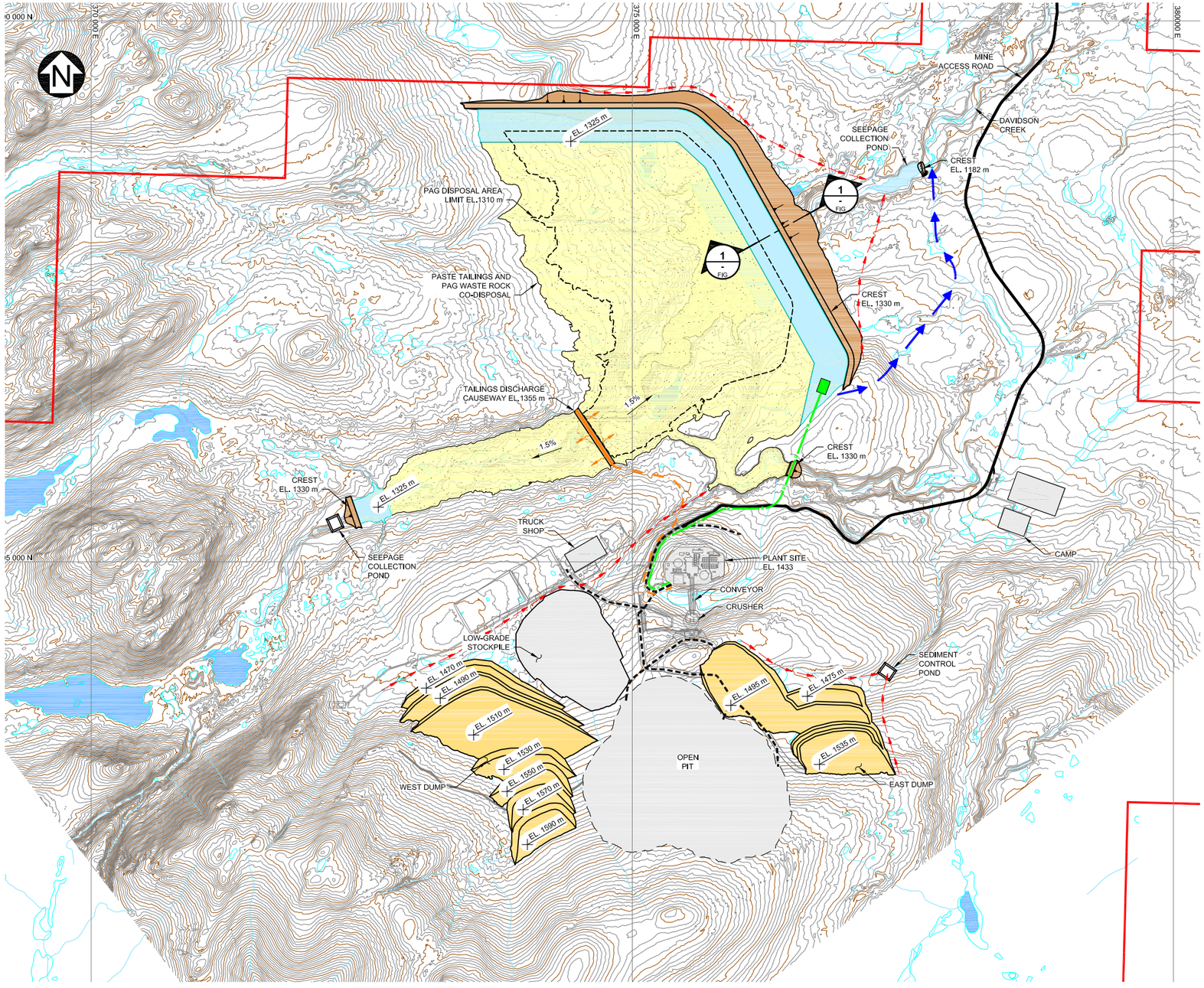
1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

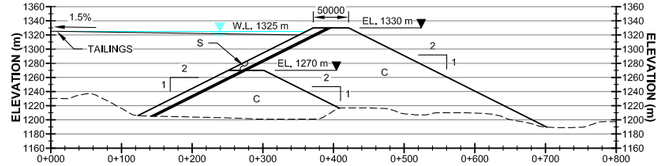
SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

**Figure 2.3-1**
**Candidate 10 – Paste Tailings / Submerged PAG Rock Tailings Storage Facility**

ERM




1 - FIG **SECTION**
**THICKENED TAILINGS DAM**
SCALE B

**LEGEND:**

- SLURRY TAILINGS
- MINE WATER
- FRESH WATER
- EMBANKMENT
- PAG WASTE ROCK
- NAG WASTE ROCK
- RECLAIM SYSTEM
- PUMPSTATION

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- SPILLWAY (CLOSURE ONLY)
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TAILINGS PIPELINE
- SLURRY TAILINGS DISCHARGE

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE C: 40 20 0 40 80 120 160 200 m
SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

Paste tailings will be pumped in a pipeline to a central point in the TSF. Tailings will be deposited by top-down method of paste placement. Paste tailings will be discharged from a central point and will settle at angle of repose sloping towards the containment dams. Water will be collected at the toe of the slope adjacent to the containment dams. The pipeline route will remain within the TSF catchment at all times.

The TSF dams will be constructed to elevation 1,330 m and the central discharge embankment will be raised to a final elevation of 1,355 m. Construction of the dams will require a total of 70 $Mm^3$, sourced from pit stripping and external borrow sources. The earth-rockfill dams will be comprised of a shell zone, transition and filter zones, and a low-permeability face. Filter and transition material will be sourced from a nearby aggregate borrow. The remainder of the material will come from the open pit. The maximum height of the main dam will be 130 m.

Process water will be stored on site in the TSF to maintain the saturated condition of the mine waste materials. The normal operating pond allowance will be 6 $Mm^3$. Process water will be retained by the dam, while maintaining minimum freeboard requirements, and reclaimed for use in the mill.

Alternatively, water could be decanted from the surface of the TSF and stored in a separate reclaim pond below the TSF. This will require construction of another large water retaining dam in an area downstream where there is increased risk of unrecoverable seepage due to the presence of naturally occurring higher permeability meltwater channels. Removal of water from the TSF will also negatively impact the reliability of initially flooding and subsequently maintaining PAG materials in a saturated condition.

The dam safety hazard classification for the tailings facility is VERY HIGH (CDA, 2014). The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the tailings dams.

The following suggested design levels were adopted from the CDA guidelines for Candidate 10 during the operational phase:

- IDF – 2/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF);
- EDGM – 1/2 between 1 in 2,475 year return period and Maximum Credible Earthquake (MCE).

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF;
- EDGM – MCE.

Tailings will be thickened to approximately 65% solids at the process plant and delivered by gravity through a pipeline to the central discharge point in the TSF. The tailings distribution system will include a fully installed standby pipeline for operational flexibility. The paste will not segregate upon deposition and very little bleed water from the tailings discharge is expected. Tailings will settle at an approximate grade of 1.5% away from the discharge point. The PAG and NAG3 waste

rock disposal area will be developed at the same or similar rate of rise as the tailings in the TSF. Waste rock will be used to manage the location of paste deposition during most of operations; however, the final tailings level will be several meters higher to cover the PAG waste rock.

Seepage will be primarily controlled by the low-permeability face zone and cut-off trenches constructed prior to the development of tailings beaches. Seepage passing through the main embankment will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main embankment. Seepage will be recycled back to the TSF. Higher relative seepage rates are expected from the impoundment compared to Candidate 1 because this option lacks a tailings beach in front of the dam, which reduces seepage flows. Seepage rates are expected to be less than those expected for Candidate 7. Unrecoverable seepage passing the collection and recycle system has the potential to affect one watershed: Davidson Creek.

## 2.4 CANDIDATE 22- FILTERED TAILINGS / PAG ROCK ON LAND

Candidate 22 is a filtered tailings alternative located at the top of the Davidson Creek catchment. The filtered tailings will be stacked in a waste pile on land in a heaped valley fill arrangement in a partially saturated condition (ultimate arrangement is presented in Figure 2.4-1). The tailings waste pile is the same size and is located at the same site as Candidate 7. PAG/NAG3 waste rock will be stored in a separate engineered surface containment in a heaped arrangement. The PAG/NAG3 waste rock dump is constrained from expanding further to the east by the open pit and to the west by the ungulate winter range. A process water management pond will be located downstream of the mine waste pile and created by constructing a water-retaining dam in a single stage with a maximum height of 40 m across Davidson Creek. Process water will be stored in the pond and reclaimed for use in the mill. An 'upset' conditions slurry tailings storage area will be required in the pond for emergency conditions.

The process water pond dam safety hazard classification is SIGNIFICANT (CDA, 2014). The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the process water pond dam. The following suggested design levels were adopted from the CDA guidelines for Candidate 22 during the operational phases of the project:

- IDF – 1 in 200 year return period;
- EDGM – 1 in 1,000 year return period.

The following design flood and earthquake levels were adopted for the closure phase:

- IDF – 1/3 between 1 in 1,000 year return period and Probable Maximum Flood (PMF);
- EDGM – 1 in 2,475 year return period.

Seepage from the process water pond will be primarily controlled by the low-permeability core zone and cut-off trenches constructed in the containment dam. Seepage passing through the core zone will be collected in embankment drains and conveyed to a seepage collection pond downstream of the main dam. Lower relative seepage rates are expected from the pond compared to other options because the pond is significantly smaller. Seepage will be recycled back to the pond or treated and discharged.

The centre of the tailings waste pile site is located 3.5 km from the deposit. Tailings will be pumped in a pipeline from the mill building to the filter plant approximately 1 km away as thickened slurry with a gravimetric solids content of 50%. Tailings will be filtered and then transported by conveyer to a truck load out building. Haul trucks will transport the filtered tailings to the stacking location where dozers will be used for placement and grading. A conveyor will be considered for placement in later years once a large working surface has been developed. Two areas of the tailings pile will be developed: a general area where tailings will be placed in 10 m thick platforms with surface grading and compaction to reduce infiltration and maintain trafficability, and a structural area with thinner lift thicknesses and compaction to maintain stability of the stack.

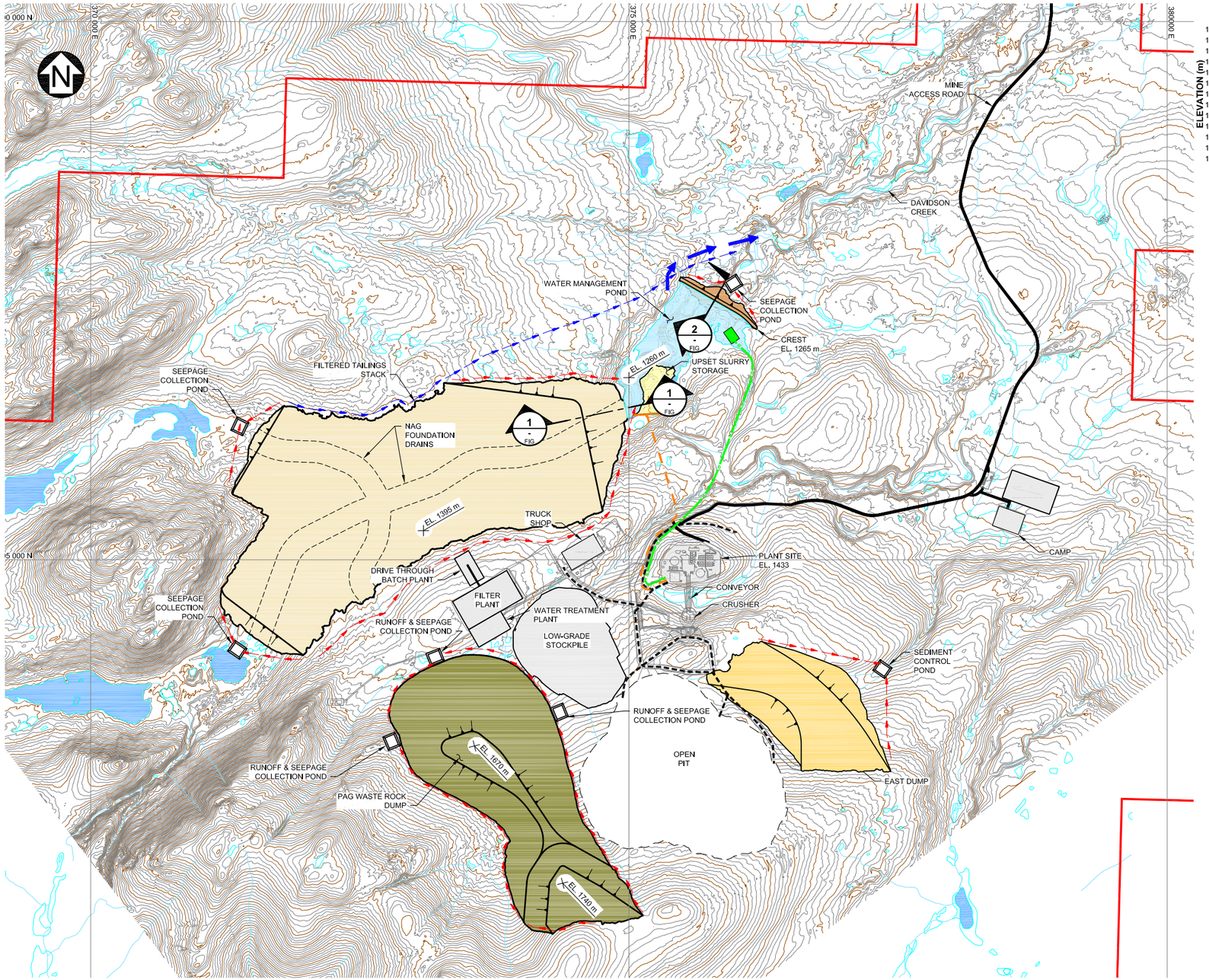
Preparation of the tailings storage area will require clearing, grubbing, stripping of topsoil, removal of unsuitable foundation soils, and installation of a complex network of foundation drains. The filtered tailings waste pile will be constructed to elevation 1,395 m with a maximum height of approximately 145 m. The working surface of the pile at ultimate extents will be approximately 800 ha, and the rate of rise of the waste pile will be roughly 9 m per year. The filtered tailings waste pile rises approximately 40 m higher than the TSF Site C facility contemplated in Candidate 1 in the same location. This change will alter the seepage and surface water flow regime such that runoff and seepage may now report to the west of the filtered tailings pile. Two seepage collection ponds will be required on the west side of the filtered tailings pile. The waste pile slopes will be reclaimed concurrent with development; however the working surface of the pile is a large area and will require reclamation at closure.

An assessment of the stability rating for the filtered tailings waste pile was carried out using the waste dump and stockpile stability rating system as described in the interim guidelines provided by the B.C. Mine Waste Rock Pile Research Committee (BCMWRPRC, 1991). The waste pile was classified as Class III, Moderate Hazard.

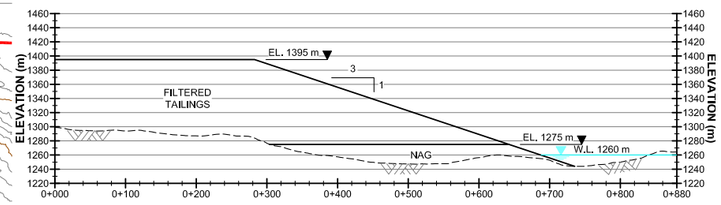
The PAG waste rock dump will have a maximum height of approximately 300 m. A NAG waste rock or overburden fill platform will be constructed at the base of the dump area to raise the topography and direct drainage in to multiple seepage collection ponds constructed around the toe of the facility. The fill platform will have an engineered soil liner constructed on top of compacted overburden from the open pit. Seepage passing through the soil liner and fill platform will be collected in one of the seepage collection ponds and pumped to the water management pond via a water treatment plant and pipeline.

Unrecoverable seepage by-passing the collection and recycle systems for the process water pond, filtered tailings waste pile and PAG/NAG3 submergence impoundment has the potential to affect two watersheds: Davidson Creek and Creek 705. Any unrecovered seepage will be acidic and has the potential to impact the groundwater system and the downstream drainage area.

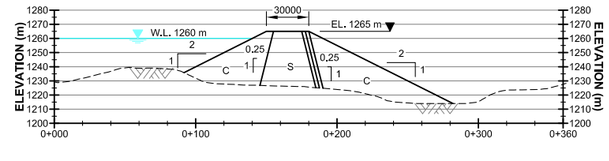
An assessment of the stability rating for the PAG waste rock dump was carried out using the waste dump and stockpile stability rating system as described in the interim guidelines provided by the B.C. Mine Waste Rock Pile Research Committee (BC MWRPRC 1991). The waste pile was classified as Class III, Moderate Hazard.




**PLAN**
**TAILINGS STORAGE FACILITY**
SCALE A




1 - FIG **SECTION**
**FILTERED TAILINGS STACK**
SCALE B




2 - FIG **SECTION**
**WATER MANAGEMENT POND**
SCALE C

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- FILTERED TAILINGS
- PAG WASTE ROCK
- NAG WASTE ROCK
- RECLAIM SYSTEM

**LEGEND:**

- MINE ACCESS ROAD
- MINE HAUL ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY
- TAILINGS PIPELINE
- TAILINGS DEPOSITION

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
4. PAG WASTE ROCK DUMP DESIGNED TO KEEP FOOTPRINT OUT OF UNGULATE WINTER RANGE.

SCALE C 40 20 0 40 80 120 160 200 m
SCALE B 80 40 0 100 200 300 400 m
SCALE A 400 200 0 400 800 1200 1600 2000 m

*Source: Knight Piesold Consulting (2015).*

# 3. ALTERNATIVES CHARACTERIZATION

This section characterizes the potential effects from the three selected candidates (from the pre-screening assessment) by evaluating their potential effects on selected Project's Valued Components (VCs), based on the Canadian Environment Assessment Agency's (2013) *Operational Policy Statement Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012.* Since the VCs evaluate the potential effects of the entire Project on environmental, social, economic, heritage, and health aspects, they are not all necessarily relevant to the evaluation of tailings and waste rock management alternatives. Table 3-1 provides a list of the Project's VCs and rationale for inclusion or exclusion for this assessment. Technical, physical stability, and Project economics characterization parameters were derived from a combination of the *Guidelines*, the EAO's March 19 letter, communications received from CEAA Agency on June 03, 2015, and professional judgement.

**Table 3-1. Consideration of Valued Components in the Assessment**

| Blackwater Gold Project Valued Component | Included in Assessment of Tailings and Waste Rock Management Alternatives | Rationale for Exclusion or Description of How Valued Component is Considered in the Analysis (*sub-account*: indicator(s)) |
|---|---|---|
| **Environment Valued Components** | | |
| Noise and vibration | Yes | *Climate and air quality*: noise and vibration |
| Climate change | Yes | *Climate and air quality*: sensitivity to climate change |
| Air quality | Yes | *Climate and air quality*: dust emissions |
| Surface water flow | Yes | *Surface water quantity*: loss of catchment area |
| Surface water quality | Yes | *Surface water quality*: storage of PAG material; seepage quantity; dam embankment area; operational discharge of treated water |
| Groundwater quantity | Yes | *Groundwater*: groundwater quantity (baseflow to downstream creeks) |
| Groundwater quality | Yes | *Groundwater*: groundwater quality |
| Wetlands | Yes | *Terrestrial ecosystems*: loss and risk to wetlands |
| Fish Habitat | Yes | *Fish, fish habitat and aquatic resources*: fish habitat |
| Fish | Yes | *Fish, fish habitat and aquatic resources*: risks to non-CRA fisheries and aquatic resources. Risks to CRA fish species, and presence of rare and endangered aquatic species were characterized but were not found to be differentiating among alternatives and were not carried forward into the MAL |
| Physiography and topography | Yes | Considered under technical account, *Containment design*: style of containment |
| Terrain and soil | Yes | *Terrain and soil*: high quality soil |
| Ecosystem composition | Yes | *Terrestrial ecosystems*: loss and risk to wetlands, as a proxy |
| Plant species and ecosystems at risk | Yes | *Terrestrial ecosystems*: loss and risk to wetlands, as a proxy |

*(continued)*

**Table 3-1. Consideration of Valued Components in the Assessment (continued)**

| Blackwater Gold Project Valued Component | Included in Assessment of Tailings and Waste Rock Management Alternatives | Rationale for Exclusion or Description of How Valued Component is Considered in the Analysis (*sub-account*: indicator(s)) |
|---|---|---|
| **Environment Valued Components** *(cont'd)* | | |
| Amphibians | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for species of conservation concern; toxicological risk to migratory birds, amphibians, and bats |
| Water birds | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for species of conservation concern; toxicological risk to migratory birds, amphibians, and bats |
| Forest and grassland birds | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for species of conservation concern; toxicological risk to migratory birds, amphibians, and bats; toxicological risk to terrestrial wildlife species |
| Moose | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for moose; toxicological risk to terrestrial wildlife species |
| Caribou | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for caribou; toxicological risk to terrestrial wildlife species |
| Grizzly bear | Yes | *Wildlife and wildlife habitat*: toxicological risk to terrestrial wildlife species |
| Furbearers | Yes | *Wildlife and wildlife habitat*: toxicological risk to terrestrial wildlife species |
| Bats | Yes | *Wildlife and wildlife habitat*: loss of high-quality habitat for species of conservation concern; toxicological risk to migratory birds, amphibians, and bats |
| Invertebrates | Yes | *Wildlife and wildlife habitat*: toxicological risk to terrestrial wildlife species |
| **Social Valued Components** | | |
| Demographics | No | Any potential changes to demographics resulting from the alternatives are unlikely to be differentiating among alternatives. |
| Regional and community infrastructure | No | Any potential changes to regional and community infrastructure resulting from the various options are unlikely to be differentiating among alternatives. |
| Regional and local services | No | Any potential changes to regional and local services resulting from the various options are unlikely to be differentiating among alternatives. |
| Family and community well-being | No | Any potential changes to family and community well-being resulting from alternatives are unlikely to be differentiating among alternatives. |

*(continued)*

**Table 3-1. Consideration of Valued Components in the Assessment (continued)**

| Blackwater Gold Project Valued Component | Included in Assessment of Tailings and Waste Rock Management Alternatives | Rationale for Exclusion or Description of How Valued Component is Considered in the Analysis (*sub-account*: indicator(s)) |
|---|---|---|
| **Social Valued Components** *(cont'd)* | | |
| Non-traditional land and resource use | Yes | *Non-traditional land use*: agricultural and range tenures; registered traplines<br>*Public recreation*: overlap of areas with recreational sensitivity and significance<br>Guide outfitting licenses were characterized but were not found to be differentiating among alternatives and were not carried forward into the MAL |
| Current land use for traditional purposes | Yes | *Current use of lands and resources for traditional purposes* (CULRTP):was characterized individually for the following Aboriginal groups or governmental organizations: LDFN, NWFN, NFN, Métis, SFN, STN, StFN, UFN, and TNG. Each of these groups or organizations were characterized for: availability (abundance and distribution) of resources harvested by Aboriginal people; access to Aboriginal hunting areas and cultural sites; quality of resources harvested by Aboriginal groups; and quality of Aboriginal harvesters' experience. |
| Visual resources | No | As the Project is relataively isolated (>15 km) from local communities, as well as Indian Reserves, provincial parks, protected areas, and recreational areas, visual resources are not anticipated to be different among alternatives. Further no alternatives are within established areas of visual quality objectives (VQOs) which are derived from the physical characteristics and the social concern for the area and identified under the *Forest Practices and Range Act* (2002a). |
| **Heritage Valued Components** | | |
| Archaeological sites | Yes | *Heritage*: known archaeological sites |
| Historic heritage sites | No | No known historic heritage sites have the potential to overlap with candidate alternatives |
| Paleontological resources | No | No known paleontological resources exist in the Project area |
| **Human Health Valued Components** | | |
| Environmental exposures | Yes | *Human health*: potential health risks |
| Workers health and safety | No | Project activities will adhere to all applicable laws and standards including the provincial *Mines Act* (1996c) and Health Safety and Reclamation Code (BC MEMPR 2008). No new or novel construction, operational or closures practices are proposed for any alternative; as such worker health and safety concerns are not expected to be differentiating among the alternatives |

*(continued)*

**Table 3-1. Consideration of Valued Components in the Assessment (completed)**

| Blackwater Gold Project Valued Component | Included in Assessment of Tailings and Waste Rock Management Alternatives | Rationale for Exclusion or Description of How Valued Component is Considered in the Analysis (*sub-account*: indicator(s)) |
|---|---|---|
| **Economic Valued Components** | | |
| Provincial economy | No | Alternatives are unlikely to differentially impact the overall provincial economy as a result of initial capital costs; sustaining capital and operating costs and closure costs. During operations, the Project would pay annual taxes of $2.3 million per year |
| Regional and local employment and businesses | Yes | *Employment*: employment opportunities |
| Regional and local government finance | No | Overall, Project construction and operations will have net positive effects on regional and local finances. During operations, the Project would pay annual taxes of $2.3 million per year to the BC Surveyor of Taxes, with these funds being used to support the activities of the three regional districts in the Project area, as well as other regional districts in BC. These taxes will largely be independent of the alternative selected for the Project and this valued component will not be discussed further in this report. |

No new baseline data were collected for the purpose of this assessment. Information to support the environmental characterization of each candidate was sourced from the studies listed below and from the experience and professional judgement of the scientists and engineers who completed the assessment:

- *Blackwater Gold Project, British Columbia – Application for an Environmental Assessment Certificate / Environmental Impact Statement* (New Gold 2015);
- *Blackwater Gold Project, British Columbia – Project Description* (New Gold 2012);
- *Blackwater Gold Project, British Columbia – 2011 - 2012 Vegetation Baseline Report* (AMEC 2013a);
- *Blackwater Gold Project, British Columbia – 2013 Vegetation Baseline Report* (AMEC 2013b);
- *Blackwater Gold Project, British Columbia – Reconnaissance Terrain and Terrain Stability Mapping, Rev. 0* (Knight Pièsold 2013b);
- *Blackwater Gold Project, British Columbia – Archaeology 2013 Baseline Report* (AMEC 2013c);
- *Blackwater Gold Project, British Columbia – Groundwater Quality 2012 – 2013 Baseline Report,* (AMEC 2013d);
- *Blackwater Gold Project, British Columbia – Social Baseline Report* (AMEC 2013e);
- *Blackwater Gold Project, British Columbia – Water and Sediment Quality Baseline Report* (AMEC 2013f);

- *Blackwater Gold Project, British Columbia – Economic Health 2011-2012 Baseline Report* (AMEC 2013g);
- *Blackwater Gold Project, British Columbia – Fish and Aquatic Resources 2011-2012 Baseline Report* (AMEC 2013h);
- *Blackwater Gold Project, British Columbia – Fish and Aquatic Resources 2013 Baseline Report* (AMEC 2013i);
- *Blackwater Gold Project, British Columbia – Non-traditional Land Use Baseline Report* (AMEC 2013j);
- *Blackwater Gold Project, British Columbia - Soils, Terrain, and Surficial Geology 2011-2012 Baseline Report* (AMEC 2013k);
- *Blackwater Gold Project, British Columbia – Wetlands 2011 - 2012 Baseline Report* (AMEC 2013l);
- *Blackwater Gold Project, British Columbia – Wildlife and Wildlife Habitat 2011 - 2012 Baseline Report* (AMEC 2013m);
- *Blackwater Gold Project, British Columbia – Baseline Report Geochemistry, version 2* (New Gold 2014);
- *Blackwater Gold Project, British Columbia – 2013 Hydrometeorology Report* (Knight Pièsold 2013a);
- *Blackwater Gold Project, British Columbia – Mine Waste and Water Management Design Report* (Knight Pièsold 2014);
- *New Gold Inc., Blackwater Gold Project – Alternative Technology Options Study* (Knight Pièsold 2015);
- *An Ethnohistory of Lhoosk'uz Dene Nation Traditional Territory* (Dewhirst 2013);
- *Ulkatcho First Nation Traditional Land Use and Ecological Knowledge of the Proposed New Gold Inc. Blackwater Project, Final Report (Public)* (DM Cultural Services Ltd. and Ulkatcho First Nation 2013);
- *Skin Tyee First Nation Traditional Land Use Study for New Gold Inc's Proposed Blackwater Project* (DM Cultural Services Ltd. 2015);
- *Stellat'en First Nation Socio-economic Study for the Proposed New Gold Inc. Blackwater Gold Project* (Firelight Group 2015);
- *Stellat'en First Nation Land and Resource Use Study Report* (Triton 2014); and
- *Saik'uz First Nation Traditional Land Use and Occupancy Study for the Blackwater Project* (Thomas 2015).

Each selected characterization criteria was characterized using either a quantitative metric (e.g., hectares or metres) or a qualtitative evaluation (e.g., low, moderate and high potential for dust generation; see Tables 3-2 to 3-6), with consideration of criteria that would be differentiating between the candidates. Several characterization criteria incorporate consideration of risk as it relates to potential effects from multiple factors (e.g., toxicological risk to wildlife and fish).

A summary of the characterization of each candiate is provided in Tables 3-2 through 3-6. Rationale for the alternative characterizations are provided in the following sections.

## 3.1 PHYSICAL STABILITY ACCOUNT

The *Guidelines* suggest that criteria related to physical stability or safety of impoundments be included within the Technical account. However, due to the high emphasis on physical safety of the impoundment in the EAO's March 19 letter, Physical Stability has been assigned its own account. The physical stability criteria used in assessing the technology alternatives are:

- Location of water storage;
- Tailings and waste rock interstitial water;
- The normal pond operating volume;
- Emergency water management (active)
- Emergency water management (passive);
- Design basis / regulatory requirements;
- Tailings density;
- Maximum dam height; and
- Operational monitoring requirements - safety.

### 3.1.1 Location of Water Storage

Candidates that store water away from the dam are preferable. For candidates where water storage is within the waste storage facility, the location of the pond during normal operations is important since operating a pond closer to the containment dam presents higher risk from overtopping /dam breach as well as increased seepage rates through the dam. Candidate 22 is preferable for this criterion because the pond is not located within the waste storage facility; instead, the water management pond is located downstream of the TSF. Candidate 7 and Candidate 10 are the least favourable candidates because the water pond is against the dam.

### 3.1.2 Tailings and Waste Rock Interstitial Water

Unsaturated conditions (i.e., lower interstitial water) in tailings and waste rock are preferable because in the event of a dam breach, higher water content can increase the material's flow potential. Candidate 22 is preferred as it has the lowest interstitial water because of the relatively unsaturated storage conditions. Candidate 1 is least favourable as it has the highest interstitial water content because the tailings and PAG waste rock will be stored in saturated conditions.

### 3.1.3 Normal Pond Operating Volume

Candidates holding lower volumes during normal operations are preferable because ponds with higher normal operating volumes have the potential to mobilize a larger volume of waste materials in the event of a dam breach. Candidate 22 is preferred because the normal operating pond volume is between 1 and 5 $Mm^3$. Candidate 1 has the largest operating pond volume of between 15 and 20 $Mm^3$ and is least favourable for this characterization criteria.

**Table 3-2. Physical Stability Characterization Criteria Summary**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| Location of water storage | Alternatives with water storage away from containment dams are preferred | The tailings pond is in the TSF but normal operation maintains TSF pond away from dam | The pond covers the waste rock storage facility and the water is against the dam | The pond is within the waste storage facility and the water is against the dam | The pond is not in the waste storage facility but a water management pond downstream of the TSF | Yes |
| Tailings and waste rock interstitial water | Alternatives which promote unsaturated conditions in tailings are preferred due to the effect of water content on potential flow in the event of a dam breach | The tailings and waste rock are fully saturated | The tailings are partially saturated and waste rock is fully saturated | The tailings and waste rock are fully saturated | The tailings are partially-saturated and waste rock is unsaturated | Yes |
| Normal operating pond volume | Alternatives with less water storage have less potential to mobilize a larger volume of waste materials and are preferred | Normal operating pond volume is between 11 $Mm^3$ and 20 $Mm^3$ | Normal operating pond volume is between 6 $Mm^3$ and 10 $Mm^3$ | Normal operating pond volume is between 6 $Mm^3$ and 10 $Mm^3$ | Normal operating pond volume is between 1 $Mm^3$ and 5 $Mm^3$ | Yes |
| Emergency water management - pumps (active) | Alternatives with higher capacity pumps to move water from the process water pond are preferred due to ability to move larger volumes of water in emergency conditions | Large reclaim pumps are able to move water quickly during an emergency: can reclaim 20 - 40 $Mm^3$ per year | Smaller reclaim pumps are not able to move water quickly during an emergency: capable of reclaiming between 5 - 10 $Mm^3$ per year | Reclaim pumps are capable of reclaiming between 10 - 20 $Mm^3$ per year | Smaller reclaim pumps are not able to move water quickly during an emergency: capable of reclaiming between 5 - 10 $Mm^3$ per year | Yes |
| Emergency water management - spillway (passive) | Alternatives that include spillways to manage emergency flood conditions are preferred because storage of excess water increases the potential consequences of failure | No spillway during operations; established after closure | No spillway during operations; established after closure | No spillway during operations; established after closure | Spillway established from water management pond during operations | Yes |
| Design basis / regulatory requirement | Alternatives that have additional design requirements and regulation with increased scrutiny are preferred | Developed and regulated TSF design requirements | Developed and regulated TSF design requirements for sub-aqueous PAG storage but undeveloped for filtered tailings | Developed and regulated TSF design requirements | Undeveloped requirements and regulation for filtered tailings. Developed requirements for on-land PAG storage. | Yes |
| Tailings density | Alternatives that increase density and reduce potential for mobilization of tailings are preferred | Thickened-slurry tailings discharged subaerially take a longer period to consolidate; lowest initial density, same final density as paste | Filtered tailings have lower moisture content and are more physically stable; they are actively compacted after placement; highest density | Paste tailings are discharged subaerially and take a longer period to consolidate; moderate initial density, same final density as thickened-slurry | Filtered tailings have lower moisture content and are more physically stable; they are actively compacted after placement; highest density | Yes |
| Maximum dam height | Dams with low maximum height have lower consequences in the event of a failure and are preferred | Dam height = 140 m | Dam height = 110 m | Dam height = 130 m | Dam height = 40 m | Yes |
| Operational monitoring requirements - safety | Alternatives that are less susceptible to sudden changes in conditions and require less monitoring effort are preferred | One facility of concern (TSF) with well-defined monitoring network and lower intensity monitoring | Two facilities of concern (TSF and PAG rock dam) with high intensity monitoring | One facility of concern (TSF) with easily defined monitoring network and higher intensity monitoring | Two facilities of concern (PAG dump and water management pond); pond is a small structure with less concern but high intensity monitoring required | Yes |

**Table 3-3. Technical Characterization Criteria Summary**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Containment Design*** | | | | | | |
| Style of containment | Alternatives that make use of natural topography are preferred | The design makes use of natural ground on two sides of the facility as a level valley-fill deposit | The design makes use of natural ground on two sides of the facility but is a heaped valley-fill deposit | The design makes use of natural ground on two sides of the facility as a level valley-fill deposit | The design makes use of natural ground on two sides of the facility but is a heaped valley-fill deposit. The PAG rock storage has natural ground on only one side (side hill fill) | Yes |
| Number of dams | Alternatives with fewer dams have less scheduling risk and less long term maintenance requirements and are preferred | Has four dams to contain tailings | Has one dam to contain PAG waste rock | Has three dams to contain tailings | Has no waste-retaining dams but a single-stage water dam | Yes |
| Construction volumes | Alternatives requiring less dam construction material are preferred | Dam will require from 60 - 80 $Mm^3$of construction material | Dam will require from 20 – 40 $Mm^3$ of construction material | Dam will require from 60 - 80 $Mm^3$ of construction material | Dam will require from 1 – 20 $Mm^3$ of construction material | Yes |
| Tailings initial settled density | Alternatives with higher initial tailings density will require reduced storage volume requirements and are preferred | Tailings are thickened but have lower initial settled density (1.2 - 1.6 $t/m^3$) compared to filtered tailings | Tailings are filtered and have higher initial settled density (1.6 - 1.8 $m^3/t$) | Tailings are thickened but have lower initial settled density (1.2 - 1.6 $t/m^3$) compared to filtered tailings | Tailings are filtered and have higher initial settled density (1.6 - 1.8 $m^3/t$) | Yes |
| Drainage provisions | Alternatives with more complex drainage provisions are less preferred | Drainage provisions are simple with easily installed embankment drains | Drainage provisions are complex for foundation drains beneath the TSF; simple, easily installed embankment drains | More complex embankment drains are required no underdrains are required | Drainage provisions are complex for foundation drains beneath the TSF and PAG waste rock facilities | Yes |
| Seepage management - physical | Alternatives with less foundation preparation and simpler seepage collection facilities are preferred | Seepage management includes cut-off trenches with single seepage collection point downgradient of dams | Seepage management includes cut-off trenches with multiple seepage collection points | Seepage management includes cut-off trenches with multiple seepage collection points | Seepage management includes cut-off trenches with multiple seepage collection points; liner and closure cover for PAG rock facility | Yes |
| Seepage management - quality | Alternatives that prevent degradation of water quality are preferred | PAG waste rock and tailings are submerged and saturated preventing water quality degradation | PAG waste rock is submerged and saturated but management of PAG tailings runoff and seepage required to prevent water quality degradation | PAG waste rock is submerged and tailings are saturated, reducing water quality degradation | Management of PAG waste rock and tailings runoff and seepage required to prevent water quality degradation | Yes |
| ***Construction Requirements*** | | | | | | |
| Foundation preparation for tailings storage area (excludes dam) | Alternatives with smaller footprint area and/or less involved requirements for surface preparation are preferred | Larger footprint but less involved foundation preparation (clearing, grubbing and stripping of TSF footprint) | More involved foundation preparation requirements (clearing, grubbing and stripping, foundation preparation and drainage installation for TSF footprint) | Larger footprint but less involved foundation preparation (clearing, grubbing and stripping of TSF footprint) | Smaller footprint but more involved foundation preparation requirements (clearing, grubbing and stripping, foundation preparation and drainage installation for TSF) | Yes |
| Tailings infrastructure | Alternatives with fewer facilities that need to be constructed and commissioned for tailings distribution are preferred | Infrastructure required for slurry production and thickening | Infrastructure required for slurry production, thickening, filtration and a load-out facility | Infrastructure required for slurry production and increased thickening | Infrastructure required for slurry production, thickening, filtration and a load-out facility | Yes |
| Foundation preparation for PAG waste rock facility | Alternatives without PAG waste rock stored on land that require additional surface preparation and/or infiltration prevention measures and are preferred | PAG waste rock co-disposed with tailings; foundation preparation requires clearing, grubbing and stripping | Underwater storage of PAG; foundation preparation for PAG waste rock facility same as TSF and requires clearing, grubbing and stripping | PAG waste rock co-disposed with tailings; foundation preparation requires clearing, grubbing and stripping | Foundation preparation for PAG waste rock facility requires clearing, grubbing, stripping, foundation preparation, liner and runoff and seepage collection installation | Yes |
| Initial dam construction | Alternatives with less complex initial dam construction are preferred | More complex initial dam construction: multiple stage with moderate construction volumes | Complex initial dam construction: multiple stage with large construction volumes | Complex initial dam construction: multiple stage with large construction volumes | Less complex initial dam construction: single stage water dam with low construction volumes | Yes |

*(continued)*

**Table 3-3. Technical Characterization Criteria Summary (continued)**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Construction Requirements*** *(cont'd)* | | | | | | |
| Sustaining construction (excludes waste delivery) | Alternatives with less complex sustaining construction requirements are preferred | Dam raise required every (1) year | Dam raise required every five (5) years | Dam raise required every two (2) years | No sustaining dam construction; completed during initial construction | Yes |
| ***Water Management*** | | | | | | |
| Catchment area | Alternatives with smaller catchment areas would develop smaller flood volumes and are preferred | Catchment area upstream of the mine facilities approximately 45 $km^2$ | Catchment area upstream of the mine facilities approximately 30 $km^2$ | Catchment area upstream of the mine facilities approximately 45 $km^2$ | Catchment area upstream of the mine facilities approximately 23 $km^2$ | Yes |
| Flood routing | Alternatives with flood routing that would limit impacts of erosion and sedimentation are preferred | Flood is routed for storage in the pond; there is no downstream discharge for the inflow design flood (IDF) | Flood is routed into active (TSF) construction area; no downstream discharge for inflow design flood (IDF) | Flood is routed for storage in the pond; there is no downstream discharge for the inflow design flood (IDF) | Flood is routed into active (TSF) construction area; discharge would be directed downstream through spillway | Yes |
| Water balance - surplus/deficit/ balance | Alternatives which can maintain a balanced condition throughout operations and closure are preferred | Water balance has slight surplus late in mine life that can be managed by additional freshwater diversions | Water balance has surplus (3 $Mm^3$ to 6 $Mm^3$ /a) managed through diversions and treated discharge during operation | Water balance has surplus (2 – 6 $Mm^3$/a) managed through diversions initially and treated discharge later on during operation | Water balance has e surplus (3 $Mm^3$ to 6 $Mm^3$ /a) managed through diversions and treated discharge during operation | Yes |
| Water recycle requirement | Alternatives that require less water recycle are preferred | Relatively large volume of annual water recycle required (10 - 20 $Mm^3$ /year) | Small volume of annual water recycle required (< 5 $Mm^3$) | Moderate volume of annual water recycle required (5 - 10 $Mm^3$) | Small volume of annual water recycle required (< 5 $Mm^3$) | Yes |
| Water treatment | Alternatives that require capture and treatment of surface water are less preferred | Capture and treatment for a single small area required. No discharge of treated mine water required during operations. | Capture and treatment for multiple areas required. Discharge of mine water during operations. | Capture and treatment for a single small area requiredDischarge of treated mine water required during operations. | Capture and treatment for multiple areas required. Operational discharge of mine water | Yes |
| Surplus water management | Alternatives that deal with surplus conditions with simpler water management are preferred | Surplus water can be managed via diversion ditches and / or pipeline conveyance | Surplus water would need to be collected, treated and discharged (1 - 5 $Mm^3$ / year) | Surplus water would need to be collected, treated and discharged (< 1 $Mm^3$ / year) | Surplus water would need to be collected, treated and discharged (1 - 5 $Mm^3$ / year) | Yes |
| Operational monitoring requirements - internal site water management | Alternatives that are less susceptible to sudden changes in conditions and require greater monitoring effort are preferred | Less susceptible to sudden changes in condition requiring standard water quality monitoring to confirm expectations | Potentially more susceptible to sudden changes in conditions; the positioning of mine facilities also complicates monitoring requirements | Potentially more susceptible to sudden changes in conditions; the positioning of mine facilities also complicates monitoring requirements | Extensive internal site water quality monitoring in multiple locations, with expected variances requiring response and correction | Yes |
| ***Execution*** | | | | | | |
| Technology precedent - processing | Alternatives utilizing tailings production technology proven at project throughput rates are preferred | Thickened slurry tailings production technology is proven at the Project throughput | Filtered tailings production technology is not proven at the Project throughput | Paste tailings production technology is not proven at the Project throughput | Filtered tailings production technology is not proven at the Project throughput | Yes |
| Technology precedent - storage | Alternatives utilizing tailings production technology at project throughput rates shown to be effective in similar site conditions are preferred | The storage technology (valley fill with staged, centre-line dam construction) is proven at the Project throughput | The most reasonable example of a mining project utilizing filtered tailings in climate conditions similar to the Project is Greens Creek located 30 km southwest of Juneau, Alaska. The throughput at Greens Creek is 1,500 TPD; however, only approximately 50% of the tailings is filtered and the remainder is used as paste backfill for underground workings; thus, the storage technology is not proven at the Project throughput; proven at less than 6000 t/day in climatic conditions similar to the Project | Candidate contemplates an alternative tailings dewatering strategy where tailings will be dewatered further (instead of being re-pulped) and discharged as a non-segregating paste in the TSF. A paste surface disposal facility at this throughput is not beyond Canadian precedent, although it is not common in BC or Canada. | The most reasonable example of a mining project utilizing filtered tailings in climate conditions similar to the Project is Greens Creek located 30 km southwest of Juneau, Alaska. The throughput at Greens Creek is 1,500 TPD; however, only approximately 50% of the tailings is filtered and the remainder is used as paste backfill for underground workings; thus, the storage technology is not proven at the Project throughput; proven at less than 6000 t/day in climatic conditions similar to the Project | Yes |

*(continued)*

**Table 3-3. Technical Characterization Criteria Summary (completed)**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Execution*** *(cont'd)* | | | | | | |
| Tailings delivery complexity | Alternatives that have less complex tailings delivery systems are preferred | Simple tailings delivery using gravity-fed pipeline | Requires complex system of conveyor / stacker (likely more than one) or truck haul delivery | Requires pumps to deliver tailings to TSF | Requires complex system of conveyor / stacker (likely more than one) or truck haul delivery | Yes |
| Tailings placement complexity | Alternatives with smaller active fill surfaces are preferred due to impact of mechanical spreading and or compaction, precipitation, snow and ice removal | Simple placement over smaller area, not affected, or to a small degree by weather conditions | Most complex tailings placement requiring spreading, compaction and management of precipitation (snow removal) | More complex placement with pumping from central dike, affected to a small degree by weather conditions | Most complex tailings placement requiring spreading, compaction and management of precipitation (snow removal) | Yes |
| PAG waste rock delivery and placement | Alternatives with less complex PAG waste rock delivery and placement are preferred due to lower placement costs | Complex as PAG waste rock has long haul and placed in thin lifts concurrent with other tailings placement | Less complex as PAG waste rock can be placed in thick lifts despite the long haul distance | Most complex as PAG waste rock has long haul and there is increased co-disposal difficulty associated with concurrent placement with paste tailings | Least complex as PAG waste rock can be placed in thick lifts and has short haul distance | Yes |
| Operational flexibility | Alternatives with secondary discharge areas and/or ease of adjustment to placement method are preferred | Most flexible because there are secondary discharge points within the primary facility that minimize production delays to less than a day | Less flexible despite provision of an upset facility for out of specification tailings, production delays up to a month are possible | Flexible as there are secondary discharge points within the TSF that would minimize production delays to less than a week | Least flexible despite provision of an upset facility for out of specification tailings, production delays more than a month are possible | Yes |
| ***Closure*** | | | | | | |
| Closure concept - physical | Alternatives with less water contained and/or water positioned away from dams within the facility at closure are preferred | The pond is within the waste storage facility but there is less water contained and water stored away from the dam at closure | The pond covers waste rock in the PAG disposal area and water is against the dam | Water produced from the paste tailings accumulates against the dam | The pond is not in the waste storage facility | Yes |
| Closure concept - geochemical | Alternatives that passively manage geochemical concerns in closure are preferred | Preferred because all PAG materials are submerged and saturated | PAG waste rock is submerged however surface management of PAG tailings will be required | PAG materials saturated. . Some surface management of PAG tailings may be required | Least preferred because of active management of all PAG materials required. | Yes |
| Closure concept - active closure period | Alternatives that require a shorter term active closure period are preferred | Shorter active closure period with pumping the tailings pond supernatant to the pit for about 18 years | Longer active closure period because pumping the tailings pond supernatant to the pit for about 29 years | Shorter active closure period because pumping the tailings pond supernatant to the pit for about 19 years | Longer active closure period with pumping seepage collection ponds to the pit lake for approximately 30 years | Yes |
| Closure concept - long-term maintenance and monitoring | Alternatives that require lower long-term maintenance and monitoring are preferred | Less long-term maintenance and monitoring because there are no facilities **o**f concern and normal confirmatory closure monitoring and maintenance expected | More long-term maintenance and monitoring as there is one facility of concern requiring site wide water quality monitoring with variances potentially requiring correction | More long-term maintenance and monitoring as there is one facility of concern requiring site wide water quality monitoring with variances potentially requiring correction | Most long-term maintenance and monitoring as there are two facilities of concern, requiring extensive internal site wide water quality monitoring, expected variances requiring correction. Potential for long-term water treatment. | Yes |
| Concurrent closure and reclamation | Alternatives where project facilities can be incrementally reclaimed during operations are preferred | Some areas can be concurrently reclaimed: TSF embankments and upstream part of TSF | Limited areas can be concurrently reclaimed: PAG rock dam embankments and lower slopes of TSF | Some areas can be progressively reclaimed; e.g., TSF embankments | Limited area progressively reclaimed: lower slopes of PAG rock dump and TSF | Yes |
| Premature closure | Alternatives that are more amenable to premature closure are preferred | Requires smallest amount of earthworks for implementation of closure plan - smaller surface area on TSF because of supernatant pond(s) | Requires minimal earthworks for implementation of closure plan because of large surface area on TSF | Requires some earthworks to fill in low spots to facilitate water management and reclamation – of large surface area on TSF | Requires substantial earthworks for implementation of closure plan: largest surface area - TSF and PAG rock dump | Yes |

**Table 3-4. Environmental Characterization Criteria Summary**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Climate and Air Quality*** | | | | | | |
| Noise and vibration | Alternatives with lower potential for noise and vibration are preferred due to fewer disturbances to wildlife and harvesting experience. | Open pit operations and co-disposal of waste rock provide a source of noise and vibration. Considered to have lower potential for noise and vibration than filtered tailings as tailings are pumped and not trucked | Open pit operations and disposal of waste rock in submerged storage area provide a source of noise and vibration. Considered to have moderate potential for noise and vibration since filtered tailings are trucked, spread and compacted | Open pit operations and co-disposal of waste rock provide a source of noise and vibration. Considered to have lower potential for noise and vibration than filtered tailings as tailings are pumped and not trucked | Open pit operations and additional disposal of PAG waste rock on land provide a source of noise and vibration. Considered to have high potential for noise and vibration since filtered tailings are trucked, spread and compacted. Large PAG waste rock facility | Yes |
| Sensitivity to climate change | Alternatives with lower risk of loss of water cover and initiation of ML/ARD from exposed tailings and PAG waste rock are preferred. Alternatives that retain the inflow design flood (IDF) during operations and the Probable Maximum Flood passes through the spillway during closure are preferred | Low sensitivity to climate change. Low risk for loss of water cover on the tailings/PAG waste rock during drought conditions. Retains the IDF during operation and passes the probable maximum flood (PMF) on closure. | Low to moderate sensitivity to climate change. Low potential for the water cover to be lost over the PAG waste rock during drought conditions. Moderate risk for loss of vegetative cover and tailings erosion during drought conditions. Retains the IDF during operation and passes the probable maximum flood (PMF) on closure. | Low to moderate sensitivity to climate change. Moderate risk for loss of vegetative cover and tailings erosion during drought conditions. Retains the IDF during operation and assess the probable maximum flood (PMF) on closure. | Moderate to high sensitivity to climate change. Moderate risk for loss of vegetative cover on PAG waste rock dump and TSF during drought conditions. Retains the 1:200 year return period (Inflow Design Flood) during operation and passes the 1/3 between the 1 in 1,000 year return period and probable maximum flood (PMF) during operation and closure.. | Yes |
| Dust emissions | Alternatives that have low potential for dust are preferred due to lower associated risks to human health, vegetation and wildlife habitat | Low potential for dust generation as tailings remain saturated | Moderate potential for dust from filtered tailings | Low to moderate potential for dust generation | Moderate to high potential for dust from filtered tailings and PAG waste rock stored on land | Yes |
| ***Surface Water Flow*** | | | | | | |
| Loss of catchment area | Alternatives with the smallest catchment and least potential to reduce flows are preferred | 45 $km^2$ diverted catchment area | 30 $km^2$ diverted catchment area | 45 $km^2$ diverted catchment area | 23 $km^2$ diverted catchment area | Yes |
| Make-up water requirement | Alternatives that require less make-up water from Tatelkuz Lake for processing are preferred | Initially requires more water for start-up pond but similar annual make-up water requirement from Tatelkuz Lake as other options (~ 1 $Mm^3$) | Annual make-up requirement from Tatelkuz Lake of approximately 1 $Mm^3$ | Annual make-up requirement from Tatelkuz Lake of approximately 1 $Mm^3$ | Annual make-up requirement from Tatelkuz Lake of approximately 1 $Mm^3$ | No - not significantly differentiating |
| ***Surface Water Quality*** | | | | | | |
| Storage of PAG material | Alternatives that store PAG waste rock and tailings sub-aqueously are preferred as there is lower risk of ML/ARD | Stores PAG waste rock and tailings sub-aqueously; low risk of ML/ARD | Stores PAG waste rock but not tailings sub-aqueously ; potential risk of ML/ARD. | Store PAG waste rock and tailings sub-aqueously low risk of ML/ARD | PAG waste rock and tailings not stored sub-aqueously; ML/ARD expected | Yes |
| Seepage quantity | Alternatives with smaller ponds situated away from dams are preferred | Has large pond but water is separated from main dam by large tailings beach | Has large pond with water against dam | Has large pond with water against dam | Has small pond with water against dam | Yes |
| Dam embankment area | Alternatives with smaller dam embankment areas are preferred as they will have less infiltration and runoff that may affect surface water quality (although can be collected) | Dam embankment area = 132 ha | Dam embankment area = 69 ha | Dam embankment area = 92 ha | Dam embankment area= 7 ha | Yes |

*(continued)*

**Table 3-4. Environmental Characterization Criteria Summary (continued)**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Surface Water Quality*** *(cont'd)* | | | | | | |
| Operational discharge of treated water | Alternatives that do not require discharge of treated water during operations are preferred | Does not require operational discharge of treated water | Discharge required and treatment of the discharge may need to be intensive to meet receiving water quality objectives given limited dilution. | Discharge required and operational discharge of treated water | Discharge required and intensive treatment requiring more than one plant for different strength effluents may be needed to meet receiving water quality objectives given limited dilution. | Yes |
| ***Groundwater*** | | | | | | |
| Groundwater quality | Alternatives with less risk to groundwater quality are preferred | PAG rock and tailings stored under water, reducing ML/ARD potential in seepage | PAG rock is stored underwater reducing ML/ARD potential in seepage; however, filtered tailing stored on land has moderate ML/ARD risk and potential to affect water quality in pond, resulting in moderate risk to groundwater quality. | PAG rock is deposited with tailings and remains saturated reducing ML/ARD potential. Low ML/ARD risk and potential to affect water quality in pond, resulting in low risk to groundwater quality. | PAG rock and filtered tailings stored on land have greatest potential for ML/ARD resulting in poor quality seepage resulting in high risk to groundwater quality. | Yes |
| Groundwater quantity | Alternatives that do not reduce groundwater flow to downstream creeks are preferred. | Large pond potentially increases flow through and beneath dam; however, large dam with engineered groundwater cut-off reduces groundwater contribution to creek flow. | Large pond and close to dam potentially increases flow through and beneath dam; however, large dam with engineered groundwater cut-off reduces groundwater contribution to creek flow. | Pond close to dam potentially increases flow through and beneath dam; however, large dam with engineered groundwater cut-off reduces groundwater contribution to creek flow. | Significantly smaller pond and dam unlikely to affect groundwater contribution to creek flow. | Yes |
| ***Terrestrial Ecosystems*** | | | | | | |
| Loss and risk to wetlands | Alternatives that directly impact less wetland surface area or have fewer risks to wetlands are preferred as they have a lower probability of affecting habitat and ecological function. | Loss of wetlands: 210 ha. Risk to wetlands considered minimal because of under water storage of all PAG materials and better water quality | Loss of wetlands: 207 ha<br>Risk of alteration to wetlands considered low because of under water storage of PAG rock | Loss of wetlands 210 ha. Low risk of alteration to downstream wetlands because of co-disposal of tailings and waste rock | Loss of wetlands: 137 ha. Moderate risk of alteration to downstream wetlands because of storage of PAG material on land | Yes |
| ***Fish, Fish Habitat and Aquatic Resources*** | | | | | | |
| Risks to non-CRA fisheries and aquatic resources | Alternatives that present less risk to aquatic resources from changes in water quantity and quality are preferred | Minimal changes in downstream water quality above background conditions predicted in modeling studies. Water quantity to be augmented with lake water during operations | Potentially minor changes in downstream water quality due to uncaptured, poor quality seepage (originating from filtered tailings) from pond. Water quantity to be augmented with lake water during operations | Minimal to potentially minor changes in downstream water quality due to uncaptured, poor quality seepage (originating from paste tailings) from pond. Water quantity to be augmented with lake water during operations | Potentially moderate changes in downstream water quality due to uncaptured, poor quality seepage from PAG waste rock and from filtered tailings. Water quantity to be augmented with lake water during operations | Yes |
| Risks to CRA fish species | Alternatives that present reduced risk to fish that are a part of, or contribute to, a commercial, recreational or Aboriginal fishery due to changes in water quantity and quality are preferred | Supplementing in-stream flow needs with releases from the Freshwater Reservoir will mitigate risks. Changes in water quality not anticipated to effect CRA fishery. | Supplementing in-stream flow needs with releases from the Freshwater Reservoir will mitigate risks. Changes in water quality not anticipated to effect CRA fishery. | Supplementing in-stream flow needs with releases from the Freshwater Reservoir will mitigate risks. Changes in water quality not anticipated to effect CRA fishery. | Supplementing in-stream flow needs with releases from the Freshwater Reservoir will mitigate risks Changes in water quality not anticipated to effect CRA fishery. | No - not significantly differentiating |
| Fish species | Alternatives that do not affect fish within the Project footprint that are a part of, or contribute to, a commercial, recreational or Aboriginal fishery are preferred | Rainbow Trout present as CRA species | Rainbow Trout present as CRA species | Rainbow Trout present as CRA species | Rainbow Trout present as CRA species | No - not significantly differentiating |

*(continued)*

**Table 3-4. Environmental Characterization Criteria Summary (completed)**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Surface Water Quality*** *(cont'd)* | | | | | | |
| Fish habitat | Alternatives with less potential for 'serious harm' and/or less area of permanently altered or destroyed habitat (PAD) for CRA fish species within the Project footprint are preferred | Loss of 14.2 km of known Rainbow Trout habitat and 12.4 km of unconfirmed Rainbow Trout habitat | Loss of 13.8 km of known Rainbow Trout habitat and 12.5 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Loss of 12.9 km of known Rainbow Trout habitat and 11.1 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Loss of 7.5 km of known Rainbow Trout habitat and 8.4 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Yes |
| Presence of rare and endangered aquatic species | Alternatives that impact rare or endangered species (as considered by the British Columbia Conservation Data Centre, the *Species at Risk Act*, and the Committee on the Status of Endangered Wildlife in Canada) are detrimental to biodiversity and may have broader ecosystem impacts. | No rare or endangered aquatic species were identified within or in close proximity. Freshwater mollusc found in Lake 01682LNRS unlikely to be impacted because of distance from TSF. | Freshwater mollusc (BC blue-listed Acroloxus coloradensis) identified in Lake 01682LNRS more likely to be impacted because of proximity of TSF. | No rare or endangered aquatic species were identified within or in close proximity. Freshwater mollusc found in Lake 01682LNRS unlikely to be impacted because of distance from TSF. | Freshwater mollusc (BC blue-listed Acroloxus coloradensis) identified in Lake 01682LNRS more likely to be impacted because of proximity of TSF. | No - not significantly differentiating |
| ***Terrain and Soil*** | | | | | | |
| Total footprint area (including TSF and MRSF) | Alternatives with smaller footprints are preferred as they have lower potential effects to terrestrial and aquatic environments. | 1,515 ha | 1,505 ha | 1,310 ha | 1,038 ha | No. The effects on this indicator are better considered under more specific habitat loss indicators |
| Soils | Alternatives that affect smaller areas of high productivity soils are preferred | 48 ha of high productivity soil (3% of total footprint) | 60 ha of high productivity soil (4% of total footprint) | 35 ha of high productivity soil (3% of total footprint) | 73 ha of high productivity soil (7% of total footprint) | Yes |
| ***Wildlife and Wildlife Habitat*** | | | | | | |
| Loss of high-quality habitat for species of conservation concern | Alternatives that have less potential impact for high quality habitat (terrestrial birds, myotis bat and western toad) are preferred | Loss of high-quality habitat = 1,279 ha (terrestrial birds = 74 ha; myotis bat = 785 ha and western toad = 420 ha) | Loss of high-quality habitat = 1,301 ha (terrestrial birds = 73 ha; myotis bat = 827 ha and western toad = 401 ha) | Loss of high-quality habitat = 1,124 ha terrestrial birds = 73 ha; myotis bat = 648 ha and western toad = 403 ha | Loss of high-quality habitat = 678 ha (terrestrial birds = 17 ha; myotis bat = 583 ha and western toad = 79 ha) | Yes |
| Loss of high-quality habitat for caribou | Alternatives that have less impact on high quality caribou habitat are preferred | Loss of high-quality caribou habitat = 402 ha | Loss of high-quality caribou habitat = 416 ha | Loss of high-quality caribou habitat = 317 ha | Loss of high-quality caribou habitat = 212 ha | Yes |
| Loss of high-quality habitat for moose | Alternatives that have less impact on high quality moose habitat are preferred | Loss of high-quality moose habitat = 272 ha | Loss of high-quality moose habitat = 257 ha | Loss of high-quality moose habitat = 259 ha | Loss of high-quality moose habitat = 95 ha | Yes |
| toxicological risk to migratory birds, amphibians and bats | Alternatives that present less toxicological risk to migratory birds, amphibians and bats are preferred | Minimal to low toxicological risk. Better water quality because PAG rock co-disposed subaqueously with tailings. Size of pond could temporarily attract migratory waterbirds but unlikely during operations. | Low to moderate potential for toxicological risk. Large size of pond could attract waterbirds, amphibians and bats. Better water quality because of sub-aqueous PAG rock storage but partially-saturated filtered tailings could affect water quality. Seepage from TSF may affect migratory birds, amphibians and bats if metals accumulate in wetland vegetation. | Low potential for toxicological risk. Pond unlikely attract waterbirds, amphibians and bats. Better quality water because of lower ML/ARD potential. May affect migratory birds, amphibians and bats if metals accumulate in wetland vegetation. | Moderate potential for toxicological risk. On land PAG and tailings disposal may affect water quality of downstream waterways used by waterfowl, amphibians and bats. Seepage from TSF may affect migratory birds, amphibians and bats if metals accumulate in wetland vegetation. Seepage collection pond from PAG rock expected to have ML/ARD affected water. | Yes |
| toxicological risk to terrestrial wildlife species | Alternatives that present less toxicological risk to wildlife species are preferred | Minimal toxicological risk associated with dusting from TSF beaches and from pond water quality and associated seepage to downstream wetlands / creeks | Low to moderate toxicological risk associated with dusting from filtered tailings stack and from pond water quality | Low toxicological risk associated with dusting from paste tailings and from pond water quality | Moderate toxicological risk associated with dusting from filtered tailings stack, PAG rock dump and poor water quality in seepage collection pond downstream of PAG rock dump | Yes |

**Table 3-5. Human Environment Criteria Summary**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation (LDN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Alternative has potential to affect access to LDN harvest areas (trapline). | Alternative has potential to affect access to LDN harvest areas (trapline). | Alternative has potential to affect access to LDN harvest areas (trapline). | Alternative has potential to affect access to LDN harvest areas (trapline). | No - not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Alternative overlaps with habitat of species harvested by LDN. Moose habitat total area = 272 ha. Caribou habitat total area = 402 ha. Loss of 14.2 km of known Rainbow Trout habitat and 12.4 km of unconfirmed Rainbow Trout habitat. | Alternative overlaps with habitat of species harvested by LDN. Moose habitat total area = 257 ha. Caribou habitat total area = 416 ha. Loss of 13.8 km of known Rainbow Trout habitat and 12.5 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by LDN. Moose habitat total area = 259 ha. Caribou habitat total area = 317 ha. Loss of 12.9 km of known Rainbow Trout habitat and 11.1 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by LDN. Moose habitat total area = 95 ha. Caribou habitat total area = 212 ha. Loss of 7.5 km of known Rainbow Trout habitat and 8.4 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Yes |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Alternative has minimal toxicological risk associated with dusting from TSF beaches and from pond water quality and associated seepage to downstream wetlands / creeks that may affect the quality of resources harvested by LDN. | Alternative has low to moderate toxicological risk associated with dusting from filtered tailings stack and from PAG pond water quality that has potential to affect the quality of resources harvested by LDN. | Alternative has low toxicological risk associated with dusting from filtered tailings stack and from pond water quality that has potential to affect the quality of resources harvested by LDN. | Alternative has moderate toxicological risk associated with dusting from filtered tailings stack, PAG rock dump and poor water quality in seepage collection pond downstream of PAG rock dump that has potential to affect the quality of resources harvested by LDN. | Yes |
| Quality of Aboriginal harvesters' experience (based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Alternative has the potential to affect the quality of experience of LDN harvesters due to low noise generation from equipment and operations | Alternative has the potential to affect the quality of experience of LDN harvesters due moderate levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of LDN harvesters due to low levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of LDN harvesters, moderate levels of noise from equipment, truck and operations | Yes |
| ***Current Use of Lands and Resources for Traditional Purposes - Nadleh Whut'en First Nation (NWFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | Based on consultations to date, no current use by NWFN in area of alternative. | No, not differentiating |

*(continued)*

**Table 3-5. Human Environment Criteria Summary (continued)**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Nazko First Nation (NFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | Based on consultations to date, no current use by NFN in area of alternative. | No, not differentiating |
| ***Current Use of Lands and Resources for Traditional Purposes – Métis*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | Based on consultations to date, no current use by Métis in area of alternative. | No, not differentiating |
| ***Current Use of Lands and Resources for Traditional Purposes - Saik'uz First Nation (SFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | No – not differentiating |

*(continued)*

**Table 3-5. Human Environment Criteria Summary (continued)**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Saik'uz First Nation (SFN)*** *(cont'd)* | | | | | | |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect Tatelkuz Lake. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect quality of resources harvested in Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect quality of resources harvested in Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect quality of resources harvested in Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake. Downstream effects not anticipated to affect quality of resources harvested in Tatelkuz Lake. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake, however TSF options will not impact visual or noise quality at Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake, however TSF options will not impact visual or noise quality at Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake, however TSF options will not impact visual or noise quality at Tatelkuz Lake. | Based on the SFN June 2015 traditional land use and occupancy study (TLOUS), there are harvest sites around Tatelkuz Lake, however TSF options will not impact visual or noise quality at Tatelkuz Lake. | No, not differentiating |
| ***Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation (STN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on the September STN TLUS (2015), the alternative has the potential to affect access to STN harvest areas (hunting) and cultural sites. Exact locations of the hunting area have not been provided. | Based on the September STN TLUS (2015), the alternative has the potential to affect access to STN harvest areas (hunting) and cultural sites. Exact locations of the hunting area have not been provided.. | Based on the September STN TLUS (2015), the alternative has the potential to affect access to STN harvest areas (hunting) and cultural sites. Exact locations of the hunting area have not been provided. | Based on the September STN TLUS (2015), the alternative has the potential to affect access to STN harvest areas (hunting) and cultural sites. Exact locations of the hunting area have not been provided. | No - not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Alternative overlaps with habitat of species harvested by STN. Moose habitat total area = 272 ha. Caribou habitat total area = 402 ha. Loss of 14.2 km of known Rainbow Trout habitat and 12.4 km of unconfirmed Rainbow Trout habitat. | Alternative overlaps with habitat of species harvested by STN. Moose habitat total area = 257 ha. Caribou habitat total area = 416 ha. Loss of 13.8 km of known Rainbow Trout habitat and 12.5 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by STN. Moose habitat total area = 259 ha. Caribou habitat total area = 317 ha. Loss of 12.9 km of known Rainbow Trout habitat and 11.1 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by STN. Moose habitat total area = 95 ha. Caribou habitat total area = 212 ha. Loss of 7.5 km of known Rainbow Trout habitat and 8.4 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Yes |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Alternative has minimal toxicological risk associated with dusting from TSF beaches and from pond water quality and associated seepage to downstream wetlands / creeks that may affect the quality of resources harvested by STN. | Alternative has low to moderate toxicological risk associated with dusting from filtered tailings stack and from PAG pond water quality that has potential to affect the quality of resources harvested by STN. | Alternative has low toxicological risk associated with dusting from filtered tailings stack and from pond water quality that has potential to affect the quality of resources harvested by STN. | Alternative has moderate toxicological risk associated with dusting from filtered tailings stack, PAG rock dump and poor water quality in seepage collection pond downstream of PAG rock dump that has potential to affect the quality of resources harvested by STN. | Yes |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Alternative has the potential to affect the quality of experience of STN harvesters due to potential low levels of noise generation from equipment and operations | Alternative has the potential to affect the quality of experience of STN harvesters due to moderate levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of STN harvesters due to moderate potential for low levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of STN harvesters due to high potential for moderate levels of noise from equipment, truck and operations | Yes |

*(continued)*

**Table 3-5. Human Environment Criteria Summary (continued)**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Stellat'en First Nation (StFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | Based on consultations to date, no current use by StFN in area of alternative. | No, not differentiating |
| ***Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation (UFN)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Alternative has potential to affect access to UFN harvest areas. Alternative may affect UFN access to a campsite (UFN TLUS); exact location not provided. | Alternative has potential to affect access to UFN harvest areas. Alternative may affect UFN access to a campsite (UFN TLUS); exact location not provided. | Alternative has potential to affect access to UFN harvest areas. Alternative may affect UFN access to a campsite (UFN TLUS); exact location not provided. | Alternative has potential to affect access to UFN harvest areas. Alternative may affect UFN access to a campsite (UFN TLUS); exact location not provided. | No - not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Alternative overlaps with habitat of species harvested by UFN. Moose habitat total area = 272 ha. Caribou habitat total area = 402 ha. Loss of 14.2 km of known Rainbow Trout habitat and 12.4 km of unconfirmed Rainbow Trout habitat. | Alternative overlaps with habitat of species harvested by UFN. Moose habitat total area = 257 ha. Caribou habitat total area = 416 ha. Loss of 13.8 km of known Rainbow Trout habitat and 12.5 km of unconfirmed Rainbow Trout habitat; Loss of critical Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by UFN. Moose habitat total area = 259 ha. Caribou habitat total area = 317 ha. Loss of 12.9 km of known Rainbow Trout habitat and 11.1 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Alternative overlaps with habitat of species harvested by UFN. Moose habitat total area = 95 ha. Caribou habitat total area = 212 ha. Loss of 7.5 km of known Rainbow Trout habitat and 8.4 km of unconfirmed Rainbow Trout habitat; Loss of Rainbow Trout spawning habitat downstream of Lake 01682LNRS | Yes |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Alternative has minimal toxicological risk associated with dusting from TSF beaches and from pond water quality and associated seepage to downstream wetlands / creeks that may affect the quality of resources harvested by UFN. | Alternative has low to moderate toxicological risk associated with dusting from filtered tailings stack and from PAG pond water quality that has potential to affect the quality of resources harvested by UFN. | Alternative has low toxicological risk associated with dusting from filtered tailings stack and from pond water quality that has potential to affect the quality of resources harvested by UFN. | Alternative has moderate toxicological risk associated with dusting from filtered tailings stack, PAG rock dump and poor water quality in seepage collection pond downstream of PAG rock dump that has potential to affect the quality of resources harvested by UFN. | Yes |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Alternative has the potential to affect the quality of experience of UFN harvesters due to potential low noise generation from equipment and operations | Alternative has the potential to affect the quality of experience of UFN harvesters due to moderate levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of UFN harvesters due to low levels of noise from equipment, trucks and operations | Alternative has the potential to affect the quality of experience of UFN harvesters due moderate levels of noise from equipment, truck and operations | Yes |

*(continued)*

**Table 3-5. Human Environment Criteria Summary (continued)**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Current Use of Lands and Resources for Traditional Purposes - Tsilhqot'in National Government (TNG)*** | | | | | | |
| Access to aboriginal harvesting areas and cultural sites | Alternatives that do not affect Aboriginal harvester's access to traditional and cultural sites and harvesting areas are preferred. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | No – not differentiating |
| Availability (abundance and distribution) of resources harvested by Aboriginal people. | Alternatives with lower potential to decrease the availability of resources harvested by Aboriginal peoples are preferred. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | No – not differentiating |
| Quality of resources harvested by Aboriginal people | Alternatives with lower potential to decrease the quality of resources harvested by Aboriginal people are preferred. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | No – not differentiating |
| Quality of Aboriginal harvesters' experience based on noise effects) | Alternatives with lower potential to decrease the quality of Aboriginal harvesters' experiences are preferred. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | Based on consultations to date, no current use by TNG in area of alternative. | No, not differentiating |
| ***Non-traditional Land-use*** | | | | | | |
| Agriculture and range tenures | Alternatives that do not overlap agriculture or range tenures are preferred as they will not affect access to and use of tenure | 268 ha (0.8% of Tenure RAN075154) | 214 ha (0.7% of Tenure RAN075154) | 248 ha (0.8% of Tenure RAN075154) | 0 ha | Yes |
| Guide outfitting licenses | Alternatives that do not overlap guide outfitting licenses are preferred as they may not affect access to and use of guiding area | 789 ha (0.2% of License 484246); 726 ha (1.3% of License 1206416) | 767 ha (0.2% of License 484246); 737 ha (1.4% of License 1206416) | 665 ha (0.2% of License 484246); 746 ha (1.2% of License 1206416) | 366 ha (0.1% of License 484246); 722 ha (1.3% of License 1206416) | No - not differentiating |
| Registered traplines | Alternatives that overlap trapline tenures may affect access to and use of tenure | 1,138 ha (3.0% of Tenure TR0512T027); 377 ha (0.4% of Tenure TR0601T003) | 1,238 ha (3.3% of Tenure TR0512T027); 267 ha (0.3% of Tenure TR0601T003) | 960 ha (2.5% of Tenure TR0512T027); 351 ha (0.3% of Tenure TR0601T003) | 1,038 ha (2.7% of Tenure TR0512T027) | Yes |
| ***Public Recreation*** | | | | | | |
| Overlap of areas with recreational sensitivity and significance | Alternatives that are not located in areas with high recreational values that may affect public use are preferred | 1,172 ha (Medium Sensitivity/Medium Significance) and 0 ha in Medium Significance / High Sensitivity total: 1,172 ha | 978 ha in (Medium Sensitivity/Medium Significance)and 43 ha in Medium Significance / High Sensitivity total: 1,021 ha | 1,021 ha (Medium Sensitivity/Medium Significance and 0 ha in Medium Significance / High Sensitivity total: 1,021 ha | 376 ha in (Medium Sensitivity/Medium Significance and 112 ha in Medium Significance / High Sensitivity total: 488 ha | Yes |
| ***Heritage*** | | | | | | |
| Known archaeological sites | Alternatives that do not overlap known archaeological sites are preferred | Overlaps with one archaeological site (FhSf-4) | Overlaps with one archaeological site (FhSf-4) | Overlaps with one archaeological site (FhSf-4) | No archaeological sites within 1,000 m | Yes |

*(continued)*

**Table 3-5. Human Environment Criteria Summary (completed)**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Human Health*** | | | | | | |
| Potential health risks | Alternatives with less human health risks (e.g., air quality from dust deposition, water quality from ML/ARD and to country foods from both dust and poor quality water) are preferred. | Minimal to low potential human health risks. Minimal potential for dust inhalation, effects of dust deposition on country foods and drinking water quality as tailings and waste rock remain saturated, reducing dusting and ML/ARD risk. | Low to moderate potential human health risks. Low risk from dust inhalation and to country foods provided tailings are reclaimed progressively. PAG rock stored underwater reduces ML/ARD risk but filtered tailings have some ML/ARD risk that may affect downstream drinking water quality. | Low potential human health risks. Low risk from dust inhalation and to country foods because of low dusting potential because of paste tailings moisture content, non-segregating and crust forming properties. PAG rock is co-disposed with tailings reducing ML/ARD risk but small ML/ARD risk of paste tailings affecting downstream drinking water quality | Moderate potential for human health risks. Moderate potential for dust inhalation from filtered tailings and waste rock (mine camp is downwind of). Any unrecovered ML/ARD from PAG waste increases risk of downstream water quality effects and to downstream fisheries | Yes |
| ***Employment*** | | | | | | |
| Employment opportunities | Alternatives that have more employment opportunities for local communities are preferred | Estimated to employ between 550 and 600 people | Estimated to employ between 600 and 650 people based on additional staff for dam construction and filter tailings placement | Estimated to employ between 550 and 600 people | Estimated to employ between 600 and 650 people based on additional staff for filter tailings placement | Yes |

**Table 3-6. Project Economics Criteria Summary**

| Characterization Criteria | Rationale | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land | Advance as Evaluation Criteria |
|---|---|---|---|---|---|---|
| ***Proponent Costs*** | | | | | | |
| Initial capital cost | Options with lower costs are preferred. | Lowest capital cost. Less than $100 M | Highest capital cost due to filters and tailings conveyance / deposition equipment: $175 M - $200 M | Lower capital cost: $100 M- $124 M | Higher capital cost due to filters and tailings conveyance / deposition equipment: $150 M - $174 M | Yes |
| Sustaining capital and operating costs | Options with lower costs are preferred. | Lower sustaining capital and operating costs: $175 M - $349 M | Very high sustaining capital and operating costs: > $875 M | Lower sustaining capital and operating costs: $175 M - $349 M | Very high sustaining capital and operating costs: > $875 M | Yes |
| Closure costs | Options with lower costs are preferred. | Lowest closure cost: $25 M - $49 M | Higher closure cost: $100 M - $125 M | Lower closure cost: $50 M - $74M | Highest closure cost: >$125 M | Yes |
| Post-closure costs | Options with minimal to no active management are preferred | Minimal to no active management / maintenance anticipated. Periodic inspections | Active management with water treatment over a period of approximately ten years, variances requiring correction expected. | Minor active management with periodic inspections | Long-term water treatment expected with regular maintenance of seepage ditches etc. | Yes |

### 3.1.4 Emergency Water Management (Passive and Active)

Emergency water management incorporates active and passive measures to reduce the volume of water held in the TSF under emergency conditions. Pumping from the TSF pond is an active measure that reduces risk of overtopping / dam breach, whereas a spillway passively removes excess water from the TSF under emergency conditions. Candidates that have larger reclaim pumps and a spillway available during operation are preferable for emergency water management. Candidate 1 has large reclaim pumps, capable of reclaiming up to 20 – 40 $Mm^3$ / year but does not have a spillway during operation as it is designed to hold the inflow design flood (IDF) with spillway only installed at closure. Candidates 7 and 22 have smaller pumps capable of reclaiming up to 5 $Mm^3$ / year and a spillway during operation. Candidate 10 has reclaim pumps capable of reclaiming up to 20 $Mm^3$ / year, although the candidate will have no spillway until closure.

### 3.1.5 Design Basis / Regulatory Requirements

Regulations that specify design requirements with increased oversite are preferable to limited guidance and regulation. For example, the regulatory requirements for conventional (slurry) tailings dams (i.e., dams classified as high to extreme consequence) as well as for subaqueous PAG rock storage are well developed (e.g., Canadian Dam Association (CDA) *Dam Safety Guidelines* (Canadian Dam Association 2007 (Revised 2013)), *Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams* (CDA 2014), *Mines Act* (1996c) whereas filtered tailings regulatory requirements in BC are generally undeveloped but presumably would be interpreted as mine waste piles (guided by British Columbia Mine Waste Rock Pile Research Committee (1991) *Mine Rock and Overburden Piles: Investigation and Design Manual – Interim Guidelines, May 1991*). Design requirements for slurry TSFs are well developed therefore Candidate 1 is preferable and the filtered tailings candidates least.

### 3.1.6 Tailings Density

Candidates with higher density tailings material are more favourable because they have reduced potential for tailings mobilization in the event of a dam failure. Filtered tailings have the highest density as their tailings have low moisture content; the placement method also promotes a high density, which can then be increased with compaction. Slurry and paste tailings both have lower density tailings, as these are discharged as slurry and take longer to consolidate. The filtered candidates (Candidates 7 and 22) are therefore preferable to Candidates 1 and 10.

### 3.1.7 Maximum Dam Height

High dams have potentially higher consequences in the event of a failure. Candidate 22 (filtered tailings / PAG rock on land) has the smallest dam with maximum height of 50 m and is preferred. All the other candidates have maximum dam heights of between 100 m and 150 m respectively.

### 3.1.8 Operational Monitoring Requirements - Safety

Candidates which are less susceptible to changes require less operational monitoring effort and are preferable. Candidate 1 has one facility of concern, the TSF, and is expected to have the most easily defined monitoring network with less intense monitoring frequency required. Candidate 10 is

expected to have a fairly easily defined monitoring network but with higher frequency monitoring requirements compared to Candidate 1. The filtered candidates (Candidates 7 and 22) are expected to have more complex monitoring requirements with high frequency monitoring required.

## 3.2 TECHNICAL ACCOUNT

Technical data were derived from the development of the design concepts for the four candidates. Technical assessment criteria were grouped under the following categories:

- Containment design;
- Construction requirements;
- Water management;
- Execution; and
- Closure.

### 3.2.1 Containment Design

The following criteria were characterized to determine the best overall candidate with respect to containment design:

- Style of containment;
- Number of dams;
- Construction volumes;
- Tailings initial settled density;
- Drainage provisions;
- Seepage management – physical; and
- Seepage management – quality.

With respect to style of containment, the candidate's containment designs are classified based on the deposit's location in relation to natural topography. For example, a valley-fill deposit abuts natural ground around most of its perimeter and typically requires a single dam or other structure to contain the waste. At the other end of the spectrum is a ring dike facility which is raised above the surrounding landscape and requires dams around the entire facility to contain the waste materials. Valley fill deposits are preferable as they utilize natural ground for improved, long-term stability. The four candidates discussed here are all valley fill deposits; however, for Candidates 7 and 22, the TSF is heaped within the valley, whereas for Candidates 1 and 10 the TSF is a level valley-fill deposit.

Candidates with fewer dams and lower volume of construction materials are more favourable due to simpler construction and operational considerations. Candidates 1 and 10 have the highest volume of construction material (60-80 $Mm^3$) and the greatest number of dams (4 and 3 respectively) as compared to the other options. Candidate 22 has the lowest construction volume requirements at

1 – 20 $Mm^3$. This option also has no waste-retaining dams, although it does contain a single-stage water dam.

Candidates with higher tailings density have lower storage volume requirements, and are preferred. Candidates 7 and 22 have an initial settled density of 1.6 – 1.8 $t/m^3$, compared to 1.2 – 1.6 $t/m^3$ for the other candidates.

Candidates with simpler drainage provision are preferred. Drainage provisions include embankment drains to control runoff and seepage from the downstream face of the TSF dike(s) as well as foundation drains installed beneath the tailings to promote unsaturated conditions in the case of the filtered tailings candidates. Since the tailings and waste rock for Candidate 1 remain saturated, no foundation drainage is required beneath the tailings and the embankment drains are simple and easily installed. In contrast, Candidates 7 and 22 require complex foundation drains to maintain unsaturated conditions and, in the case of Candidate 22, underdrains to prevent natural groundwater entering the onland PAG waste damp and to collect seepage from that dump.

The physical management of seepage varies for the candidates and considered an important criterion of containment design. In the case of the Candidate 1, seepage management includes cut-off trenches with a single collection pond downgradient of the dam. Both filtered tailings candidates, in addition to the cut-off trenches, require multiple seepage collection points downgradient of the TSF. Candidate 22 would require a liner and closure cover to manage ML/ARD and is considered the least preferable for seepage management. The quality of the seepage is also considered a criterion for differentiating the candidates. Seepage from Candidate 1 is less likely to degrade water quality as tailings are saturated compared to the filtered tailings candidates, particularly Candidate 22 where PAG waste rock is stored on land.

### 3.2.2 Construction Requirements

The following criteria were characterized to determine the best overall candidate with respect to construction requirements:

- Foundation preparation for TSF (excludes dam);
- Tailings infrastructure;
- Foundation preparation for PAG waste rock facility;
- Initial dam construction; and
- Sustaining construction (excludes water delivery).

Construction requirements include foundation preparations in the TSF and PAG/NAG3 waste rock facility, the complexity of tailings infrastructure and initial dam construction and the ongoing (sustaining) construction needs. Foundation preparations for all the candidates include clearing vegetation, grubbing roots and large rock, and soil stripping. In the case of the filtered candidates (Candidates 7 and 22), foundation drainage must be installed to maintain unsaturated conditions in the deposit. For PAG waste rock storage, foundation preparations include clearing, grubbing and stripping; however, where PAG/NAG3 waste rock is stored on land, a liner would likely be required.

Initial and sustaining dam construction is more complex for Candidate 1 as it has a multiple-stage dam that requires moderate volumes of construction material and raising of the dam every year. In Candidate 7, although large volumes of construction material are required initially, subsequent dam raises only occur every five years.

### 3.2.3 Water Management

The following criteria were characterized to determine the best overall candidate with respect to water management:

- Catchment area;
- Flood routing;
- Water balance – surplus / deficit / balance;
- Water recycle requirement;
- Water treatment;
- Surplus water management; and
- Operational monitoring requirements – internal site water management.

Water balance and water management are key aspects of operational and post-closure risk and potential environmental effects. Water management criteria are incorporated into both the physical stability and technical accounts because of its critical role in containment facility safety and stability.

The size of the affected catchment includes the project infrastructure footprint as well as the catchment area upstream of the infrastructure. Upstream runoff is usually diverted; however, diversion measures can be less effective during high-flow events. Smaller affected catchment areas are preferred as there is less water to manage during a flood event. Candidate 22 (has the smallest affected catchment area and is preferred; Candidate 10 has a slightly larger catchment area and is less favourable whereas the other Candidates have larger catchment areas and are least favourable.

Flood routing is an important criterion that is differentiating among the candidates. In the case of Candidate 1 and Candidate 10, flows are routed for storage in the TSF; the facility is designed to hold the IDF and there is no downstream discharge during operations. Candidate 7 is designed to hold the IDF; thus, there is no downstream discharge during operations. Candidate 22 is further disadvantaged as, in addition to flood flow routing through the active construction area of the TSF, the downstream water management pond is sized to hold a smaller flow event (1:200 year return period flow) and any flows above this return period frequency would discharge downstream through a spillway.

A large excess or deficit water balance is problematic as it means additional, potentially complex and costly diversion measures or finding make-up water to supplement the Project's requirement. A small surplus or deficit is preferred as it can more easily be managed, particularly if it occurs later in the mine life. Candidate 7 and 22 have large water balance surpluses because of the reduced water demand resulting from the filtering process; this means that water accumulating in the ponds will

not be recycled to the extent for Candidate 1. Candidate 1's facilities are in a balance or at slight surplus condition throughout operations, because the water accumulated within the supernatant ponds (as well as Open Pit dewatering) will satisfy the process requirements under average precipitation conditions.

Water recycling is required to maintain the TSF's water balance; less water recycling is more favourable from a technical perspective. Relatively large volumes of process water are reclaimed (10 - 20 $Mm^3$ / year) from the TSF pond of Candidate 1. In contrast, the recycle requirements for Candidates 7 and 22 are relatively small (< 5 $Mm^3$ / year) because the tailings are less saturated.

The Project will not discharge water that does not meet receiving water quality criteria. Alternatives requiring water treatment are less favourable due to the costs and technical complexities associated with (potentially long-term) water treatment. Candidates 7 and 22 will likely require long-term water treatment. No water treatment is expected for Candidate 1.

Site-wide water monitoring and management requirements are expected to be less onerous for Candidate 1 as it is considered less susceptible to changing conditions that can affect water quality. Water quality monitoring would be largely confirmatory based on experience and expectation with this type of TSF. For Candidates 7 and 22, more locations require monitoring and there is susceptibility to changing conditions that may affect water quality thereby requiring more intensive monitoring and a response / correction.

### 3.2.4 Execution

The following criteria were characterized to determine the best overall candidate with respect to execution:

- Technology precedent - processing;
- Technology precedent – storage;
- Tailings delivery complexity;
- Tailings placement complexity;
- PAG waste rock delivery and precedent; and
- Operational flexibility.

Candidates with proven and well-established technology precedents with respect to tailings processing are preferred. Slurry tailings production technology is proven at the Project production rate (60,000 tpd); however no precedent exists for filtered tailings processing at the Project production rate. The closest precedent identified for an operating filtered tailings facility is about 40,000 tonnes per day or about 2/3$^{rd}$ of the Project throughput. Most of the operating filtered tailings facilities are at much lower throughput and in arid to semi-arid climates.

The delivery of slurry tailings is much simpler as it can be pumped and gravity-fed through a pipeline whereas filtered tailings require a complex system of conveyors and stacker or a large fleet of trucks to place the material. The placement of slurry tailings is through spigots which discharge to

relatively small areas and are not significantly affected by weather conditions. Filtered tailings placement requires spreading from the stacker or dumping from trucks across a relatively large working area, tailings compaction to limit infiltration and management of precipitation including snow removal.

The delivery and placement of PAG/NAG3 waste rock is simplest for Candidate 22 as it is a short haul from the pit to the TSF and the PAG/NAG3 waste rock can be placed in thick lifts. For Candidates 1, 7, and 10 with PAG/NAG3 waste rock stored under water, delivery and placement are more complex as the haul from the pit to the TSF is longer and, in the case of Candidate 1, the waste rock must be placed in thin lifts as it is co-disposed with tailings.

Operational flexibility considers alternative discharge areas or ease of adjustment of the placement method. Candidate 1 is considered the most flexible because there are alternative discharge points in the tailings spigot system that minimizes production interruptions. Candidate 7 comprises an upset facility for out of specification tailings that will minimize production interruptions. Candidate 22 has less capacity to store off-specification tailings because the water management pond is relatively small.

### 3.2.5 Closure

The following criteria were characterized to determine the best overall candidate with respect to closure:

- Closure concept - physical;
- Closure concept – geochemical;
- Closure concept – active closure period;
- Closure concept – long-term maintenance and monitoring;
- Concurrent closure and reclamation; and
- Premature closure.

For Candidate 22 the pond is not in the storage facility and is the most favourable closure concept for physical stability. In Candidate 1 the pond is within the storage facility but not against the dam at closure and therefore less favourable. For Candidates 7 and 10 the storage facility is within the storage facility and against the dam at closure and therefore least favourable.

For Candidates 1 and 10 at closure, the geochemical concerns are passively managed as all PAG/NAG3 waste rock are submerged and saturated thereby reducing the risk of ML/ARD. Candidate 7 and 22 will require active management of ML/ARD from the TSF and/or the PAG/NAG3 waste rock facility.

The active closure period for Candidates 1 and 10 (10 to 20 years for slurry and paste tailings) is considered shorter than for Candidates 7 and 22 (30 to 40 years for filtered tailings). Closure activities for Candidates 1 and 10 are similar and would comprise placement of overburden cover, establishing wetlands and revegetating upland beaches and spillway installation. The TSF supernatant would be pumped to fill the pit and ultimately result in a small seasonal pond and surrounding wetland area

on the surface of the TSF. The large areas for Candidates 7 and 22 are also considered to have longer active closure periods with potentially large volumes of cover material including a barrier layer to prevent interaction of the growth medium with potentially acidic tailings.

Candidates 1 and 10 are considered to have less long-term maintenance and monitoring because there is no or only one facility of concern requiring site-wide water quality monitoring with variances that potentially require correction. A paste TSF may require longer term monitoring because of the pond location and potential water quality variances. Monitoring and maintenance will be longer for Candidate 7 and longest for Candidate 22 because there are more facilities of concern requiring intensive site-wide water quality monitoring as well as potential for more maintenance of the reclaimed TSF and waste rock surfaces.

The opportunities for concurrent reclamation are considered more favourable for Candidates 1 and 10. Concurrent reclamation activities include the TSF embankments and the Site C Main Dam in the case of Candidate 1. Concurrent reclamation opportunities are less favourable for Candidates 7 and least favourable for Candidate 22 as reclamation of large surface areas such as the filtered tailings surface and the PAG waste rock dump would be challenging during operation. In the event of premature closure, Candidate 1 is preferable as it requires minimal earthworks for implementation of the closure plan compared to Candidates 7 and 22 where the large surface areas for the TSF and PAG waste rock facility will require substantial earthworks for implementation of the closure plan. Candidate 1 is also preferable in the event of temporary closure as PAG materials are submerged or can be submerged by controlling the water balance; this is not possible for the filtered tailings candidates.

## 3.3 ENVIRONMENTAL ACCOUNT

### 3.3.1 Climate and Atmosphere

The following criteria were characterized to determine the best overall candidate with respect to impacts to climate and atmosphere:

- Noise and vibration;
- Dust emissions; and
- Sensitivity to climate change.

Noise and Vibration

The effect of the Project on the local noise and vibration conditions is assessed from the perspective of potential pathway effects to other receptors, such as current use of lands and resources for traditional purposes. Candidates 1 and 10 are preferred as they would have relatively low noise levels because tailings would be pumped and discharged from spigots around the TSF, rather than be transported by trucks. Candidates 7 and 22 would be associated with a large fleet of trucks to transport the tailings and waste rock, as well as with equipment to spread and compact the material and are less preferred. Candidate 22 would have the highest noise and vibration outputs because material would require transportation and handling for the large waste rock facility.

Dust Emissions

The effect of the Project on the local atmosphere is assessed from the perspective of potential dust generation from the candidates because this can affect terrestrial ecosystems and human health. The Project has the potential to produce dust at all stages of mining, from initial stripping and handling of soil and rock to processing, transporting and storage of tailings. Primary dust sources during mine construction and operation associated with waste handling and storage include roads used by vehicles (e.g., haul truck from the pit to the plant), and the tailings beaches and embankments. Dust from blasting would be similar for the candidates, however, if trucks were used to convey filtered tailings there would be significantly greater dust emissions from Candidates 7 and 22.

Filtered tailings have properties that can reduce dust potential including a trafficable surface which provides more options for direct dust control, whereas slurry and paste tailings are more difficult to access as they have higher moisture content and lower density affecting trafficability. In addition, the phasing of a filtered tailings facility can be optimized, to some degree, to allow progressive reclamation of final slopes as they are constructed thereby reducing potential for dust generation.

Slurry and paste tailings are more favourable as they have higher moisture contents and remain saturated or partially saturated over large areas of a TSF, which reduces their potential to generate dust. Paste tailings are non-segregating and tend to form a crust which results in less fine particulates available at surface for transport as dust. Although it is difficult to state whether one of the disposal technologies has significantly lower dusting potential, filtered tailings are expected to generate dust earlier after placement due to their low moisture content and to generate more dust per unit area without mitigation and therefore considered less favourable. Importantly, since the tailings and some of the waste rock are PAG/ML and have high metal content, there is hazard from potentially toxic dust for the candidate that does not store PAG material sub-aqueously. This can constitute risk to human health, vegetation and wildlife habitat.

Sensitivity to Climate Change

Sensitivity to climate change in this assessment is based on the ability to maintain water cover of PAG/NAG3 material in droughts and the ability to manage high flows in extremely wet conditions.

Drought conditions and loss of vegetative cover on reclaimed waste storage facilities can expose PAG/ML materials to oxidation and generation of ML/ARD that could require long-term water treatment. Therefore, candidates that store PAG materials sub-aqueously are considered less sensitive to climate change.

Impoundments that are designed to hold or pass during closure higher return period floods (e.g., the PMF) during operations and post-closure are more resilient to climate change. Candidates 1, 7, and 10 are more favourable as they submerge PAG/NAG3 waste rock and are designed to hold the IDF and therefore considered less sensitive to climate change. Candidate 22 is less favourable as the water management pond is designed to pass the 1:200 year return period flood and PAG/ML materials are not submerged.

### 3.3.2 Surface Water Quantity

The following criteria were characterized to determine the best overall candidate with respect to impacts to surface water quantity:

- Catchment loss; and
- Water make-up requirement.

Catchment Loss

During operation of the TSF (and waste rock facilities) all contact water will be isolated from downstream creeks by the dam and collection ditches / ponds that will collect contact water for recycling. For Candidate 1 augmentation of surface flow in Davidson Creek during the Operation phase is required to meet the in-stream flow needs (New Gold 2015). Flow augmentation would also be required for the other candidate alternatives based on the affected catchment area.

The candidate footprints and watershed boundaries are shown in Figure 3.3-1 and illustrate that the TSF footprints are predominantly within the Davidson Creek catchment. Catchment areas upstream of the TSFs were calculated for each candidate to provide an estimate of effect on surface water quantity. The analysis of upstream catchment indicate that Candidates 1 and 10 have the largest upstream catchment area and less favourable and Candidate 22 has the smallest catchment area and is the most favourable candidate from the perspective of catchment loss.

Water Make-up Requirement

Water make-up requirement is the volume of freshwater (i.e., not reclaimed water) that a project requires to meet its processing and other water needs. Candidate 1 and 10 recovers some water prior to pumping to the TSF deposition and more water is recovered from a reclaim barge in the TSF. More process water is recovered from filtered tailings than slurry tailings prior to deposition in a TSF. The recovered water is recycled thereby reducing the fresh water (make up) requirement for processing.

Water balances assessment for the candidates indicate that although Candidate 1 requires more water for the start-up pond at the beginning of operation, the annual make-up water requirements (from Tatelkuz Lake) are similar (approximately 1 $Mm^3/a$) to Candidates 7, 10, and 22.

### 3.3.3 Surface Water Quality

The following criteria were characterized to determine the best overall candidate with respect to impacts to surface water quality:

- PAG storage;
- Seepage quantity;
- Dam embankment area; and
- Operational discharge of treated water.

PAG Storage

The potential effect on surface water quality was assessed by contrasting the potential for ML/ARD based on whether storage of PAG materials (tailings and waste rock) is on land or under water. Sub-aqueous storage reduces the ML/ARD potential because of much reduced oxidation of sulphide materials compared to on land storage. For Candidate 1, PAG/ML materials are stored sub-aqueously, whereas for the filtered tailings candidates (Candidates 7 and 22), tailings and/or PAG/NAG3 waste rock are stored on land. On land storage of PAG/ML materials has a greater likelihood of affecting downstream surface water quality particularly in post-closure with a potential consequence being that long-term water treatment may be required to meet downstream water quality objectives.

Seepage Quantity

Seepage through the TSF's containment dam is influenced by, inter-alia, the proximity of the water pond to the dam. Dams with adjacent water ponds can have seepage rates several times higher than TSFs where the pond is at some distance from the dam. Candidate 1 has a large pond but lowest expected seepage rate because the pond is separated from main dam by a large tailings beach. The paste (Candidate 10) and filtered tailings (Candidates 7 and 22) candidates have water ponds abutting the dam and would therefore be expected to have the highest seepage rates. Candidate 22 has the smallest dam but is expected to have more seepage than Candidate 1 because the water pond is adjacent to the dam.

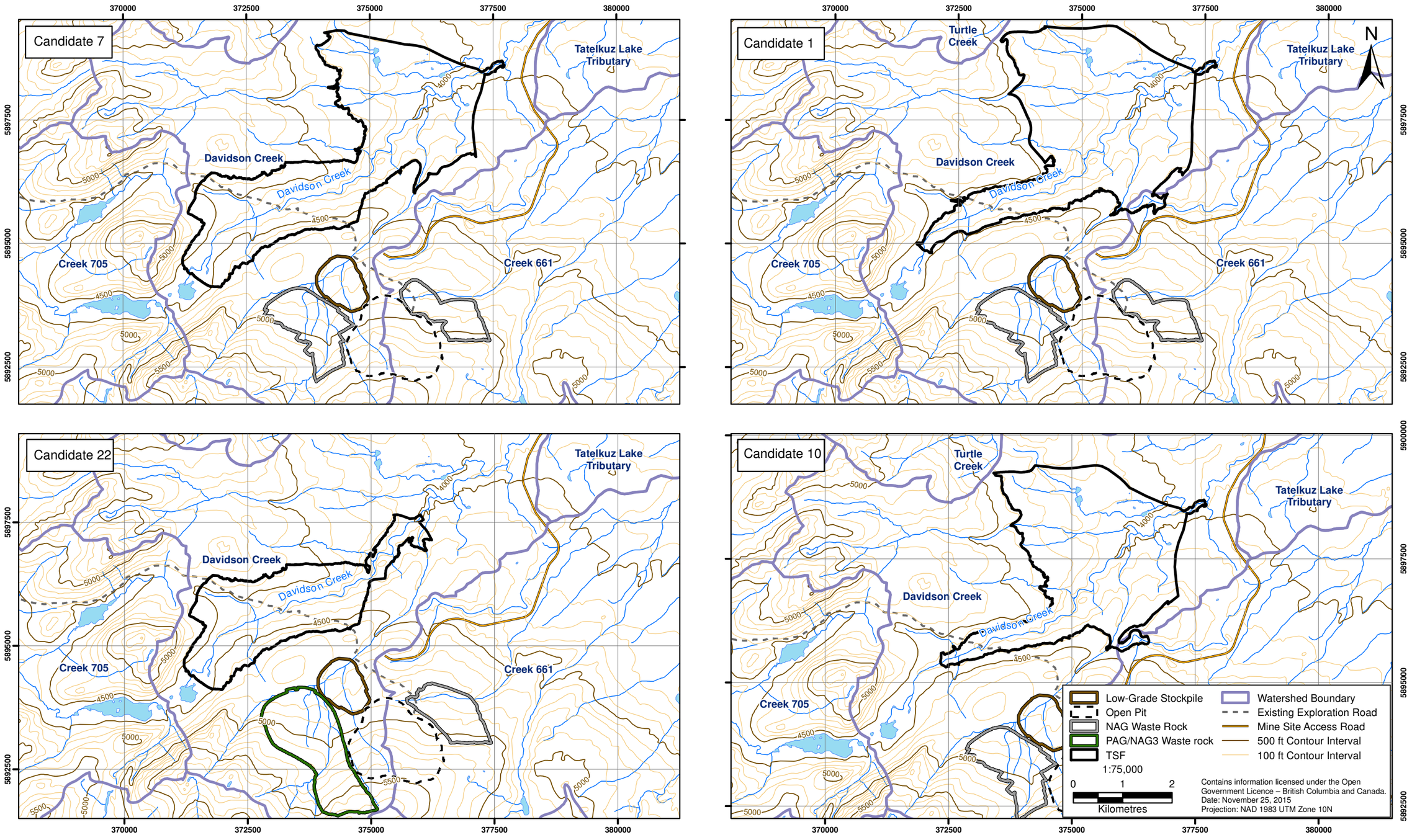
Dam Embankment Area

Surface water quality of the receiving environment can be affected by the quality of dam contact water. The surface area of the containment dam is proportional to the volume of runoff and seepage from the dam construction materials. NAG waste rock used to construct the containment dam has potential to effect surface water quality because of neutral metal-leaching (albeit low potential) from the NAG waste rock and nitrogen compounds from explosive residuals. Although dam seepage will mostly be collected in the downstream seepage collection ponds, a very small volume might by-pass the collection system and discharge to the environment (New Gold 2015). In addition, although there is sufficient NAG waste rock and overburden to construct the dams, larger dams have greater potential for inclusion of limited PAG waste rock due to incomplete segregation with the construction material. Therefore, the candidates with large dams are considered to have greater potential to affect downstream water quality. Candidates 1, 7, and 10 have the largest containment dams and therefore less favourable.

Operational Discharge of Treated Water

The requirement to treat contact water prior to discharging to the receiving environment introduces risks if complications occur and compliance with regulatory guideline values becomes unattainable. More than one treatment method may be required to lower the concentrations of a mixture of exceeding parameters. Operational discharge of treated water is not planned for Candidate and therefore this is more favourable whereas water treatment is expected for the other candidates, especially for Candidate 22, and is less favourable.

**Figure 3.3-1**
**Major Watershed Boundaries**



### 3.3.4 Groundwater

The following criteria were characterized to determine the best overall candidate with respect to impacts to groundwater:

- Groundwater quantity; and
- Groundwater quality.

Groundwater effects from the Project are predicted to be minimal provided mitigation measures, including seepage cut-off and collection ponds are in place and effective around the perimeter of the TSF. Seepage and contact water collection is especially important where discharge is to relatively low flow streams.

Groundwater Quantity

Groundwater flow is affected by the hydraulic conductivity of the geologic materials underlying the TSF, the hydraulic gradient between the TSF and adjacent groundwater regime as well as the surface storage area. A large TSF can result in higher groundwater flows because of the larger area and hydraulic gradient compared to a smaller structure. However, the engineered groundwater cut-off downstream of a TSF dam is expected to intercept groundwater flow and reduce its contribution to downstream creek flow compared to a smaller structure where less groundwater is intercepted. Therefore, the candidates with large dams that divert larger upstream catchment areas are expected to reduce groundwater contribution to downstream creeks to a greater extent than a small dam. Upstream diverted catchment area has been used as a metric for assessing changes in groundwater flow between the candidates. Candidate 22 is most favorable with the least diverted catchment and Candidates 1 and 10 least favourable as they have the largest diverted catchment.

Groundwater Quality

Groundwater quality is influenced by the generation of infiltration to aquifers by ML/ARD, primarily from PAG/ML material. PAG/ML materials stored on land are expected to generate ML/ARD, resulting in higher risk of affecting groundwater quality compared to those candidates where PAG materials are submerged. Candidates 1 and 10 are more favourable for groundwater quality effects since all the PAG/ML materials are stored sub-aqueously. Candidates 7 and 22 are less favourable as there is greater potential for groundwater quality deterioration because of PAG/NAG3 tailings and waste rock stored on land.

### 3.3.5 Terrestrial Ecosystems

The following criteria were characterized to determine the best overall candidate with respect to impacts to terrestrial ecosystems:

- Loss and risk to wetlands.

Terrestrial ecosystems were mapped during baseline studies conducted between 2011 and 2013 for the Vegetation Local Study Area (VLSA) and Vegetation Regional Study Area (VRSA). The results of

these studies were used to assess the loss and risk to wetlands and listed ecosystems from the candidate candidates.

Loss and Alteration Risk to Wetlands

Bogs and swamps are the most common wetlands which occur in the Project area, though fens, marshes, shallow-water, and ponds are also present. The wetland areas lost for each candidate were calculated using terrestrial ecosystem mapping (TEM) shapefiles clipped to the footprints of each candidate (Figure 3.3-2). The wetland areas shown in the figure are not entirely comprised of wetlands; for example: the first decile are areas where wetland was mapped in at least 40% of the TEM area and in the second and third decile areas, wetlands areas comprise between 10% to 40% and 10% - 30% of the TEM area respectively. Risk to wetlands was assessed on the basis of the potential for poor quality run-off and seepage from the mine facilities altering adjacent wetlands. Although blue-listed wetlands are present in the Mine Site area, they comprise less than 0.9% of the area; therefore total wetland area was used instead to quantify the wetland loss.

Candidates 1, 7, and 10 remove more wetland than Candidate 22; however, the latter is considered to present a greater alteration risk to downstream wetland because of poorer water quality resulting from storage of PAG/NAG3 material on land.

### 3.3.6 Fish, Fish Habitat and Aquatic Resources

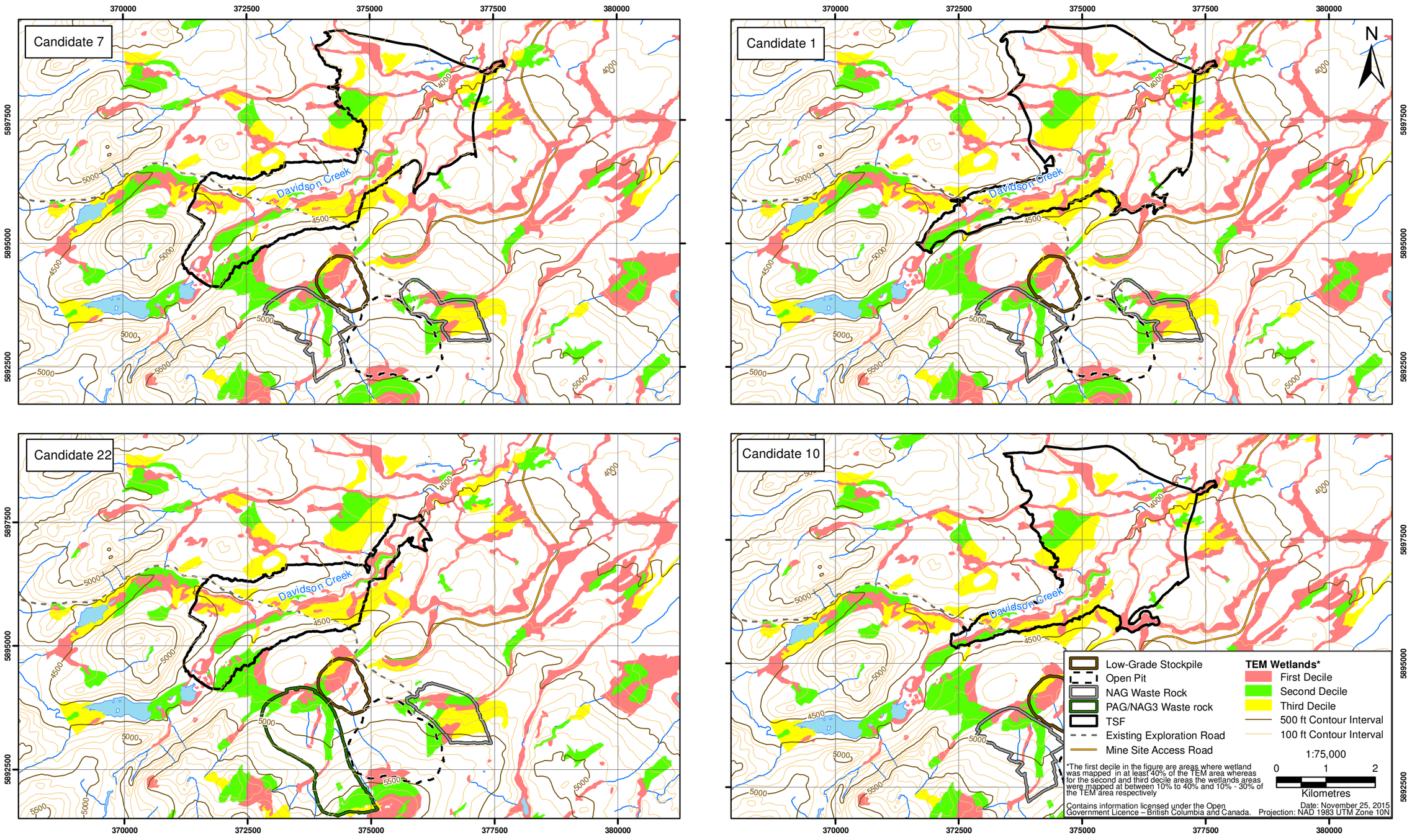
The storage of mine tailings and waste rock can potentially affect stream and lake habitats, resulting in direct effects to fish, or indirect effects on biological resources such as primary and secondary producers. The following criteria were characterized to determine the best overall candidate with respect to impacts to fish, fish habitat, and aquatic resources:

- Risks to non-CRA (commercial, recreational, and Aboriginal) fisheries and aquatic resources;
- Risks to CRA fish species;
- Fish species;
- Fish habitat; and
- Presence of rare and endangered aquatic species.

Fish and aquatic resources baseline studies were conducted within the Aquatics Local Study Area (ALSA) and Aquatics Regional Study Area (ARSA) specifically for the project from 2011 to 2013 (AMEC 2013j and 2013k). Twelve species of fish were captured in the ALSA and ARSA, including Kokanee (*Oncorhynchus nerka*), Rainbow Trout (*Oncorhynchus mykiss*), Lake Chub (*Couesius plumbeus*), Longnose Sucker (*Catostomus catostomus*), Brassy Minnow (*Hybognathus hankinsoni*), Mountain Whitefish (*Prosopium williamsoni*), Burbot (*Lota lota*), Longnose Dace (*Rhinichthyes cataractae*), Slimy Sculpin (*Cottus cognatus*), Northern Pikeminnow (*Ptycheilus oregonensis*), Largescale Sucker (*Catostomus macrocheilus*), and White Sucker (*Catostomus commersonii*).

**Figure 3.3-2**
**Listed Wetland Extent**

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Presence of Rare and Endangered Aquatic Species

All of the candidates are within the Project's Local Study Area (LSA) and the data collected during the Project's baseline sampling program were used to determine the presence of rare and endangered aquatic species. Species of special concern, due to their conservation status in lakes and streams within and downstream from the candidates, were identified by screening the baseline information on the phytoplankton, zooplankton, and benthic invertebrate communities with the BC Conservation Data Centre on-line database (BC CDC 2013). The taxonomy lists reported in the *Blackwater Gold Project: Fish and Aquatic Resources 2011-2012 Baseline Repor*t (AMEC 2013h) were cross-referenced with the lists of organisms with special conservation status in the Bulkey-Nechako, Central Coast, and Kitimat-Stikine regional districts. The BC Conservation Data Centre on-line database contains the current species listings under SARA and COSEWIC.

The BC blue-listed (BC CDC 2013) freshwater mollusc *Acroloxus coloradensis* was observed in the headwater 01682LNRS Lake, which will be potentially affected by all of the candidates. *Acroloxus coloradensis* is listed as a taxon of "Special Concern", which is assigned to organisms potentially sensitive or vulnerable to human activities or natural events. No aquatic species of conservation concern, including the aforementioned mollusc, were identified in the Section 79(1) notification under SARA. There is no significant difference among the candidates in potential effects to rare or endangered aquatic species and therefore this criterion was not carried forward in this assessment for evaluation of the candidates.

Risks to Non-commercial / Recreational / Aboriginal (non-CRA) Fishery Species and Aquatic Resources

Risk to non-CRA fish species and aquatic resources result from potential changes to downstream water quality and water quantity. Risk from water quantity changes will be mitigated by augmenting flow in Davidson Creek with water piped from Tatelkuz Lake. Water quality changes may result from poor quality runoff and seepage entering downstream creeks.

The potential for poor quality water are greater for candidates that store PAG materials on land. For the Candidates 1 and 10 all PAG/NAG3 materials will be stored under water or saturated, so the potential for poor quality water is reduced and risk to non-CRA species considered minimal to low. For the filtered tailings candidates (Candidates 7 and 22) the risk is considered higher because of greater potential for poor quality runoff and seepage.

Risks to Commercial / Recreational / Aboriginal (CRA) Fishery Species

Kokanee Salmon and Rainbow Trout were the most common fish species encountered within and downstream of the proposed Mine Site. Rainbow Trout were the only species considered as a potential CRA fishery within the area of the candidate TSF. Risks to CRA fishery species include potential changes in water quantity and quality downstream of the Project. Regardless of the candidate, mitigation of flow in Davidson Creek will be required to meet in-stream flow needs and ensure the viability of CRA fishery species. The augmentation of creek flow as well as seepage and runoff collection infrastructure and water treatment (active or passive) will mitigate downstream water quality effects such that effects to the CRA fishery are not anticipated. Risk to CRA fishery species was not carried forward in this assessment as the mitigation that will be in place for all

candidates is expected to result in insignificant, and non-differentiating, impact to these fishery species.

Loss of Fish Habitat

Assessment of fish habitat loss was based on the length of known Rainbow Trout habitat lost as a result of the candidate footprints, including spawning habitat downstream of Lake 01682LNRS. Candidates 7 and 22 encroach to a greater extent on spawning habitat than Candidates 1 and 10 as they encroach closer to Lake 01682LNRS which has been identified as spawning habitat. The candidates with larger footprints within the Davidson Creek valley result in greater loss of fish habitat (Figure 3.3-3).

### 3.3.7 Wildlife and Wildlife Habitat

The disposal of tailings and waste rock material removes high quality wildlife habitat within a TSF footprint, and indirectly affects adjacent high quality habitat through effects such as noise, fugitive dust, and habitat isolation. Important wildlife species were identified as species of conservation concern, species of regional importance, and keystone species (Aboriginal cultural and traditional use). Key life stages and seasons include feeding winter, summer, spring, and security thermal – growing/living, and/or hibernating) and the habitat suitability models were based on TEM.

Habitat suitability modeling provides valuable information on the availability of high-quality habitat for important wildlife species at various life stages and seasons within an area. The candidates considered here are within the Project's habitat suitability modeling areas, and data available are sufficient to compare the effects of the candidates on high quality wildlife habitat.

Loss of High-quality Habitat for Species of Conservation Concern

Species of conservation concern include terrestrial birds, myotis bats and western toad. The olive-sided flycatcher (*Contopus cooperi*) and the red-tailed hawk (*Buteo jamaicensis*) are species of conservation concern that have high-quality habitat within the LSA. Three bats species of conservation concern: eastern red bat (*Lasiurus borealis*), northern myotis (*Myotis septentrionalis*), and little brown myotis (*Myotis lucifugus*) were detected within the LSA. Western toad is a species of conservation concern, listed as Special Concern on Schedule 1 of SARA. Most of the high-quality habitat for these species is located in the northeastern area of the candidate footprints (Figure 2.8-1).

For this assessment, the high-quality habitat areas for each of these species for key life stages and seasons within the candidate footprints were added together to provide an indication of high-quality habitat loss. Candidates, 7, and 10 remove more terrestrial birds, myotis bats and western toad habitat because of their larger footprint within lower reaches of the Davidson Creek valley compared to Candidate 22 (Figure 3.3-4).

**Figure 3.3-3**
**Rainbow Trout Habitat**

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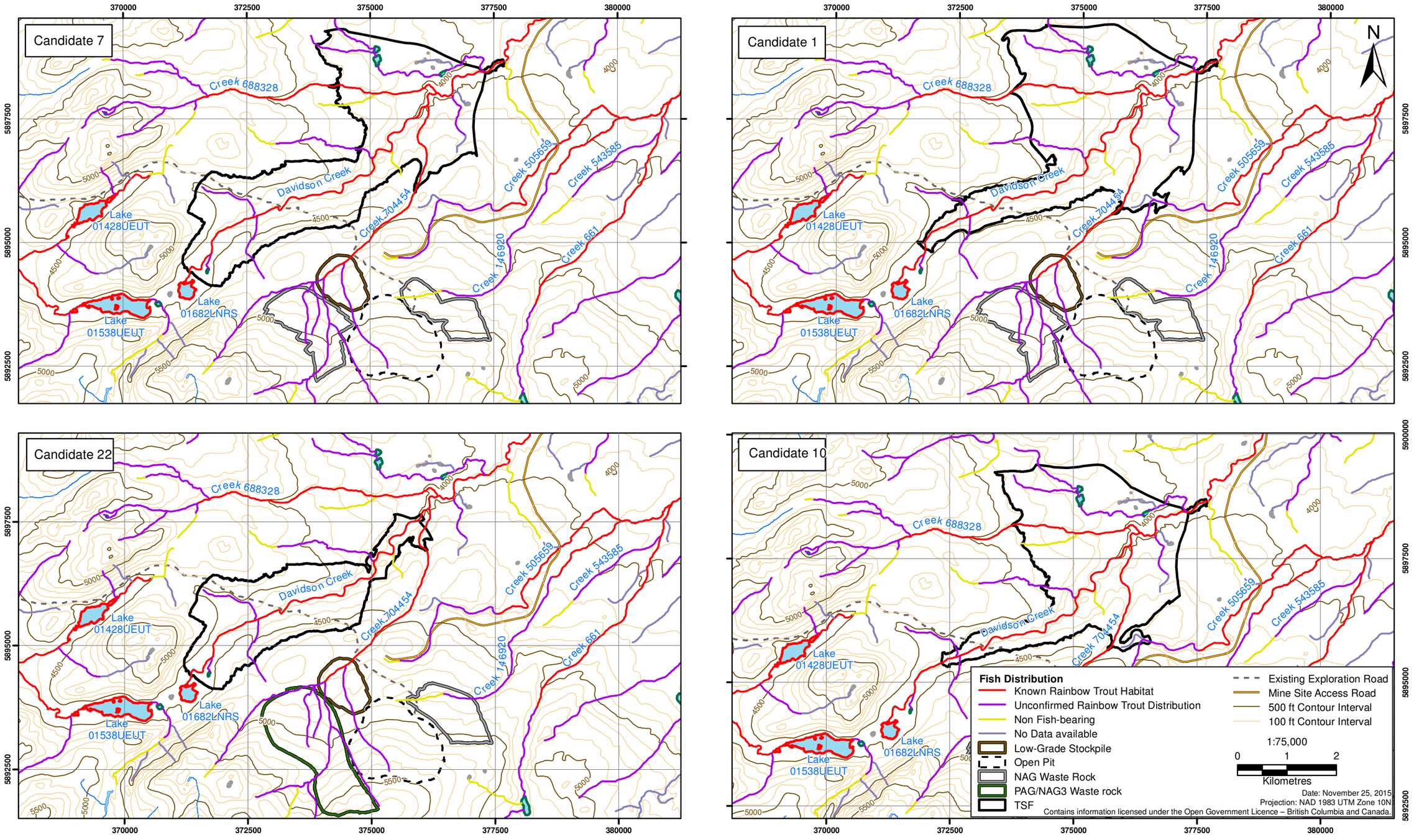
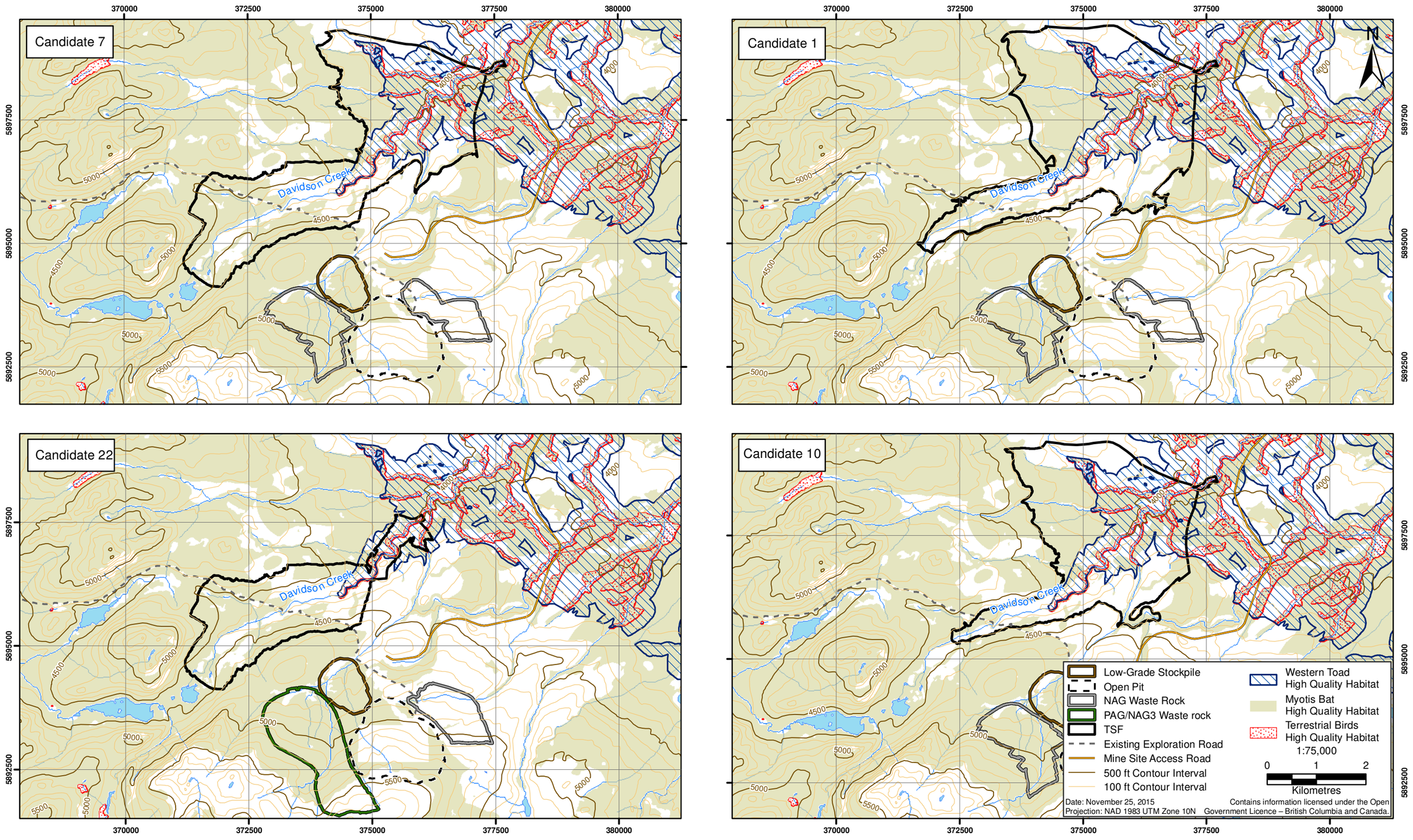


**Figure 3.3-4**
**High Quality Habitat for Terrestrial Birds, Myotis Bats and Western Toad**

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Loss of High-quality Caribou and Moose Habitat

Habitat suitability modeling was conducted for caribou (*Rangifer tarandus*) that potentially use the area during various life stages and seasons. This includes habitat used for feeding in winter, spring and summer; habitat for security/thermal in winter. The reported losses of high-quality habitat areas represents the sum of the areas used for various life stages and seasons; since there is overlap in these areas, it does not represent the actual area of habitat loss but used to represent the difference between the candidates.

The loss of high-quality habitat for moose (*Alces alces*) and caribou was assessed by calculating the area of high-quality habitat lost from the candidates for these species. Candidates 1, 7, and 10 remove more high-quality moose and caribou habitat than Candidate 22 (Figure 3.3-5).

Toxicological Risk to Migratory Birds, Amphibians and Bats

### Migratory Birds

Migratory birds and amphibian species were combined because of their exposure to contaminants of potential concern (COPCs) in water: through dermal contact and ingestion of vegetation, insects and water in ponds. During construction and operation, the tailings pond is unlikely to provide foraging for these species due to the abiotic nature of these facilities. Mine ponds may be used as resting places for migrating birds particularly post-closure, however the water quality is anticipated to meet guidelines after reclamation.

The potential for elevated concentrations of COPCs in downstream wetlands can occur during all phases of the Project and water birds drinking and foraging on vegetation and aquatic invertebrates in these areas can be exposed to elevated concentrations of COPCs. Insect prey that inhabits these areas may have elevated concentrations of COPCs in their tissues and water birds can bio-accumulate these COPCs into their bodies when consuming this prey with elevated concentrations of COPCs.

Although the TSF could attract water birds, the better water quality anticipated in Candidates 1 and 10 TSF implies less toxicological risks compared to the filtered tailings candidates.

### Amphibians

The primary exposure pathway of COPCs for amphibians is through dermal absorption and through bioaccumulation of COPCs in the food web when consuming insect prey with elevated concentrations of COPCs. Water with elevated concentrations of COPCs will occur at the Mine Site and potentially downstream of the Mine Site. As breeding habitat for amphibians was primarily documented in anthropogenic fishless waterbodies during baseline studies, amphibians, particularly Western toad, may be attracted to the TSF for breeding purposes. In addition, toads have been documented using downstream tributaries and lakes for breeding, thus have potential to accumulate COPCs through dermal absorption from these waterbodies if these waterbodies have elevated concentrations of COPCs and if they are being used for breeding purposes. In addition, insect prey that inhabits both the TSF and downstream areas may potentially have elevated concentrations of COPCs in their tissues and amphibians can bioaccumulate these chemicals into their bodies when consuming these prey.

Candidates 7 and 22 are considered to present greater toxicological risk, particularly Candidate 22 because of poor water in runoff and seepage collection ponds and potentially in downstream wetlands.

### Bats

During baseline studies conducted within the Project area between 2011 and 2013, nine species of bats were detected, including three species of conservation concern: eastern red bat, northern myotis, and little brown myotis. All three species of conservation concern were detected within the Mine Site, freshwater supply pipeline, and airstrip areas, which represents the LSA, and within the RSA. Detections occurred within various types of forested and wetland habitats including small waterbodies and lakes, as well as within a regenerating lodgepole pine forest. The majority of little brown myotis detections were within a wetland in the headwaters of Davidson Creek at an elevation just below the Mine Site.

The main COPC exposure pathway for bats from project-related activities occurs via bioaccumulation through insect prey. Exposure through drinking water and dust are minimal for bats. Bats in this area forage on night-flying insects, and some bat species forage over water on emergent aquatic insects (O'Shea, Clark, and Boyle 2000). The myotis bats forage over water on emergent aquatic insects.

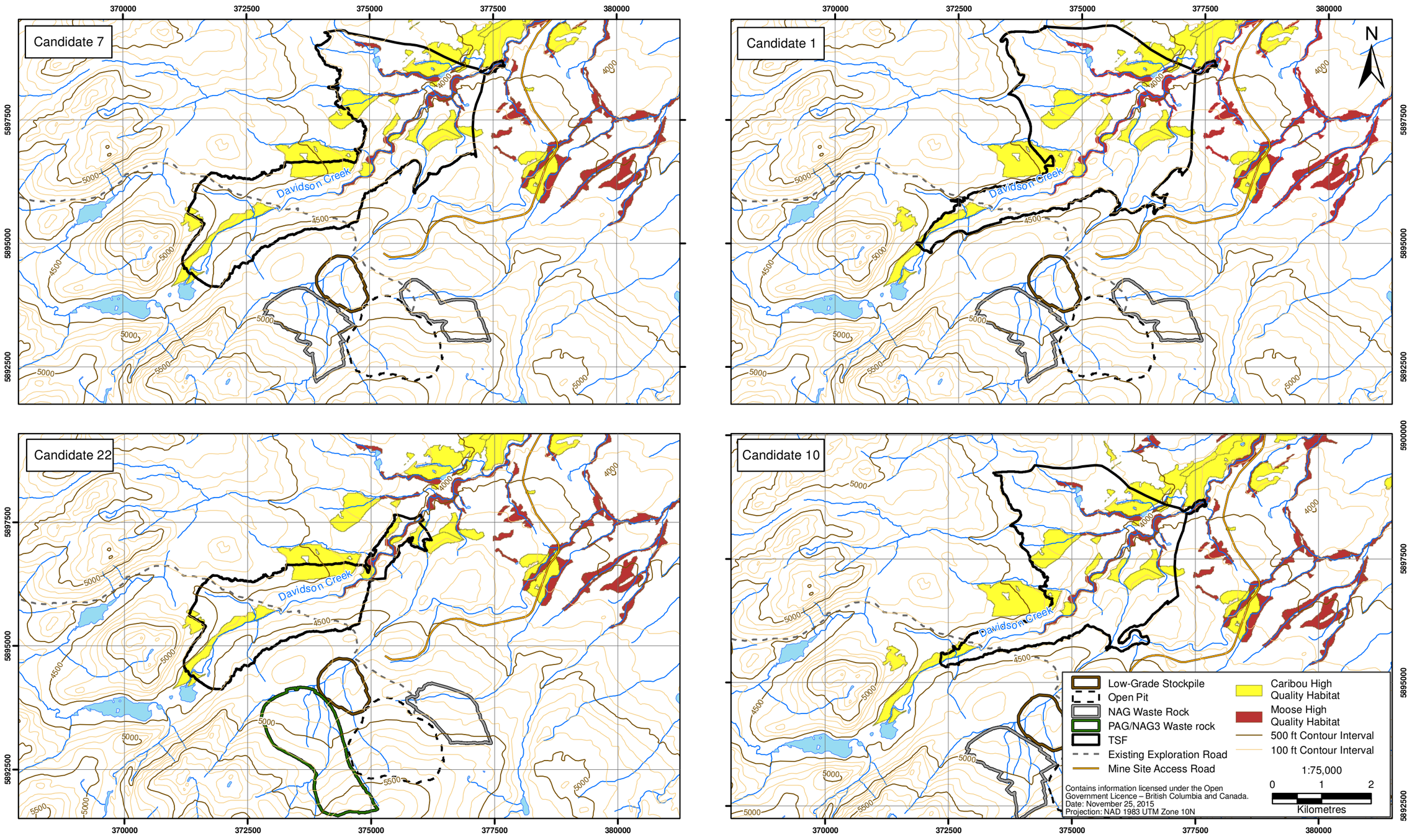
Water with elevated concentrations of COPCs will occur at the Mine Site and potentially downstream of the Mine Site and insect prey that inhabit these areas may have elevated concentrations of COPCs in their tissues which bats can bio-accumulate when consuming prey with elevated concentrations of COPCs. At the Mine Site, the TSF is likely to have few insects during Construction and Operation phases of the Project due to the abiotic nature of the pools with little support for insect life. At closure when these pools are reclaimed, a greater abundance of insects at the TSF is anticipated and thus the potential for bats foraging on these insects at this time is greater. The TSF is anticipated to meet water quality guidelines after mine closure.

Bats are likely to occur during all Project phases in the downstream wetlands, as disturbance will be minimized in these areas. Bats were recorded in the greatest abundance in these downstream wetlands during baseline studies conducted for the Project. The potential for elevated concentrations of COPCs in downstream wetlands, where the greatest abundance of bats were recorded is highest for Candidate 22 as a result of ML/ARD. The potential for elevated concentrations of COPCs in downstream wetlands is lowest for Candidate 1 due to low potential for poor quality runoff and seepage from ML/ARD. Candidate 7 is considered to have low to moderate toxicological risk and Candidate 10 low toxicological risk for bats.

## Toxicological Risk to Terrestrial Wildlife Species

Species-specific habitat, distribution, and primary exposure route can dictate the potential for interaction and risk of COPC exposure from various Project-related sources. Species considered as subject to toxicological risk from COPC from the Project include caribou, moose, grizzly bear (*Ursus arctos*), furbearers, and terrestrial birds.

**Figure 3.3-5**
**High Quality Habitat for Caribou and Moose**



### Caribou

Reconnaissance-level baseline surveys conducted in 2011 and 2012 did not detect any caribou in the LSA and RSA; however, incidental detections of sign was detected within the Mine Site and LSA during other field surveys indicating limited use by caribou in the Mine Site LSA. Habitat suitability modelling indicated that Davidson Creek contains areas suitable for caribou foraging. Taken together with baseline results, caribou use within the LSA is likely confined to infrequent late spring, summer, and fall use for foraging and travel to and from wintering grounds.

Ungulates are most susceptible to the effects of COPCs through the ingestion of water, and through the consumption of forage and can also ingest COPCs incidentally through the consumption of soil while eating forage. Water with elevated concentrations of COPCs will occur at the Mine Site and potentially downstream of the Mine Site for all candidates.

The potential for elevated concentrations of COPCs in downstream wetlands is highest for Candidate 22 and lowest for Candidates 1 and 10. Caribou foraging on vegetation in areas nearby the PAG waste rock facility may accumulate COPCs in their diet through the consumption of vegetation and soil where Project-related dust has fallen with elevated concentrations of COPCs.

Uptake of COPCs in caribou may also be associated with the processes of bioaccumulation from the consumption of forage that has accumulated concentrations of COPCs in the plant tissue. There is a greater potential for the consumption of vegetation with elevated concentrations of COPCs for the filtered tailings candidates (i.e., Candidates 7 and 22) relative to Candidate 1 as there is greater potential for dust with elevated concentrations of COPCs to be generated from on land tailings and for Candidate 22 also from PAG waste rock storage. However, caribou may also bioaccumulate COPCs from aquatic vegetation downstream of the Mine Site if vegetation in these areas bioconcentrate COPCs from downstream waters with elevated concentrations of COPCs.

Caribou are likely to avoid the Mine Site during Construction and Operation phases of the Project due to disturbance from noise, and thus, are likely only to be exposed to COPCs downstream of the Mine Site. At closure, when disturbance is minimized and the Mine Site is reclaimed, caribou may use the Mine Site again for travel and foraging. At this time, COPCs are anticipated to meet water quality guidelines.

### Moose

Moose are year-round residents within the Project area that are dependent upon upland and lowland habitats for their survival. Moose use both forest and open habitats (e.g., wetlands, burns, and clear-cuts) to satisfy their life requisites. During baseline studies conducted between 2011 and 2013, moose were observed along Davidson Creek in the Proposed Mine Site boundary, along the proposed Water Supply Route, and along the Proposed Airstrip Access Road. Winter track surveys conducted in the RSA in 2011 and 2012 indicated that the lower Davidson Creek corridor was an important area for wintering moose relative to higher elevations where the Mine Site is located.

Ungulates are most susceptible to the effects of COPCs through the ingestion of water, and through the consumption of forage and can also ingest COPCs incidentally through the consumption of soil while eating forage. Water with elevated concentrations of COPCs will occur at the Mine Site and

potentially downstream of the Mine Site. The potential for elevated concentrations of COPCs in downstream wetlands is highest for Candidate 22 and lowest for Candidate 1.

Moose foraging on vegetation in areas nearby the PAG waste rock facility may accumulate COPCs in their diet through the consumption of vegetation and soil that is covered in dust with elevated concentrations of COPCs. Uptake of COPCs in moose may also be associated with the processes of bioaccumulation from the consumption of forage that has accumulated concentrations of COPCs in the plant tissue. There is a greater potential for the consumption of vegetation with elevated concentrations of COPCs for the filtered tailings candidates (i.e., Candidates 7 and 22) as there is greater potential for dust with elevated concentrations of COPCs to be generated from the dry tailings and for Candidate 22 also from PAG waste rock.

Moose are anticipated to largely avoid the Project footprint during construction and operation phases of the Project due to noise disturbance and human presence, thus moose are primarily susceptible to the effects of COPCs in water and forage downstream of the Mine Site. Moose may access the Mine Site during closure when disturbance is minimized. However, as the Mine Site sits at a high elevation and the TSF and associated infrastructure are anticipated to be located at a high elevation ( > 1250 m), moose are only anticipated to access those areas during the summer months. At this time, COPCs in the TSF are anticipated to meet guidelines. However, with the filtered tailings candidates (i.e., Candidates 7 and 22), particularly Candidate 22, vegetation in the surrounding areas of the Mine Site that have accumulated COPCs into their tissues as a result of uptake from soil and run off may have elevated concentrations of COPCs for many years beyond closure.

### Grizzly Bear

Grizzly bears are year-round residents within the general Project area, and are dependent on mature and old-growth coniferous forests, although deciduous and mixed forests also contribute to their life requisites. Baseline surveys conducted in the Project area between 2011 and 2013 indicate that grizzly bears occur across the Project area. Wildlife cameras detected grizzly bear presence along rivers, creeks, games trails, roads, clearcuts, forest edges, and wetlands during summer and early fall and abundant bear sign, including scat, tracks, and trampled vegetation, was observed along Creek 661 and Chedakuz Creek during baseline surveys. In addition, a total of four non-active bear dens of unknown species, were discovered incidentally in the LSA indicating that suitable habitat for denning exists in the LSA. Incidental sightings of grizzly bear were also reported along the Kluskus Forest Service Road (FSR), along the Vantine FSR, approximately 25 km west-northwest of the LSA, and near the edge of camp downslope.

Grizzly bears are most susceptible to the effects of COPCs through the ingestion of water, and through the consumption of forage and incidental consumption of soil while eating forage. In addition, grizzly bears are susceptible to the effects of COPCs through bioaccumulation. Water with elevated concentrations of COPCs will occur at the Mine Site and potentially downstream of the Mine Site. The potential for elevated concentrations of COPCs in downstream wetlands is highest for Candidate 22 and lowest for Candidate 1.

Grizzly bears foraging on vegetation in areas nearby the PAG waste rock facility may accumulate COPCs in their diet through the consumption of vegetation and soil that is covered in dust with elevated concentrations of COPCs. Uptake of COPCs in grizzly bears may also be associated with the processes of bioaccumulation from the consumption of forage near the Mine Site that has accumulated concentrations of COPCs in the plant tissue as well as the consumption of fish in downstream waterways that have accumulated COPCs through the food chain. There is a greater potential for the consumption of vegetation and fish with elevated concentrations of COPCs for the filtered tailings candidates (i.e., Candidates 7 and 22) as there is greater potential for dust with elevated concentrations of COPCs to be generated from the dry tailings and PAG waste rock and run off of COPCs into downstream waterways.

Grizzly bear are likely to avoid the Mine Site and associated infrastructure during Construction and Operation phases, due to disturbance by noise and human presence in these areas. During this time, grizzly bears are most susceptible to the effects of COPCs through ingestion of water, aquatic vegetation and fish downstream of the Mine Site. At closure, when disturbance is minimized and the Mine Site is reclaimed, grizzly bears may use the Mine Site again for foraging. At this time, COPCs in the TSF are anticipated to meet guidelines. For Candidate 22, vegetation in the surrounding areas of the Mine Site that have accumulated COPCs into their tissues as a result of uptake from soil and run off may have elevated concentrations of COPCs for many years beyond closure.

### Furbearers

Furbearers are year-round residents in the Project area. During winter snow track surveys conducted during baseline studies in 2012, six species of furbearers were detected in the higher elevation subalpine fir including snowshoe hare, red squirrel, weasel spp., marten, coyote, and red fox. American beaver and least weasel were also detected incidentally within the Mine Site and LSA. However detections of furbearers in these areas were lower than in habitat at lower elevation, likely due to snow conditions and lack of cover.

Furbearers are primarily susceptible to the effects of COPCs through the ingestion of water, and through bioaccumulation. In addition, some furbearers that forage on vegetation, including beaver, muskrat, and red squirrel may also be susceptible to the effects of COPCs through the incidental ingestion of soil and aquatic sediment while consuming forage. Water with elevated concentrations of COPCs will occur at the Mine Site and potentially downstream of the Mine Site. The potential for elevated concentrations of COPCs in downstream wetlands is highest for Candidate 22 and lowest for Candidate 1.

Furbearers foraging on vegetation in areas nearby the PAG dump may accumulate COPCs in their diet through the consumption of vegetation and soil that is covered in dust with elevated concentrations of COPCs. Uptake of COPCs in furbearers may also be associated with the processes of bioaccumulation from the consumption of forage near the Mine Site that has accumulated concentrations of COPCs in the plant tissue as well as the consumption of fish in downstream waterways that have accumulated COPCs through the food chain. There is a greater potential for the consumption of vegetation and fish with elevated concentrations of COPCs for the filtered tailings candidates (i.e., Candidates 7 and 22) relative to Candidate 1 as there is greater potential for dust

with elevated concentrations of COPCs (which can to be taken up into plant tissues) as a result of the dry tailings and on land PAG waste rock storage.

Furbearers are likely to avoid the Mine Site and associated infrastructure during construction and operation phases, due to disturbance by noise and human presence in these areas. During this time, furbearers are most susceptible to the effects of COPCs through ingestion of water, aquatic vegetation and fish downstream of the Mine Site. At closure, when disturbance is minimized and the Mine Site is reclaimed, furbearers may use the Mine Site again for foraging. At this time, COPCs in the TSF are anticipated to meet guidelines. For Candidate 22, vegetation in the surrounding areas of the Mine Site that have accumulated COPCs into their tissues as a result of uptake from soil and run off may have elevated concentrations of COPCs for many years beyond closure.

### Terrestrial Birds

Forest and grassland birds include songbirds, raptors, and upland game birds. Three species including olive-sided flycatcher, red tailed hawk, and Clark's nutcracker (*Nucifraga columbiana*) were selected as indicator species in the EA to cover habitat requirements for all other forest and grassland birds. Baseline surveys for forest and grassland birds were conducted from 2011 to 2013 in the Project area. Baseline surveys detected 99 forest and grassland bird species, including 76 species of songbirds, 5 species of upland game birds, and 18 species of raptors.

Olive-sided flycatchers, a species of conservation concern, were detected, most often in matrices of old-growth forest and harvested areas adjacent to wetlands. Nesting was not confirmed for this species, likely due to the lack of specific surveys. However, due to the large number of territorial males observed, this species likely nests throughout the RSA. A total of 18 raptor species were detected in the RSA during baseline surveys with the greatest species diversity recorded in the Moist Cold Sub-boreal Spruce (SBSmc3) variant, followed by the Engelmann Spruce-Subalpine Fir (ESSF) Moist Very Cold (ESSFmv) subzone. Red-tailed hawks detected throughout the LSA. The short-eared owl was the only federal and provincial listed raptor species detected during raptor surveys. The detection of one individual short-eared owl occurred during the breeding season in an agricultural field and grassland near Davidson Creek, however the breeding status of the owl could not be confirmed.

The main pathway for COPC exposure for forest and grassland birds is through the consumption of vegetation, seeds, and incidental ingestion of soil that has been covered with dust containing elevated concentrations of COPCs and through bioaccumulation processes. Bioaccumulation of COPCs in forest and grass birds can occur by the consumption of vegetation with elevated tissue concentrations of COPCs in plant tissues and by foraging on flying insects that have elevated COPCs from the environment (water and vegetation that may be elevated in COPCs due to Project-related activities). Exposure to COPCs through drinking water may also occur for forest and grassland birds but is likely to be minimal relative to the accumulation of COPCs from vegetation and insect prey.

Vegetation near the Mine Site could result in elevated concentrations of COPCs if dust is created by project activities and is transported to nearby areas where it can settle on vegetation and soil, or be accumulated into plant tissue. There is a greater potential for the consumption of vegetation, seeds and soil with elevated concentrations of COPCs for the filtered tailings candidates (i.e., Candidates 7

and 22) relative to Candidate 1 and Candidate 10 as there is greater potential for the creation of dust with elevated concentrations of COPCs as a result of the dry tailings and for Candidate 22, from on land PAG/NAG3 waste rock storage.

Water with elevated concentrations of COPCs will occur at the Mine Site. Insect prey that inhabit these areas may have elevated concentrations of COPCs in their tissues and forest and grassland birds can bioaccumulate these COPCs into their bodies when consuming prey with elevated concentrations of COPCs. At the Mine Site, the TSF is likely to have few insects during construction and operation phases of the Project due to the abiotic nature of the pools with little support for insect life. At closure when these pools are reclaimed, a greater abundance of insects at the TSF is anticipated and thus the potential for forest and grassland birds foraging on these insects during closure is greater than during construction and operation phases of the Project. The TSF is anticipated to meet water quality guidelines at this time. However, during all phases of the Project, the potential for elevated concentrations of COPCs in downstream wetlands can occur and forest and grassland birds foraging on insects in these areas can be exposed to elevated concentrations of COPCs. The risk of elevated COPCs in downstream waters and vegetation and biota using these areas is highest for Candidate 22 because of ML/ARD primarily from the on land PAG waste rock facility; the risk is considered lowest for the Candidate 1 due to under water storage of PAG materials.

Forest and grassland birds will largely avoid the Project footprint during construction and operation phases due to habitat loss and alteration and sensory disturbance. However, at closure, forest and grassland birds may use the TSF, after reclamation, for foraging on insects. Forest and grassland birds will also forage along the river and creek corridors, around the Mine Site.

In conclusion, the toxicological risk to terrestrial wildlife is considered highest for Candidate 22 and least for Candidate 1 primarily because of the ML/ARD potential of Candidate 22 and their susceptibility for dust generation. Candidate 7 is considered to have second highest toxicological risk and Candidate 10 the third highest toxicological risk for terrestrial wildlife.

### 3.3.8 Terrain and Soil

Soils have been mapped as part of the Project's soil resource baseline mapping and soil management units. The soil mapping is at a reconnaissance scale and has been supplemented with TEM site series mapping to better define land characteristics (primarily drainage differences), which influence soil productivity within the mapped soil polygon.

The primary impact associated with the loss of soil is interpreted as the loss of potential land/soil productivity as related to forest site productivity. High quality soils were based on soil productivity ratings, which have Site Index Values of 14.8 $m^2$ – 19.9 $m^2$ (i.e. the mean tree height in metres versus tree diameter at breast height for 50 year old tree).

Candidate 22 removes the largest area of high quality soil (73 ha) and is the least favourable. Candidates 7 and 1 are less favourable as they remove 60 ha and 48 ha of high quality soil whereas Candidate 10 removes the smallest area (35 ha) and is the most favourable.

## 3.4 HUMAN ENVIRONMENT ACCOUNT

### 3.4.1 Effects of Changes to the Environment on Aboriginal Peoples

Section 10.1.3 of the Environmental Impact Statement Guidelines for the Project (February 19, 2013) requires the effects of any changes the Project may cause to the environment, with respect to Aboriginal peoples, on health and socio-economic conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. In a letter dated June 03, 2015, the CEA Agency requested that environmental effects, as defined in section 5 of the CEAA 2012, be included as factors to be considered in the assessment of the preferred option. In particular, section 5(1)(c) requires consideration of "with respect to aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on

(i) health and socio-economic conditions,

(ii) physical and cultural heritage,

(iii) the current use of lands and resources for traditional purposes, or

(iv) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance"

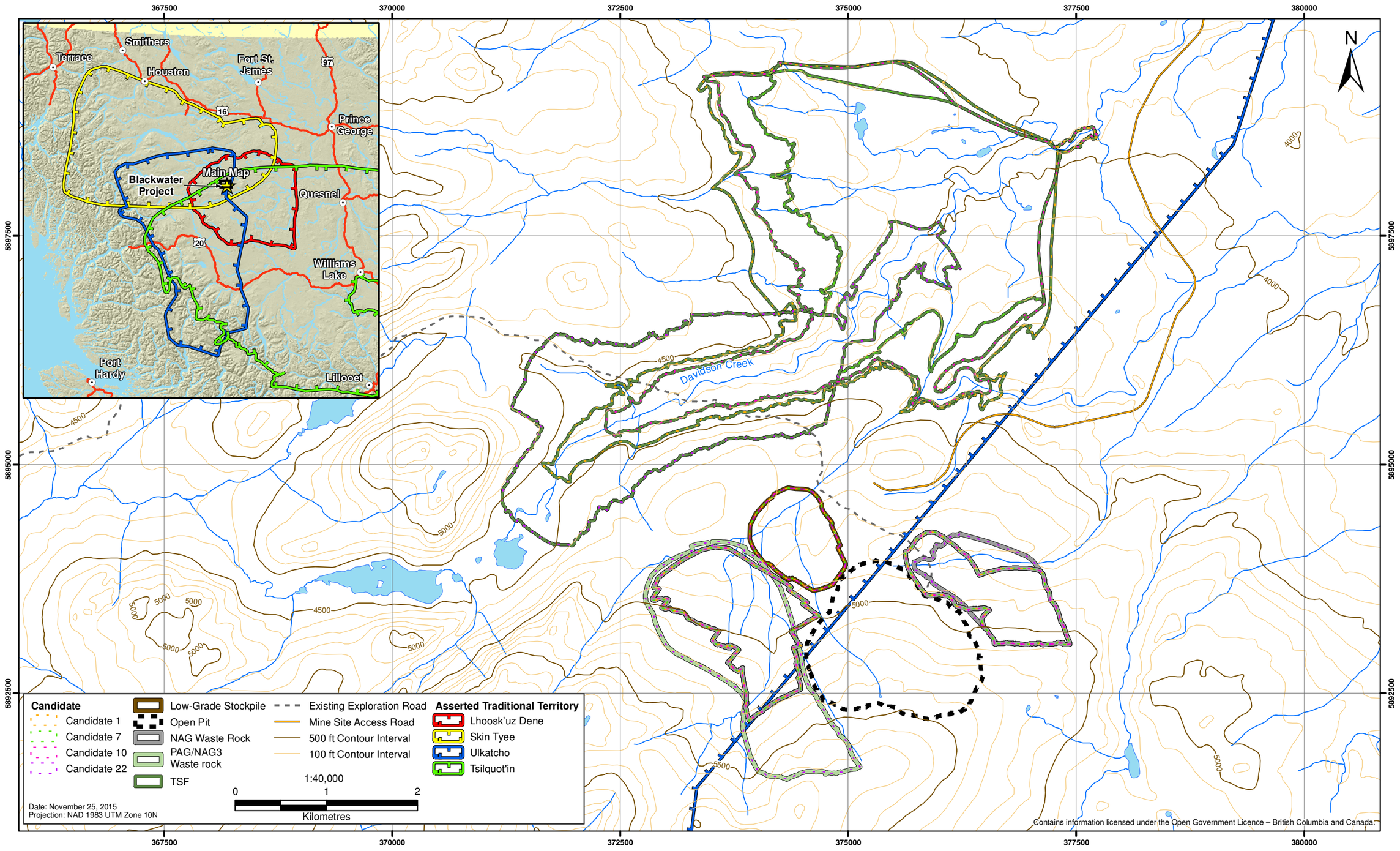
The proposed Mine Site is located within the asserted traditional territories of LDN, UFN, STN and the within the established territory of the Tsilhqot'in National Government (TNG) (within Engagement Zone A under the Tsilhqot'in Framework Agreement 2009; Figure 3.4-1). The candidates have the potential to affect the current use of lands and resources for traditional purposes to different degrees, as detailed in Table 3-5.

Potential effects on Aboriginal physical and cultural heritage (including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance) are considered in section 3.4.2 (Heritage). Potential effects on Aboriginal health are considered in section 3.4.5 (Human Health). Potential effects on Aboriginal socio-economic conditions could result from interference with activities supporting Aboriginal subsistence economies and/or with Aboriginal-owned land-based businesses. Activities supporting Aboriginal subsistence economies are considered to be current use of lands and resources for traditional purposes and are assessed in this section as such. No Aboriginal-owned land-based businesses having the potential to interact with candidates have been identified, other than registered traplines. Trapline TR0512T027 is registered to a member of the LDN. An interview with the holder of the trapline indicated that line has not been used for 20 years. Potential interactions with the trapline are assessed in section 3.4.3 (Non-Traditional Land Use).

Characterization criteria for assessing potential impacts to current use of lands and resources for traditional purposes include:

- access to Aboriginal harvesting areas and cultural sites;
- availability (abundance and distribution) of resources harvested by Aboriginal people;
- quality of resources harvested by Aboriginal people; and
- quality of Aboriginal harvesters' experience.

**Figure 3.4-1**
**Blackwater Gold Project: Aboriginal Setting**



Differences in access to Aboriginal harvesting areas and cultural sites are insignificant among the candidates. For example, the registered trapline (TR0512T027) held by members of Lhoosk'uz Dene Nation overlaps the Mine Site but there are no differentiating impacts with any of the candidates (see Section 3.4.3 Non-Traditional Land Use).

Candidates with larger footprints (i.e., Candidates 1 and 22) overlap to a greater extent with Rainbow Trout, moose, and caribou, habitat (see sections 3.3.6 Fish and Fish Habitat, and 3.3.7 Wildlife and Wildlife Habitat of this report). Candidates with larger footprints would also potentially remove a larger extent of harvestable plants. Consequently, these candidates have greater potential to decrease the availability of resources harvested by Aboriginal peoples.

The candidates have differential potential to reduce the quality of the resources harvested by Aboriginal people. The filtered tailings candidates (i.e., Candidates 7 and 22) have a higher toxicological risk to harvestable resources associated with dusting from filtered tailings stack, the PAG waste rock facility, and poor water quality in the seepage collection pond downstream of the PAG waste rock facility.

The quality of the Aboriginal peoples' harvesting experience is expected to be more affected by Candidates 7 (filtered tailings /submerged PAG) and 22 (filtered tailings /PAG on land) because of higher dust generation and noise levels from equipment and trucks.

### 3.4.2 Heritage

The archaeological impact assessment (AIA) conducted for the Project under *Heritage Conservation Act* (HCA; 1996b), Heritage Inspection Permit 2012-0295, identified an archaeological site in the vicinity of the Project. Candidates 1, 7, and 10 overlap with an archaeological site, identified under Heritage Inspection Permit 2012-0295, whereas Candidate 22 does not overlap with any archaeological or heritage site.

### 3.4.3 Non-traditional Land-use

The Mine Site is located within areas of non-traditional land and resource use as discussed below.

Agricultural and Range Tenures

The candidates may disrupt access and use of range tenures. Candidates 1, 7, and 10 overlap less than 1% of one range tenure (RAN075154), whereas Candidate 22 does not overlap with any range tenure (Figure 3.4-2).

Guide Outfitting Licenses

The candidates overlap with two guide outfitting licenses (1205415 and 484246), (Figure 3.4-3). The total areas overlapped by the candidates are similar however; therefore guide outfitting was not carried forward because it is not differentiating among the candidates.

Registered Traplines

The candidates may cause disruption to the access and use of overlapping registered traplines. Candidates 1, 7, and 10 all overlap with two tenures (TR0512T02 and TR0601T003), whereas Candidate 22 overlaps with one tenure (TR0512T02; Figure 3.4-3).

### 3.4.4 Public Recreation

Public recreation on Crown land may be affected if the public are prevented from using or accessing areas where they recreate. All candidates overlap with public recreations areas that are rated as having moderate sensitivity and moderate to high significance (Figure 3.4-2). Candidates 1, 7, and 10 overlap with approximately 1,000 ha of moderate sensitivity and moderate to high significance land whereas Candidate 22 overlaps with approximately 500 ha (Figure 3.4-2).

### 3.4.5 Human Health

Human health risks related to air quality, country foods and drinking water have been assessed for all of the candidates. Potential effects to human health from air quality are from windblown dust generated from the TSF embankments and beaches of Candidates 1 and 10. The exposed tailings beach area for Candidate 1 is expected to be smaller than the working surface of the filtered tailings candidates (i.e., Candidates 7 and 22), therefore the former are considered to have lower potential for dust generation. Candidate 22 is expected to generate more dust than the other candidates because of the large area of the PAG waste rock facility and its upwind location relative to the camp suggest moderate potential for dust inhalation. In addition, the dust generated from Candidate 22 presents a higher risk for human health as it is expected to have elevated concentrations of COPC.

Dust generation as well as poor quality water from the waste facilities can affect the quality of country foods and have potential effects to human health if consumed. Candidate 22 is expected to pose greater risk for country foods compared to the other candidates because of the large exposed tailings and waste rock surface areas that can generate dust, and poor quality runoff and seepage than can potentially affect water quality. Candidates 1 and 10 have lower risk for country foods compared to Candidate 7 because all PAG/ML materials are submerged, thereby reducing the potential for poor quality runoff and seepage as well as dust generation. Candidate 10 is expected to generate more dust and risk of poor quality runoff compared to Candidate 1 because of the lower moisture content of waste material that may cause acidic conditions and metal leaching to develop. Candidate 7 has low to moderate risk for country foods because the PAG/NAG3 waste rock is submerged, however, the tailings are exposed during operations and have potential to generate dust and poor quality runoff and seepage.

The risk to human health from drinking water quality is similar as for country foods and air quality. Candidate 22 has the highest risk for drinking water because of poor quality runoff and seepage potentially affecting Davidson Creek or aquifers that may be used as a drinking water supply. Candidates 1 and 10 have the lowest risk for drinking water.

**Figure 3.4-2**
**Blackwater Gold Project: Range Tenures and Recreational Significance Ratings**

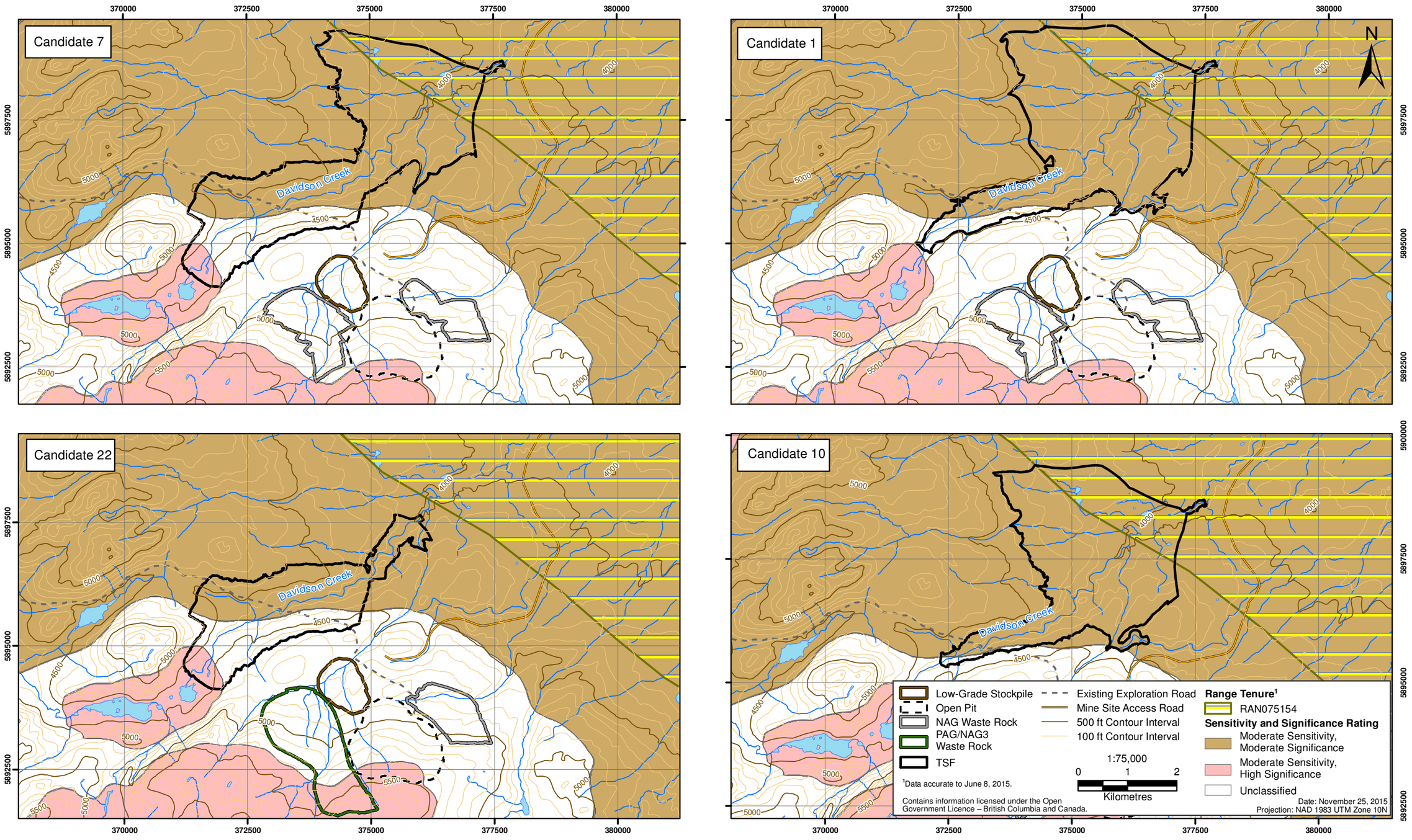
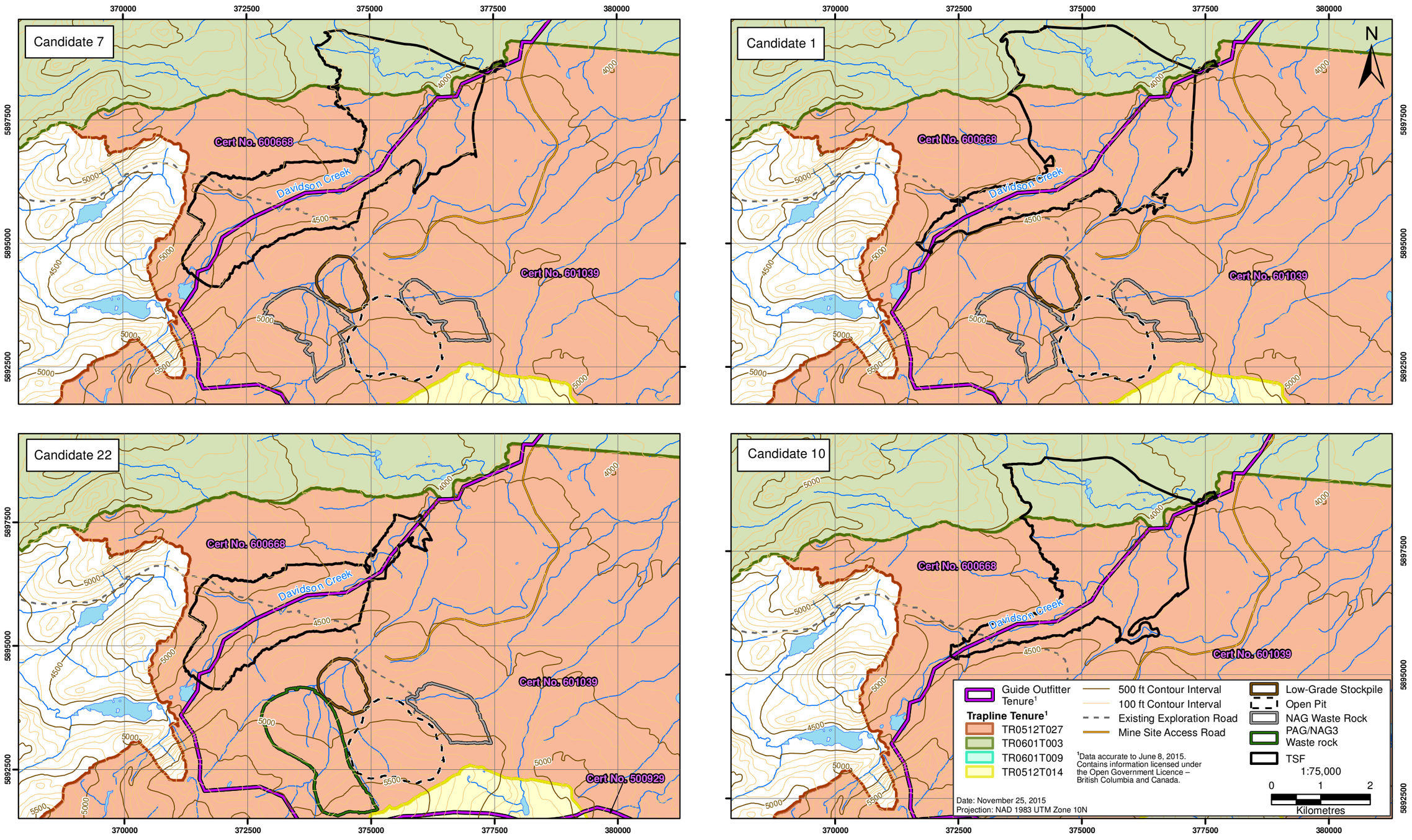


**Figure 3.4-3**
**Blackwater Gold Project: Guide Outfitting Licenses and Trapline Tenures**



### 3.4.6 Employment

Candidates associated with higher employment opportunities are more favourable. The number of jobs created by the Project will depend to some extent on the complexity of waste material processing (e.g., slurry vs. filtered) and handling (e.g., depositing as slurry or spreading/ compacting the tailings). The filtered tailings candidates (i.e., Candidates 7 and 22) are expected to generate around 50 more employment opportunities due to the operation of the filter plant, placement and compaction of tailings, and a water treatment plant compared to Candidate 1. Candidate 10 is expected to generate few additional employment opportunities compared to Candidate 1.

## 3.5 PROJECT ECONOMICS

Project economics include the costs for construction, operation and closure of each candidate. The costs allow for a quantitative comparison of initial capital costs, sustaining capital and operating costs, closure and post-closure costs. The filtered tailings candidates (i.e., Candidates 7 and 22) have significantly higher initial capital, sustaining capital and operating costs because of the large investment in a filter plant as well as very high cost associated with operating a filtered tailings facility at 60,000 tpd (e.g., conveyors or trucks and spreading equipment). These candidates are also expected to have closure and post-closure costs of two to three times that of Candidates 1 and 10 because of long-term water treatment and maintenance of areas affected by acidic conditions for Candidate 22 (Table 3-6).

# 4. MULTIPLE ACCOUNTS LEDGER

## 4.1 EVALUATION CRITERIA (SUB-ACCOUNTS)

The evaluation criteria must be differentiating (i.e., an aspect that distinctly differentiates one alternative from another) and non-redundant so that no more than one sub-account measures the same evaluation criteria. The evaluation criteria should also be 'impact driven'; relevant in the context of the alternative being evaluated; understandable and have 'judgemental independence' such that one sub-account cannot depend on another (Environment Canada 2011). The evaluation criteria presented in Table 4.1-1 are derived from the candidate characterizations provided in Section 3.

**Table 4.1-1. Evaluation Criteria and Rationale for Selection**

| Account | Evaluation Criteria (Sub-Account) | Rationale |
|---|---|---|
| Physical stability | Physical stability | Alternatives that promote physical stability through robust design and water management are preferred. |
| Technical | Construction Requirements | Alternatives with less complex construction requirements are preferred |
| | Water Management | Alternatives with simpler water management requirements are preferred. |
| | Execution | Alternatives with simpler execution strategies and requirements are preferred. |
| | Closure | Alternatives that facilitate earlier and safer closure are preferred. |
| Environmental | Climate and Air Quality | Alternatives that have low potential for dust generation are preferred due the potential for dust to affect other environmental and human environment areas of importance. |
| | Surface water quantity | Alternatives with lower potential effects to surface water quantity are preferred due the potential for altered flows to affect other environmental and human environment areas of importance. |
| | Surface water quality | Alternatives with lower potential effects to surface water quality are preferred due the potential for degradation in surface water quality to affect other environmental and human environment areas of importance. |
| | Groundwater | Alternatives with potentially lower risks to groundwater quality and quantity are preferred. |
| | Fish, Fish Habitat and Aquatic Species | Alternatives with lower impacts to fish or fish habitat, endangered aquatic species, and pose a risk to fish and non-fish species are preferred due to their high biodiversity values. |
| | Terrestrial Ecosystems | Alternatives that have lower risks and impacts to wetlands and other terrestrial aquatic ecosystems are preferred due to their high biodiversity values. |

*(continued)*

**Table 4.1-1. Evaluation Criteria and Rationale for Selection (completed)**

| Account | Evaluation Criteria (Sub-Account) | Rationale |
|---|---|---|
| Environmental *(cont'd)* | Wildlife and Wildlife Habitat | Alternatives with lower risks and impacts to species of conservation concern, present increased risk to migratory birds and potential toxicological risk to wildlife species are less preferred due to their high biodiversity values. |
| Human Environment | Current use of Lands and Resources for Traditional Purposes – Lhoosk'uz Dene Nation | Alternatives with lower potential impacts to CULTRP for Lhoosk'uz Dene Nation are preferred. |
| | Current use of Lands and Resources for Traditional Purposes – Skin Tyee Nation | Alternatives with lower potential impacts to CULTRP for Skin Tyee Nation are preferred. |
| | Current use of Lands and Resources for Traditional Purposes – Ulkatcho First Nation | Alternatives with lower potential impacts to CULTRP for Ulkatcho First Nation are preferred. |
| | Non-traditional Land Use | Alternatives with lower impacts to non-traditional land use (i.e., the economic interests of commercial tenure holders) are preferred. |
| | Public Recreation | Alternatives with lower impacts to public recreation are preferred. |
| | Heritage | Archaeological sites are protected under the Heritage Conservation Act (1996a) and non-protected heritage sites may hold cultural and social value. Alternatives that do not impact heritage resources are preferred. |
| | Human Health | Alternatives that have lower risk human health risks are preferred. |
| | Employment | Alternatives with higher employment requirements are preferred. |
| Project Economics | Proponent costs | Alternatives with lower lifecycle costs are preferred. |

[1] *Note that CULRTP was characterized for the following First Nations or governmental organziations: Lhoosk'uz Dene Nation, Ulkatcho First Nation, Skin Tyee First Nation, Saik'uz First Nation, Nadleh Whut'en First Nation, Stellat'en First Nation, Nazko First Nation, Tsilhqot'in National Government, and Metis Nation British Columbia. Only those First Nations whose CULRTP was determined to be differentiating among the candidate alternatives are included here (i.e., for Lhoosk'uz Dene Nation, Skin Tyee Nation, and Ulkatcho First Nation).*

## 4.2 MEASUREMENT CRITERIA (INDICATORS)

Measurement criteria allow the sub-accounts and accounts to be measured. A six-point scale is used because it provides sufficient range to differentiate without being overly detailed, and it is an even number scale which eliminates the tendency to select the "middle-of-the road" value. Qualitative (i.e., value-based) scales were developed (e.g., very high, high, low) when precise measurability was not possible, as per the *Guidelines*.

Value scales were developed to be:

- reliable such that reviewers can rate an alternative according to the value scale and assign the same score;

- directly relevant to the indicator being scored; and
- justifiable so that a reviewer can conclude that the value scale is reasonable and representative.

Table 4.2-1 lists the indicators and their associated indicator parameters and unit of measurements that have been assigned for the multiple accounts ledger.

The measurement criteria and scores for each candidate under physical stability, technical, environmental, human environment and project economic accounts are provided in Appendix A.

**Table 4.2-1. Multiple Accounts Ledger**

| Account | Sub-Account (Evaluation Criteria) | Indicator (Measurement Criteria) | Indicator Parameter | Unit |
|---|---|---|---|---|
| Physical stability | Physical stability | Location of water storage | Qualitative Value | - |
| | | Tailings and waste rock interstitial water | Qualitative Value | - |
| | | Normal operating pond volume | Volume | $Mm^3$ |
| | | Emergency water pond management – active | Reclaim pump capacity | $Mm^3/y$ |
| | | Emergency water pond management – passive | Qualitative Value | - |
| | | Design basis / regulatory requirement | Qualitative Value | - |
| | | Tailings density | Qualitative Value | - |
| | | Maximum dam height | Height | m |
| | | Operational monitoring requirements - safety | Qualitative Value | - |
| Technical | Containment design | Style of containment | Qualitative Value | - |
| | | Number of dams | Number | # |
| | | Construction volumes | Volume | $Mm^3$ |
| | | Tailings initial settled density | Density | $t/m^3$ |
| | | Drainage provisions | Qualitative Value | - |
| | | Seepage management - physical | Qualitative Value | - |
| | | Seepage management – quality | Qualitative Value | - |
| | Construction requirements | Foundation Preparation for Tailings Storage Area (excludes dam) | Qualitative Value | - |
| | | Tailings infrastructure | Qualitative Value | - |
| | | Foundation preparation for PAG waste rock facility | Qualitative Value | - |
| | | Initial dam construction | Qualitative Value | - |
| | | Sustaining construction (excludes waste delivery) | Dam raise frequency | years |
| | Water management | Catchment area | Area | $km^2$ |
| | | Flood routing | Qualitative Value | - |
| | | Water balance – surplus / deficit / balance | Qualitative Value | - |
| | | Water recycle requirement | Volume | $Mm^3/y$ |
| | | Water treatment | Qualitative Value | - |
| | | Surplus water management | Volume | $Mm^3/y$ |
| | | Operational monitoring requirements – internal site water management | Qualitative Value | - |

*(continued)*

## Table 4.2-1. Multiple Accounts Ledger (continued)

| Account | Sub-Account (Evaluation Criteria) | Indicator (Measurement Criteria) | Indicator Parameter | Unit |
|---|---|---|---|---|
| Technical *(cont'd)* | Execution | Technology precedent – processing | Proven to Project throughput ratio | ratio |
| | | Technology precedent – storage | Proven to Project throughput ratio | ratio |
| | | Tailings delivery complexity | Qualitative Value | - |
| | | Tailings placement complexity | Qualitative Value | - |
| | | PAG waste rock delivery and placement | Qualitative Value | - |
| | | Operational flexibility | Qualitative Value | - |
| | Closure | Closure concept – physical | Qualitative Value | - |
| | | Closure concept – geochemical | Qualitative Value | - |
| | | Closure concept – active closure period | Years | # |
| | | Closure concept – long-term maintenance and monitoring | Qualitative Value | - |
| | | Concurrent closure and reclamation | Qualitative Value | - |
| | | Premature closure | Qualitative Value | - |
| Environmental | Climate and air quality | Sensitivity to climate change | Qualitative value | - |
| | | Noise and vibration | Qualitative value | - |
| | | Dust emissions | Qualitative Value | - |
| | Surface water quantity | Loss of catchment area | Area | $km^2$ |
| | Surface water quality | Storage of PAG materials | Qualitative Value | - |
| | | Dam embankment area | Volume | $Mm^3$ |
| | | Seepage quantity | Qualitative value | - |
| | | Operational discharge of treated water | Qualitative value | - |
| | Groundwater | Groundwater quality | Qualitative value | - |
| | | Groundwater quantity (base flow to downstream creeks) | Area | $km^2$ |
| | Terrain and soils | High productivity soils | Area | ha |
| | Fish, Fish Habitat and Aquatic Species | Fish habitat | Stream length | km |
| | | Risks to non-CRA fish aquatic resources | Qualitative value | - |
| | Vegetation and ecosystems | Loss of and risk to wetlands | Area | ha |
| | Wildlife and wildlife habitat | Loss of high-quality habitat for species of conservation concern | Area | ha |
| | | Loss of high-quality habitat for caribou | Area | ha |
| | | Loss of high-quality habitat for moose | Area | ha |
| | | Toxicological risk to migratory birds and amphibians | Qualitative value | - |
| | | Toxicological risks to terrestrial wildlife species | Qualitative value | - |

*(continued)*

## Table 4.2-1. Multiple Accounts Ledger (completed)

| Account | Sub-Account (Evaluation Criteria) | Indicator (Measurement Criteria) | Indicator Parameter | Unit |
|---|---|---|---|---|
| Human Environment | Current use of lands and resources for traditional purposes – Lhoosk'uz Dene Nation | Availability (abundance and distribution) of resources harvested by Aboriginal people | Area and length | ha and km |
| | | Quality of resources harvested by Aboriginal people | Qualitative Value | - |
| | | Quality of Aboriginal harvesters' experience | Qualitative Value | - |
| | Current use of lands and resources for traditional purposes – Skin Tyee First Nation | Availability (abundance and distribution) of resources harvested by Aboriginal people | Area and length | ha and km |
| | | Quality of resources harvested by Aboriginal people | Qualitative Value | - |
| | | Quality of Aboriginal harvesters' experience | Qualitative Value | - |
| | Current use of lands and resources for traditional purposes – Ulkatcho First Nation | Availability (abundance and distribution) of resources harvested by Aboriginal people | Area and length | ha and km |
| | | Quality of resources harvested by Aboriginal people | Qualitative Value | - |
| | | Quality of Aboriginal harvesters' experience | Qualitative Value | - |
| | Non-traditional land use | Agricultural and range tenures | Project overlap of tenure area | % |
| | | Registered traplines | Project overlap of tenure area | % |
| | Public recreation | Overlap with areas of recreational sensitivity and significance | Project overlap of recreational areas | ha |
| | Heritage | Known archaeological sites | Distance / overlap with known sites | m / # |
| | Human Health | Potential health risks | Qualitative Value | - |
| | Employment | Employment opportunities | People employed | # |
| Project Economics | Proponent cost | Initial capital costs | Cost | $ |
| | | Sustaining capital and operating costs | Cost | $ |
| | | Closure costs | Cost | $ |
| | | Post-closure costs | Qualitative value | - |

# 5. VALUE-BASED DECISION PROCESS

## 5.1 INDICATOR WEIGHTING

The indicator weightings presented in this section are based on professional experience and judgement of the Project team. All values were evaluated on a six-point scale, with 6 being the most significantly valued and 1 being the least. Weightings are relevant only when there is more than one indicator since they contrast the relative importance of each indicator within a given sub-account. The tables provide the indicators for each sub-account along with a scalar value and metric on which to score the candidates. Not all scalar value (i.e., from 1 to 6) have a metric for all indicators. This can be the case for the more qualitative indicators where the metric can be candidate-specific than for the quantitative metrics. In cases where the scalar values are not sequential (e.g., 1, 3, 5) the difference between the metric is considered more significant than when they are sequential (i.e., 2, 3, 4).

### 5.1.1 Physical Stability

Indicator weighting for the physical stability sub-account are provided in Table 5.1-1. Indicator weighting was assigned based on recommendation and findings from the *Panel Report* (IEEIRP 2015). The indicators weighted with the highest values for the physical stability sub-account are *location of water storage* and *normal operating pond volume*. These indicators are implicit in the BAT principle of "eliminating surface water from the TSF" and were major factors in the events that led to the failure of the Mount Polley TSF (IEEIRP 2015).

**Table 5.1-1. Physical Stability Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Location of water storage | 6 |
| Tailings and waste rock interstitial water | 5 |
| Normal operating pond volume | 6 |
| Emergency water management - pumps (active) | 2 |
| Emergency water management - spillway (passive) | 4 |
| Design basis / regulatory requirement | 3 |
| Tailings density | 5 |
| Maximum dam height | 4 |
| Operational monitoring requirements - safety | 5 |

Indicators weighted with high values include *tailings physical stability*, *tailings and waste rock interstitial water*, and *operational monitoring requirements*. The overarching goal of BAT for tailings management from the Panel Report is to assure physical stability of the tailings deposit (IEEIRP 2015, section 9.3.1), which can be achieved by increasing the density of tailings through thickening or filtering the material. An additional goal of the *Panel Report* is to "promote unsaturated conditions in the tailings with drainage provisions" and "achieve dilatant conditions throughout the tailings

deposit", which can be is achieved by reducing interstitial water in waste materials and by compaction. Operational monitoring, although not relevant to all failure modes, is considered vital to safety as it can provide early warning of conditions that deviate from design specifications.

Indicators weighted with moderate values include *emergency water management – spillway (passive), maximum dam height*, and *design basis / regulatory requirement*. The storage facilities are designed to hold high return flood events. Routing excess water through a spillway during emergency conditions is a more reliable method of emergency water management than pumping the water out of the impoundment. Higher dams do not necessarily have higher risk of failure; however, they generally have higher consequence if they do fail. Regulatory requirements for TSF design are important as they allow for increased regulatory scrutiny.

Indicators weighted with low values include *emergency water management – pumps (active)*. The waste management facilities are designed to hold the IDF; in an emergency situation, active pumping of water from the TSF would be less effective and reliable than routing the water through a spillway; this indicator is thus assigned a correspondingly low weighting.

### 5.1.2 Technical

The indicators for each technical sub-account were each assigned a weighting according to professional judgment, as well as the associated risk of each indicators. For each sub-account with multiple indicators, these assigned weightings are presented in Tables 5.1-2 to 5.1-6.

#### *5.1.2.1 Containment Design*

The indicator weighting values for the sub-account *containment design* were assigned based on their relative importance with respect to ease of construction and operation; weightings are presented in Table 5.1-2.

**Table 5.1-2. Containment Design Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Style of containment | 6 |
| Number of dams | 5 |
| Construction volumes | 3 |
| Tailings initial settled density | 1 |
| Drainage provisions | 4 |
| Seepage management - physical | 3 |
| Seepage management - quality | 5 |

The indicators assigned the highest value include *style of containment*, *number of dams*, and *seepage management - quality*. Style of containment is important because the storage location within the natural topography affects safety and construction / operational complexity; for example, a valley fill TSF is considered safer and easier to operate than a ring-dike TSF. Poor quality seepage reporting

to the seepage collection ponds indicates ML/ARD is occurring within the waste materials; this is difficult to mitigate and has potentially long-term implications for water treatment and monitoring.

Indicators weighted with moderate values include *drainage provisions*, *construction volumes*, and *seepage management – physical*. Drainage provisions include embankment and foundation drains, and while potentially onerous in the case of the latter, are not critical for safety or ease of construction and operation. Similarly, construction volumes are important but not a critical factor provided there is sufficient suitable (i.e., NAG) material. Seepage management (physical) is important and required for all mine waste facilities; it includes cut-off trenches, collection ponds and covers and liners encapsulating reactive waste material. Seepage rates, while important, can be more easily managed by sizing pumps, whereas seepage quality deterioration is more difficult to manage, particularly in the long-term.

The indicator weighted with a low value is *tailings initial settled density* because this indicator is primarily important to the size of the TSF, which is considered less important to safety and ease of construction and operation than the indicators listed above.

#### *5.1.2.2 Construction Requirements*

The indicator weighting values for the sub-account *construction requirements* were assigned based on their relative importance with respect to potential construction effort and complexity; weightings are presented in Table 5.1-3.

**Table 5.1-3. Construction Requirements Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Foundation preparation for tailings storage area (excludes dam) | 6 |
| Tailings infrastructure | 4 |
| Foundation preparation for PAG waste rock facility | 6 |
| Initial dam construction | 6 |
| Sustaining construction (excludes waste delivery) | 4 |

The indicators of the highest significance include *foundation preparation for tailings storage area*; *foundation preparation for PAG waste rock facility*, and *initial dam construction*. These indicators are weighted as most important because the four candidates under considered in this assessment represent large areas with considerable variability in construction requirements and complexity. In addition, *initial dam construction* is vulnerable to timing (i.e., single stage versus multiple stage construction) and the potential shortage of suitable construction material.

Indicators weighted with moderate values include *tailings infrastructure* and *sustaining construction*. These indicators are rated as less important because they tend to be known quantities (e.g., pipe, pumps and construction material volumes).

### *5.1.2.3 Water Management*

The indicator weighting values for the sub-account *water management* were based on safety, environmental risk, and complexity of water treatment; weightings are presented in Table 5.1-4.

**Table 5.1-4. Water Management Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Catchment Area | 3 |
| Flood Routing | 4 |
| Water Balance - Surplus/Deficit/Balance | 6 |
| Water Recycle Requirement | 2 |
| Water Treatment | 4 |
| Surplus Water Management | 5 |
| Operational monitoring requirements - internal site water management | 4 |

The indicator *water balance* was assigned the highest value: maintaining water balance on a TSF is a key performance criterion for tailings management. Water balance adequacy, including provisions and contingencies for wet years, was identified as an important measure for regulatory review in the *Panel Report* (section 9.4.4). Surplus water, more common in a project's later years of operation, risks overtopping of the TSF. *Surplus water management* is assigned a high weighting because this indicator relates to the ability to manage surplus water on the TSF; inability to manage surplus water presents a significant safety risk to an impoundment.

Indicators assigned moderate values include *flood routing, water treatment*, *operational monitoring requirements*, and *catchment area*. The capacity to retain a flood event and prevent discharge during operations is important because of potential downstream effects of a release. Flood routing through an active construction area has the potential to erode and transport tailings into the water storage pond and, if discharged through a spillway, have downstream effects. Potential for long-term water treatment exists should the waste materials generate ML/ARD that need to be collected and treated prior to discharge. In addition to the cost implication, water treatment is important because of the risks associated with system failure or inability to meet discharge objectives. Internal water monitoring requirements during operations are expected to be different for the technology alternatives. Monitoring requirements are anticipated to be more onerous as a result of the greater potential for ML/ARD and sudden changes in conditions associated with filtered tailings and PAG waste rock stored on land. The indicators *catchment areas* and *water recycle requirements* are well understood and considered less important as they are managed through clean water diversion and sizing of recycle infrastructure.

### *5.1.2.4 Execution*

Execution incorporates delivery and placement of the waste materials at a throughput of 60,000 tonnes per day and also considers flexibility during upset conditions; indicator weightings are presented in Table 5.1-5.

**Table 5.1-5. Execution Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Technology Precedent - processing | 2 |
| Technology Precedent - storage | 4 |
| Tailings Delivery Complexity | 6 |
| Tailings Placement Complexity | 5 |
| PAG Waste Rock Delivery and Placement | 4 |
| Operational Flexibility | 5 |

The indicators *tailings delivery complexity*, *tailings placement complexity*, and *operational flexibility* are weighted with high values because they have the potential to disrupt or stop operations if unable to meet specifications. Greater complexity for tailings delivery and placement generally implies greater likelihood of failure whereas *operational flexibility* relates to robustness of the system tailings to manage upset conditions. Filtered tailings require transportation via an overland conveyor with a stacker followed by spreading and compaction; alternatively a large fleet of haul trucks would be required to transport the tailings. Since thickened-slurry tailings are conveyed through a pipeline and do not require spreading or compaction, they are significantly less complex to manage. PAG waste rock delivery is an important criterion because there are challenges associated with placing the rock underwater and at suitable 'lift-thickness' to ensure stability.

The *technology precedent – processing* indicator is weighted lower than other indicators because technology is generally scalable and for this reason increasing the processing capacity for filtered tailings while potentially challenging, is considered less important than other indicators.

### *5.1.2.5 Closure*

High significance closure concepts include physical and geochemical stability as well as long-term monitoring and maintenance requirements; indicator weightings are presented in Table 5.1-6. These indicators were weighted with high values as ensuring long-term physical and chemical stability whilst reducing long-term maintenance and monitoring requirements are key closure objectives. The ability to implement the closure plan should the mine close prematurely is also important but was weighted with a moderate value because a closure plan is usually amenable to modification specific to the project stage. The active closure period and capacity for concurrent reclamation are considered less important than the long-term physical and geochemical stability and were weighted lower accordingly.

**Table 5.1-6. Closure Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Closure concept - physical | 6 |
| Closure concept - geochemical | 5 |
| Closure concept - active closure period | 2 |
| Closure concept - long-term maintenance and monitoring | 5 |
| Concurrent closure and reclamation | 1 |
| Premature closure | 4 |

### 5.1.3 Environmental

The indicators for each environmental sub-account were each assigned a weighting according to professional judgment, as well as on the strength of regulatory protection and concern for a given indicator and whether the indicator is related to an area of Aboriginal concern. For each sub-account with multiple indicators these assigned weightings are presented in Tables 5.1-7 to 5.1-13 below.

#### *5.1.3.1 Climate and Air Quality*

The indicator weighting values for the sub-account *climate and atmosphere* were assigned based on the relative risk to human health and environment (Table 5.1-7). The indicator *dust emissions* was assigned the highest weighting, as the storage of on-land tailings and waste rock may cause negative effects to workers and the surrounding environment (e.g., country foods).

**Table 5.1-7. Climate and Air Quality Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Sensitivity to climate change | 3 |
| Dust emissions | 5 |
| Noise and Vibrations | 2 |

The indicator *sensitivity to climate change* was assigned a moderate weighting because, although the time frames under consideration in this indicator would primarily occur after the Project's closure phase, the presence of tailings and PAG waste rock on-land would most-likely require long-term maintenance because of the facility sensitivity to extreme dry or wet events and require active water treatment, which may become more challenging with climate change.

The indicator *noise and vibration* was assigned a low weighting because the temporal period over which noise and vibration effects are expected to occur is relatively short (i.e., only during mine life and for a relatively short period during reclamation).

### *5.1.3.2 Surface Water Quality*

The indicator weighting values for the sub-account *surface water quality* were assigned based on the relative risk to the environment (Table 5.1-8). The prevention of ML/ARD by storing PAG materials under water is considered the most significant indicator for the surface water quality sub-account. The requirement to treat contact water prior to discharging to the receiving environment introduces risks if complications occur and compliance with regulatory guideline values becomes unattainable.

**Table 5.1-8. Surface Water Quality Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Storage of PAG material | 6 |
| Seepage quantity | 3 |
| Dam embankment area | 2 |
| Operational discharge of treated water | 5 |

The quantity and quality of seepage through the tailings dam, although mostly captured by the collection ditches and reporting to the seepage collection pond, could affect downstream water quality. The seepage quantity is greater where water is close to the dam. The quality of the seepage is related to the embankment area since there would be more infiltration coming into contact with mine rock for larger dams. Although important, these indicators were weighted lower than *storage of PAG material* and *operational discharge of treated water* because the mine has been designed to collect and recycle seepage and runoff from the TSF dam.

### *5.1.3.3 Groundwater*

The groundwater quality indicator is weighted with a high value because deterioration in *groundwater quality* has potentially significant implications for downstream surface water quality, fish and fish habitat and long-term management (Table 5.1-9). The *groundwater quantity* indicator is weighted with moderate value because, although important for maintaining flows in downstream creeks, these will be mitigated by augmenting creek flow during operations.

**Table 5.1-9. Groundwater Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Groundwater quality | 5 |
| Groundwater quantity | 3 |

### *5.1.3.4 Fish, Fish Habitat and Aquatic Resources*

The indicator values for the sub-account *fish, fish habitat and aquatic resources* were assigned based on legislative requirements and relative risk to the species under consideration (Table 5.1-10). The indicator *loss of fish habitat* was assigned the highest weighting because of the importance of fish habitat to CRA fish species, and their relative importance to biodiversity and traditional use. The

indicators *risk to non-CRA fish and aquatic species* is weighted lower as they are not CRA fishery species.

**Table 5.1-10. Fish, Fish Habitat and Aquatic Resources Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Loss of Fish Habitat | 6 |
| Risk to non-CRA fish and aquatic resources | 1 |

#### *5.1.3.5 Wildlife*

Indicators for the sub-account *wildlife* were assigned considering the relative strength of the legal protection for each indicator, the stated concerns of Aboriginal groups for each species, the habitat specificity of the affected species, the sensitivity of species to disturbance, and the amount of suitable habitat in the general Project region (Table 5.1-11).

The indicators *toxicological risk to migratory birds and amphibians and bats* and *loss of high quality habitat for caribou* were assigned the highest weighting because of the legal status, both provincially and federally, of these species as well as Aboriginal concern around caribou habitat.

The *toxicological risk to terrestrial wildlife species* indicator was assigned a moderate weighting because most wildlife species are inclined to avoid the mining area during operations; after closure there would be minimal exposure to COPC because of reclamation. The *loss of high-quality habitat for species of conservation concern* indicator, which includes myotis bat habitat, was assigned a moderate weighting because there is abundant high-quality habitat in regional area and the lost areas are relatively small. The *loss of high quality habitat for moose* indicator is weighted with a low value because there is similar high quality habitat in the regional area and the area lost is small.

**Table 5.1-11. Wildlife Indicator Weighting**

| Indicator | Weighting Value |
|---|---|
| Loss of high-quality habitat for species of conservation concern | 3 |
| Loss of high quality habitat for caribou | 6 |
| Loss of high quality habitat for moose | 2 |
| Toxicological risk to migratory birds and amphibians and bats | 6 |
| Toxicological risk to terrestrial wildlife species | 4 |

### 5.1.4 Human Environment

#### *5.1.4.1 Current Use of Lands for Traditional Purposes*

For the three First Nations with potential for CULRTP to interact with the candidate alternatives (LDN, STN and UFN), relative indicator weightings are assigned based on the degree of the relative potential impact. Potential changes in the quality of harvested resources were weighted highest

because of health implications of poor quality foods for consumers. The change in the quality of experience of the area and availability of harvested resources were weighted lower because although they may affect enjoyment and access to harvested resources, they are not as important as the quality of the harvested resources (Table 5.1-12). In addition, the areas of overlap with traplines are relatively small (< 5%).

**Table 5.1-12. Indicator Weighting for Current Use of Lands for Traditional Purposes – Lhoosk'uz Dene Nation, Skin Tyee Nation, and Ulkatcho First Nation**

| Indicator | Weighting Value |
|---|---|
| Availability (abundance and distribution) of resources | 3 |
| Quality of resources harvested by Aboriginal people | 6 |
| Quality of Aboriginal harvesters' experience | 4 |

#### *5.1.4.2 Non-traditional Land Use*

The weightings for the indicators under *non-traditional land use* (Table 5.1-13) are based on the relatively small percentages of registered tenures overlapped by the candidate footprints. *Agricultural and range tenures*, and *registered trap lines* were assigned with low and moderate values respectively.

**Table 5.1-13. Indicator Weighting for Non-traditional Land Use**

| Indicator | Weighting Value |
|---|---|
| Registered trap lines | 3 |
| Agricultural and range tenures | 2 |

### 5.1.5 Project Economics

*Proponent costs* indicators (*initial capital costs*, *sustaining capital and operating costs*, *closure costs,* and *post-closure costs*) have been assigned the same weightings (i.e., 1) to remove any bias that weighting the costs towards Net Present Value would present (i.e. calculating a higher value for capital costs versus closure and post-closure costs).

## 5.2 SUB-ACCOUNT WEIGHTING

The sub-account weightings presented in this section are based on professional judgement of the Project team who assembled this report. Only accounts with more than one sub-account are discussed in this section. All values were evaluated on a six-point scale, with 6 being the most significantly valued and 1 being the least.

### 5.2.1 Physical Stability Sub-Account Weightings

*Physical stability* is an account does not have any sub-accounts but indicators listed in section 5.1.1

### 5.2.2 Technical Sub-Account Weightings

*Technical* sub-account weightings were assigned according to the relative Project risk associated with the sub-account. *Containment design*, *water management*, *execution,* and *closure* were considered to all have equally high risk to safe TSF construction, operation, closure, and post-closure (Table 5.2-1). The *construction requirements* sub-account was considered lower risk because although foundation preparations and infrastructure installation could lead to cost and scheduling delays during construction, there are fewer implications for Project outcomes during operation and for closure.

**Table 5.2-1. Technical Sub-Accounts Weighting**

| Sub-Account | Weighting Value |
|---|---|
| Containment Design | 6 |
| Construction Requirements | 4 |
| Water Management | 6 |
| Execution | 6 |
| Closure | 6 |

### 5.2.3 Environmental Sub-Account Weightings

*Environmental* sub-account weightings were assigned based on the relative sensitivities of the sub-accounts to the differences in candidate alternatives, as well as the relative legal protection and Aboriginal interest in a given sub-account (Table 5.2-2). The *fish, fish habitat and aquatic resources* sub-account was assigned the highest weighting because of the presence of species of importance for CRA fisheries and potential risks to non-CRA fish and aquatic resources resulting from the different candidate alternatives (Table 5.2-2). The related *surface water quality* sub-account was also ranked highly because of potential sensitivity of downstream aquatic resources to any poor quality water releases from the Project. The sub-accounts *wildlife* was also weighted with a high value because of potenital loss of high quality habit and toxicological risk from the different waste management technologies.

**Table 5.2-2. Environmental Sub-Account Weighting**

| Sub-Account | Weighting Value |
|---|---|
| Climate and air quality | 3 |
| Surface water quantity | 4 |
| Surface water quality | 6 |
| Groundwater | 3 |
| Terrain and Soils | 1 |
| Fish, fish habitat and aquatic resources | 6 |
| Terrestrial Ecosystems | 3 |
| Wildlife | 5 |

The sub-account *terrestrial ecosystems* was moderately weighted because, although improtant to many important wildlife and plant species, the overall affected habitat associated with each candidate footprint is small relative to the available habitat within the regional area. The sub-account *climate and air quality* was also weighted moderately because robust design and operational procedures will mitigate the potential effects to and resulting from the waste storage facilities. The sub-account *groundwater* was weighted with a moderate value because, although important for providing base flow to streams during critical low-flow periods, the project design will cut-off and intercept most poor quality groundwater seepage. Also, stream flow augmentation to meet downstream stream flow needs will mitigate the effects from the Project. The sub-account *terrain and soils* was weighted with a low value because the candidates are all located within stable terrain and the area of high quality soil affected by the candidate footprints is small.

### 5.2.4 Human Environment Sub-Account Weightings

*Human environment* sub-account weightings were assigned based on the relative sensitivities of the sub-accounts to the differences in candidate alternatives, as well as to emphasize the importance of minimizing impacts to Aboriginal groups resulting from the alternatives (Table 5.2-3). Thus, the sub-accounts *Current Use of Lands and Resources for Traditional Purposes – Lhoosk'uz Dene Nation*, *Current Use of Lands and Resources for Traditional Purposes – Ulkatcho First Nation*, and *Current Use of Lands and Resources for Traditional Purposes – Skin Tyee Nation*" were assigned the highest weighting. In addition, the sub-account *human health* was also assigned the highest weighting as these are considered most important within the context of potential effects to local communities.

**Table 5.2-3. Human Environment Sub-Account Weighting**

| Sub-Account | Weighting Value |
|---|---|
| Current Use of Lands and Resources for Traditional Purposes – Lhoosk'uz Dene Nation | 6 |
| Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | 6 |
| Current Use of Lands and Resources for Traditional Purposes – Ulkatcho First Nation | 6 |
| Non-traditional Land Use | 2 |
| Public recreation | 2 |
| Heritage | 4 |
| Human Health | 6 |
| Employment | 3 |

The sub-account *heritage* was assigned moderate value weighting because of potential effects to archaeological and/or heritage sites and concerns expressed by LDN and UFN. There are few known overlaps with archaeological / heritage sites from the candidate footprints although there is potential for finds during Project construction. The sub-account *public recreation* was assigned a moderate value weighting because of the disturbance to public recreation that a mining operation would bring to the upper catchment of Davidson Creek; although there is other highly rated recreational land in proximity

of the Project footprint. The sub-account *employment* has a moderate value weighting because of benefits to local communities that potentially arise from greater employment opportunities. The incremental opportunities arising from the different waste management technologies is small relative to the overall staffing requirements and some of these positions may be specialized and not directly benefit local communities.

The sub-account *non-traditional land use* includes range and registered trapline tenures and was assigned a low weighting. Although LDN and SFN have expressed concern about potential effects on trapline holders, the percentage of total tenure areas which the candidate footprints overlap are small relative to the total tenure areas.

## 5.3 ACCOUNT WEIGHTING

The recommended base-case account weightings were derived from the *Guidelines*, and are presented in Table 5.3-1. Although physical stability is not traditionally an account under the *Guidelines*, it has been separated from the Technical Account and assigned the highest weighting (along with the Environment Account) to emphasize the *Panel Report's* emphasis on the physical safety / stability of waste impoundments.

**Table 5.3-1. Account Weighting for Base-case Value Scenarios**

| Account | Weighting Base Case |
|---|---|
| Physical stability | 6 |
| Technical | 3 |
| Environment | 6 |
| Human Environment | 3 |
| Project Economic | 1.5 |

# 6. QUANTITATIVE ANALYSIS

The overall results are presented in Table 6-1. The scoring represents the sum of the five Accounts with Base Case weightings as per Table 5.3-1. Candidate 1 scored highest overall with 3.9, indicating that it is the preferred alternative for the base case analysis. Sensitivity analysis of this result is presented in Section 7.

The base case MAA calculation tables are included in Appendix B.1.

**Table 6-1. Multiple Accounts Analysis Base Case Results**

| | Candidate 1 - Slurry Tailings / Submerged PAG | Candidate 7 - Filtered Tailings / Submerged PAG | Candidate 10 - Paste Tailings / Submerged PAG | Candidate 22 - Filtered Tailings / PAG on Land |
|---|---|---|---|---|
| Base Case | 3.9 | 3.0 | 3.4 | 3.3 |

# 7. SENSITIVITY ANALYSIS

The sensitivity analysis re-assigns the weightings of the accounts and sub-accounts to provide alternative value systems base case discussed in section 6.

Twelve sensitivity analyses were performed for this assessment (Table 7-1):

1. all accounts were given an equal weighting (i.e., a value of 1; Appendix B.2);
2. all accounts and sub-accounts were assigned equal weightings (i.e., a value of 1; Appendix B.3);
3. *Project Economics* were weighted towards their relative contribution to the NPV (Appendix B.4);
4. *Project Economics* were removed from the analysis (Appendix B.5);
5. *Physical Stability* was incorporated into the *Technical* account consistent with the *Guidelines* (Appendix B.6)
6. Only *Current Use of Lands and Resources for Traditional Purposes* considered in the analysis (Appendix B.7)
7. only differentiating indicators considered (Appendix B.8);
8. only *Physical Stability* Account considered (Appendix B.1; Figure 7-1);
9. only *Technical* Account considered (Appendix B.1; Figure 7-1);
10. only *Environment* Account considered (Appendix B.1; Figure 7-1);
11. only *Human Environment* Account considered (Appendix B.1; Figure 7-1); and
12. only *Project Economics* Account considered (Appendix B.1; Figure 7-1).

**Table 7-1. Results of Sensitivity Analyses**

| Sensitivity Run | Candidate 1 - Slurry tailings / submerged PAG | Candidate 7 - Filtered tailings / submerged PAG | Candidate 10 - Paste tailings / submerged PAG | Candidate 22 - Filtered tailings / PAG dump |
|---|---|---|---|---|
| 1 - all accounts given equal weighting | 3.6 | 2.3 | 3.1 | 2.2 |
| 2 – all accounts and sub-accounts given equal weighting | 4.2 | 2.9 | 3.7 | 3.1 |
| 3 – Project economics weighted towards contribution to net present value (NPV) | 4.0 | 3.0 | 3.4 | 3.3 |
| 4 –Project economics removed from the analysis | 3.8 | 3.1 | 3.3 | 3.4 |

*(continued)*

**Table 7-1. Results of Sensitivity Analyses (completed)**

| Sensitivity Run | Candidate 1 - Slurry tailings / submerged PAG | Candidate 7 - Filtered tailings / submerged PAG | Candidate 10 - Paste tailings / submerged PAG | Candidate 22 - Filtered tailings / PAG dump |
|---|---|---|---|---|
| 5 - Physical Stability incorporated into Technical account | 3.9 | 2.7 | 3.3 | 2.7 |
| 6 – Only Current Use of Lands and Resources for Traditional Purposes considered | 5.1 | 3.2 | 4.0 | 3.2 |
| 7 – Only differentiating indicators considered | 3.1 | 2.4 | 2.7 | 2.5 |
| 8 – only Physical Stability account considered | 4.0 | 3.6 | 3.6 | 4.8 |
| 9 – only Technical account considered | 4.5 | 3.1 | 3.8 | 2.9 |
| 10 – only Environmental account considered | 3.0 | 2.4 | 2.6 | 2.3 |
| 11 – only Human Environment account considered | 4.5 | 3.3 | 3.8 | 3.6 |
| 12 – only Project Economics account considered | 5.5 | 2.0 | 4.8 | 1.5 |

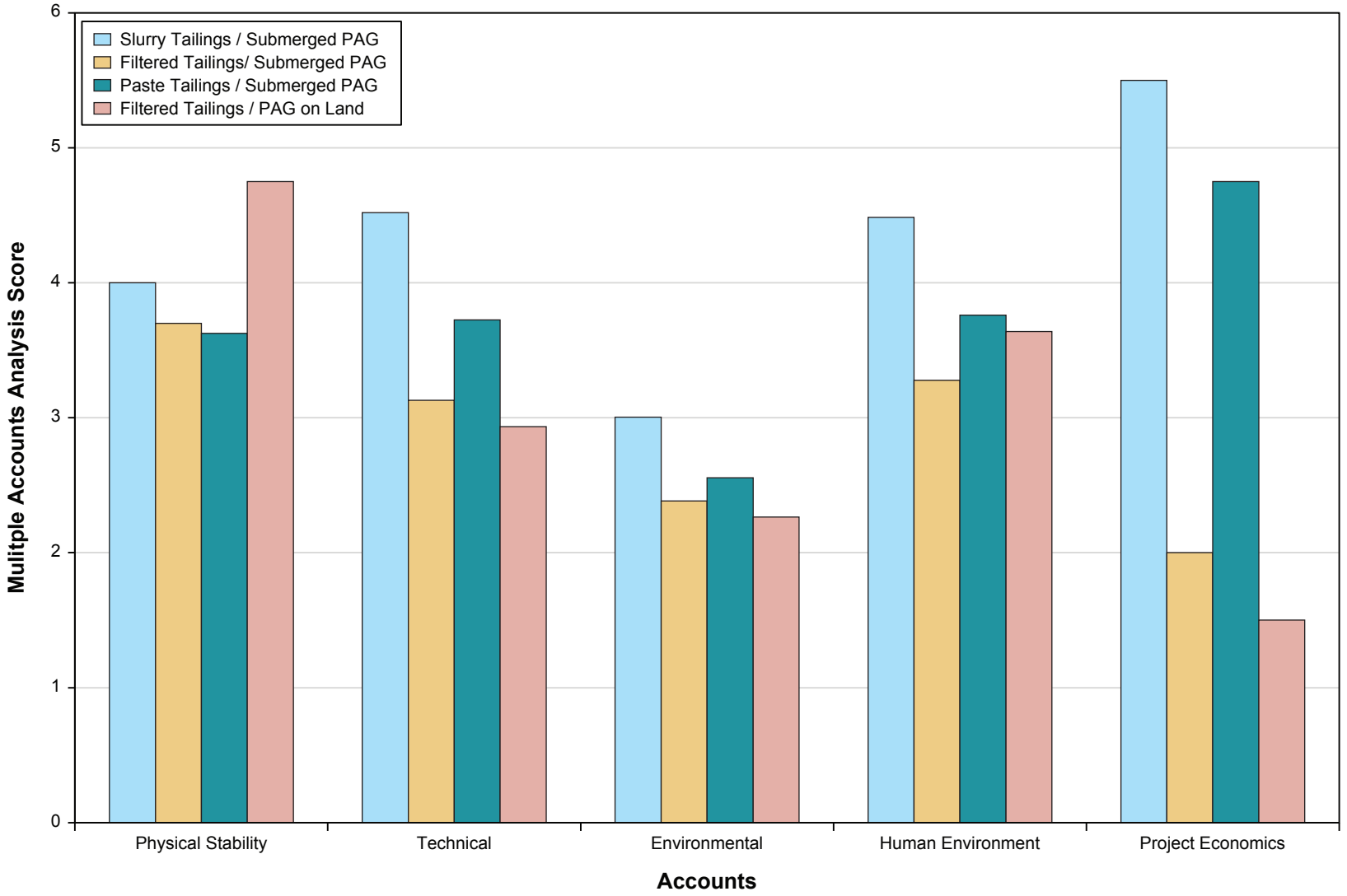
*Note: green highlighting indicates the option that has the highest score for a given sensitivity analysis*

The sensitivity analyses indicate that the overall rankings are relatively insensitive to other value systems as Candidate 1 scores highest in all other sensitivity runs, with the exception of sensitivity run 8: only *Physical Stability* account considered.

The scoring of the individual accounts is shown graphically below (Figure 7-1; sensitivity analyses 8 - 12) and illustrates that Candidate 1 scored highest for all accounts except *Physical Stability*. As expected, Candidate 22 scored highest with respect to *Physical Stability* because it meets many of the BAT principles suggested in the *Panel Report* (e.g., water not stored within the active waste storage facility and dry, compacted tailings promote strength). However, it does not score high in the other accounts because of the technical challenges of operating a filtered TSF at the Project throughput and the geochemical risks associated with unsaturated storage of PAG materials. The scores on the vertical axis of Figure 7-1 are relative to each account and not comparable across accounts

Candidate 1 scored highest for the *Technical* account because this candidate allows for the best management of seepage through development of a long tailings beach. Candidate 1 also entails fewer foundation construction requirements and infrastructure for tailings production compared to the other alternatives. Water management is simplest with a small and manageable water surplus later in the mine life. There will be no requirement for discharge of treated water during operations. Slurry deposition is the only tailings technology proven at the Project throughput. Slurry deposition allows the greatest flexibility in the event of plant upset conditions as the tailings can easily be rerouted to other depositional areas. The submergence of PAG/ML materials is very important in ameliorating geochemical conditions so that ML/ARD is minimized; long-term monitoring and maintenance is reduced with only one facility of concern.

**Figure 7-1**
**Account Scores for Technology Candidates**



Candidate 1 scored highest for the *Environment* account because the effects from poor water quality (ML / ARD) are minimized by submergence. Saturated waste also minimizes dust generation. The seepage quantity is less than the other candidates as water is kept away from the dam by a large beach. The better water quality and lower dust emissions means toxicological risk to wildlife is minimized. Candidate 1 also scored highest for the human environmental account because less dust and better water quality minimize the potential health effects from harvested resources.

The *Project Economics* are more favourable for Candidate 1 and candidate 10 because they do not require the cost of operating a filter plant and equipment for tailings deposition. The closure costs are significantly less for Candidates 1 and 10 because they do not require long-term management associated with water treatment and maintenance of areas affected by acidic conditions.

# 8. CONCLUSIONS

The conclusions of this analysis are:

- In the base case analysis, Candidate 1 is the most favourable tailings and waste rock management alternative, and with an overall score of 3.9. The next highest scoring alternative is Candidate 10 with an overall score of 3.4. The filtered tailings candidates are least favourable with Candidate 22 scoring 3.3 and Candidate 7 scoring 3.0.
- Candidate 1 scores highest for the technical, environmental, human environment and project economics accounts but not for physical stability. Candidate 22 scored highest for physical stability as it does not comprise a combined tailings and water storage facility;
- The sensitivity analyses indicate that the overall rankings are relatively insensitive to other value systems as Candidate 1 scores highest in all other sensitivity runs, with the exception of sensitivity run 8: only *Physical Stability* account considered, where Candidate 22 scored highest.

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# *Appendix A*

*Indicator Scoring Tables*

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| Physical Stability | | | | | | | | |
| | Physical Stability | Location of water storage | | | 3 | 1 | 1 | 5 |
| | | | 6 | Pond stored in natural depression | | | | |
| | | | 5 | Pond not in active waste storage facility | | | | |
| | | | 4 | | | | | |
| | | | 3 | Pond in waste storage facility, water away from dam | | | | |
| | | | 2 | | | | | |
| | | | 1 | Pond in waste storage facility, water against dam | | | | |
| | | Tailings and waste rock interstitial water | | | 3 | 4 | 3 | 5 |
| | | | 6 | Tailings partially saturated and waste rock unsaturated | | | | |
| | | | 5 | Tailings partially saturated and waste rock partially saturated | | | | |
| | | | 4 | Tailings partially saturated and waste rock saturated | | | | |
| | | | 3 | Tailings saturated and waste rock saturated | | | | |
| | | | 2 | | | | | |
| | | | 1 | Sub-aqueous deposition and storage of tailings and waste rock | | | | |
| | | Normal operating pond volume | | | 4 | 5 | 5 | 6 |
| | | | 6 | Between 1 and 5 $Mm^3$ | | | | |
| | | | 5 | Between 6 and 10 $Mm^3$ | | | | |
| | | | 4 | Between 11 and 20 $Mm^3$ | | | | |
| | | | 3 | Between 21 and 35 $Mm^3$ | | | | |
| | | | 2 | Between 36 and 50 $Mm^3$ | | | | |
| | | | 1 | Greater than 51 $Mm^3$ | | | | |
| | | Emergency water management - pumps (active) | | | 5 | 3 | 4 | 3 |
| | | | 6 | Reclaim greater than 40 $Mm^3$ per year | | | | |
| | | | 5 | Reclaim 20 - 40 $Mm^3$ per year | | | | |
| | | | 4 | Reclaim 10 - 20 $Mm^3$ per year | | | | |
| | | | 3 | Reclaim 5 - 10 $Mm^3$ per year | | | | |
| | | | 2 | Reclaim 0 - 5 $Mm^3$ per year | | | | |
| | | | 1 | No Reclaim requirement | | | | |
| | | Emergency water management - spillway (passive) | | | 4 | 4 | 4 | 6 |
| | | | 6 | Spillway available throughout operations | | | | |
| | | | 5 | | | | | |
| | | | 4 | Spillway available only in closure | | | | |
| | | | 3 | | | | | |
| | | | 2 | | | | | |
| | | | 1 | No spillway | | | | |
| | | Design basis / regulatory requirement | | | 6 | 5 | 6 | 3 |
| | | | 6 | EXTREME consequence classification dams | | | | |
| | | | 5 | VERY HIGH consequence classification dams | | | | |
| | | | 4 | HIGH consequence classification dams | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 3 | SIGNIFICANT consequence classification dams and HIGH failure hazard waste piles | | | | |
| | | | 2 | LOW consequence classification dams and MODERATE failure hazard waste piles | | | | |
| | | | 1 | LOW failure hazard waste piles | | | | |
| | | Tailings density | | | 3 | 5 | 3 | 5 |
| | | | 6 | Filtered, spread and compacted tailings in thin lifts | | | | |
| | | | 5 | Filtered, placed loose with surface compaction | | | | |
| | | | 4 | | | | | |
| | | | 3 | Slurried tailings, subaerial discharge, with long term consolidation | | | | |
| | | | 2 | | | | | |
| | | | 1 | Subaqueous discharge of tailings, little long term consolidation | | | | |
| | | Maximum dam height | | | 3 | 3 | 3 | 5 |
| | | | 6 | Less than 20 m high | | | | |
| | | | 5 | Between 20 m and 50 m high | | | | |
| | | | 4 | Between 50 m and 100 m high | | | | |
| | | | 3 | Between 100 m and 150 m high | | | | |
| | | | 2 | Between 150 m and 200 m high | | | | |
| | | | 1 | Greater than 200 m high | | | | |
| | | Operational monitoring requirements - safety | | | 6 | 3 | 5 | 3 |
| | | | 6 | Most easily defined monitoring network with lower intensity monitoring | | | | |
| | | | 5 | Easily defined monitoring network with higher intensity monitoring | | | | |
| | | | 4 | Moderately defined monitoring network with higher intensity monitoring | | | | |
| | | | 3 | More complex monitoring network at 2 facilities with high intensity monitoring | | | | |
| | | | 2 | Most complex monitoring network at 2 facilities with high intensity monitoring | | | | |
| | | | 1 | Difficult to establish robust monitoring network | | | | |
| Technical | | | | | | | | |
| | | | | | | | | |
| | Containment Design | Style of Containment | | | 5 | 4 | 5 | 3 |
| | | | 6 | Full containment with natural ground - lake/depression | | | | |
| | | | 5 | Natural ground on two sides - level (valley fill) | | | | |
| | | | 4 | Natural ground on two sides - heaped (valley fill) | | | | |
| | | | 3 | Natural ground on one side - level (side hill fill) | | | | |
| | | | 2 | Natural ground on one side - heaped (side hill fill) | | | | |
| | | | 1 | No containment with natural ground - ring dike | | | | |
| | | Number of dams | | | 2 | 5 | 3 | 6 |
| | | | 6 | No dams or single stage dam(s) only | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 5 | One dam | | | | |
| | | | 4 | Two dams | | | | |
| | | | 3 | Three dams | | | | |
| | | | 2 | Four dams | | | | |
| | | | 1 | Five or more dams | | | | |
| | | Construction Volumes | | | 2 | 4 | 2 | 6 |
| | | | 6 | < 10 $Mm^3$ | | | | |
| | | | 5 | 10 - 20 $Mm^3$ | | | | |
| | | | 4 | 20 - 40 $Mm^3$ | | | | |
| | | | 3 | 40 - 60 $Mm^3$ | | | | |
| | | | 2 | 60 - 80 $Mm^3$ | | | | |
| | | | 1 | > 80 $Mm^3$ | | | | |
| | | Tailings Initial Settled Density | | | 3 | 4 | 3 | 4 |
| | | | 6 | > 2.00 $t/m^3$ - tailings solids density | | | | |
| | | | 5 | 1.80 - 2.00 $t/m^3$ | | | | |
| | | | 4 | 1.60 - 1.80 $t/m^3$ | | | | |
| | | | 3 | 1.20 - 1.60 $t/m^3$ | | | | |
| | | | 2 | 0.80 - 1.20 $t/m^3$ | | | | |
| | | | 1 | < 0.80 $t/m^3$ | | | | |
| | | Drainage Provisions | | | 5 | 2 | 4 | 1 |
| | | | 6 | No drainage requirements | | | | |
| | | | 5 | Easily implemented embankment drains only | | | | |
| | | | 4 | Complex embankment drains only | | | | |
| | | | 3 | Easily implemented foundation drains and complex embankment drains | | | | |
| | | | 2 | Complex foundation and easily implemented embankment drains | | | | |
| | | | 1 | Complex foundation and embankment drains | | | | |
| | | Seepage Management - Physical | | | 4 | 3 | 3 | 2 |
| | | | 6 | Single seepage collection point, no additional prevention measures required | | | | |
| | | | 5 | Multiple seepage collection points, no additional prevention measures required | | | | |
| | | | 4 | Cut-off trenches, single seepage collection point | | | | |
| | | | 3 | Cut-off trenches, multiple seepage collection points | | | | |
| | | | 2 | Liner, cut-off trenches, multiple seepage collection points, closure covers | | | | |
| | | | 1 | Multiple layer liner system required | | | | |
| | | Seepage Management - Quality | | | 6 | 4 | 5 | 1 |
| | | | 6 | Submergence and saturation of PAG materials | | | | |
| | | | 5 | | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 4 | Submergence of PAG waste rock and surface management of PAG tailings | | | | |
| | | | 3 | | | | | |
| | | | 2 | | | | | |
| | | | 1 | Surface management of all PAG materials | | | | |
| | | | | | | | | |
| | Construction Requirements | Foundation Preparation for Tailings Storage Area (excludes dam) | | | 4 | 2 | 4 | 2 |
| | | | 6 | No footprint preparation required | | | | |
| | | | 5 | Clearing only | | | | |
| | | | 4 | Clearing, grubbing and stripping | | | | |
| | | | 3 | Clearing, grubbing, stripping, foundation preparation | | | | |
| | | | 2 | Clearing, grubbing, stripping, foundation preparation and drainage | | | | |
| | | | 1 | Clearing, grubbing, stripping, foundation preparation, liner | | | | |
| | | Tailings Infrastructure | | | 4 | 2 | 3 | 2 |
| | | | 6 | No tailings produced as part of project operation | | | | |
| | | | 5 | Slurry production, unthickened | | | | |
| | | | 4 | Slurry production, thickening | | | | |
| | | | 3 | Slurry production, increased thickening | | | | |
| | | | 2 | Slurry production, increased thickening, filtration, load-out facility | | | | |
| | | | 1 | Slurry production, conveyance off-site, increased thickening, filtration, load-out facility | | | | |
| | | Foundation Preparation for PAG Waste Rock Facility | | | 4 | 4 | 4 | 1 |
| | | | 6 | No footprint preparation required | | | | |
| | | | 5 | Clearing only | | | | |
| | | | 4 | Clearing, grubbing and stripping | | | | |
| | | | 3 | Clearing, grubbing, stripping, foundation preparation | | | | |
| | | | 2 | Clearing, grubbing, stripping, foundation preparation and drainage installation | | | | |
| | | | 1 | Clearing, grubbing, stripping, foundation preparation, liner installation | | | | |
| | | Initial Dam Construction | | | 4 | 3 | 3 | 6 |
| | | | 6 | Single dam, single stage, low construction volumes | | | | |
| | | | 5 | Multiple stage initial construction, low construction volumes | | | | |
| | | | 4 | | | | | |
| | | | 3 | Multiple stage initial construction, large construction volumes, delivered by mine | | | | |
| | | | 2 | | | | | |
| | | | 1 | Multiple stage initial construction, large construction volumes, exceeds mine waste delivery capacity | | | | |
| | | Sustaining Construction (excludes waste delivery) | | | 2 | 4 | 3 | 6 |
| | | | 6 | Dam construction completed in during initial construction | | | | |
| | | | 5 | Dam raise every 10 years | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 4 | Dam raise every 5 years | | | | |
| | | | 3 | Dam raise every 2 years | | | | |
| | | | 2 | Dam raise every year | | | | |
| | | | 1 | Dam raise semi-annually | | | | |
| | | | | | | | | |
| | Water Management | Catchment Area | | | 2 | 3 | 2 | 4 |
| | | | 6 | Direct upstream reporting catchment less than 10 $km^2$ | | | | |
| | | | 5 | Direct upstream reporting catchment 10-15 $km^2$ | | | | |
| | | | 4 | Direct upstream reporting catchment 15-25 $km^2$ | | | | |
| | | | 3 | Direct upstream reporting catchment 25-35 $km^2$ | | | | |
| | | | 2 | Direct upstream reporting catchment 35-45 $km^2$ | | | | |
| | | | 1 | Direct upstream reporting catchment greater than 45 $km^2$ | | | | |
| | | Flood Routing | | | 6 | 3 | 6 | 1 |
| | | | 6 | Flood routing in ponds, no downstream discharge for inflow design flood (IDF) | | | | |
| | | | 5 | | | | | |
| | | | 4 | | | | | |
| | | | 3 | Flood routing in active construction areas, no downstream discharge for IDF | | | | |
| | | | 2 | | | | | |
| | | | 1 | Flood routing in active construction areas, discharge directed downstream by spillway | | | | |
| | | Water Balance - Surplus/Deficit/Balance | | | 5 | 2 | 4 | 2 |
| | | | 6 | Balance | | | | |
| | | | 5 | Balance with mild deficit/surplus late in mine life - easily managed | | | | |
| | | | 4 | Mild deficit/surplus during operations - easily managed | | | | |
| | | | 3 | Mild deficit/surplus during operations - difficult management | | | | |
| | | | 2 | Large deficit/surplus during operations | | | | |
| | | | 1 | No water / unmanageable water | | | | |
| | | Water Recycle Requirement | | | 3 | 5 | 4 | 5 |
| | | | 6 | No Reclaim requirement | | | | |
| | | | 5 | Reclaim 0 - 5 $Mm^3$ per year | | | | |
| | | | 4 | Reclaim 5 - 10 $Mm^3$ per year | | | | |
| | | | 3 | Reclaim 10 - 20 $Mm^3$ per year | | | | |
| | | | 2 | Reclaim 20 - 40 $Mm^3$ per year | | | | |
| | | | 1 | Reclaim greater than 40 $Mm^3$ per year | | | | |
| | | Water Treatment | | | 5 | 2 | 5 | 1 |
| | | | 6 | No capture, treatment, or mine water discharge required | | | | |
| | | | 5 | Capture and treatment required, single small area, no mine water discharge required | | | | |
| | | | 4 | | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 3 | Capture and treatment required, multiple areas, no mine water discharge expected | | | | |
| | | | 2 | | | | | |
| | | | 1 | Capture and treatment required, operational discharge of mine water expected | | | | |
| | | Surplus Water Management | | | 5 | 3 | 4 | 3 |
| | | | 6 | No surplus, no water management | | | | |
| | | | 5 | Diversion ditching and/or pipeline conveyance | | | | |
| | | | 4 | Treat and discharge less than 1 $Mm^3$ per year | | | | |
| | | | 3 | Treat and discharge 1 - 5 $Mm^3$ per year | | | | |
| | | | 2 | Treat and discharge 5 - 10 $Mm^3$ per year | | | | |
| | | | 1 | Treat and discharge greater than 10 $Mm^3$ per year | | | | |
| | | Operational monitoring requirements - internal site water management | | | 5 | 4 | 4 | 1 |
| | | | 6 | Cursory internal water quality monitoring, to confirm expectations | | | | |
| | | | 5 | | | | | |
| | | | 4 | Positioning of mine facilities complicates monitoring requirements | | | | |
| | | | 3 | | | | | |
| | | | 2 | | | | | |
| | | | 1 | Extensive internal site water quality monitoring in multiple locations, with expected variances requiring response and correction | | | | |
| | Execution | Technology Precedent - processing | | | 6 | 4 | 2 | 4 |
| | | | 6 | Production technology proven above project throughput | | | | |
| | | | 5 | Production technology proven at project throughput | | | | |
| | | | 4 | Ratio of proven throughput to project throughput 0.5 to 1 (30,000 tpd - 60,000 tpd) | | | | |
| | | | 3 | Ratio of proven throughput to project throughput 0.25 to 0.5 (15,000 tpd - 30,000 tpd) | | | | |
| | | | 2 | Ratio of proven throughput to project throughput 0.05 to 0.25 (6,000 tpd - 15,000 tpd) | | | | |
| | | | 1 | Ratio of proven throughput to project throughput less than 0.05 (6000 tpd) | | | | |
| | | Technology Precedent - storage | | | 6 | 1 | 1 | 1 |
| | | | 6 | Storage technology proven above project throughput | | | | |
| | | | 5 | Storage technology proven at project throughput | | | | |
| | | | 4 | Ratio of proven throughput to project throughput 0.5 to 1 (30,000 tpd - 60,000 tpd) | | | | |
| | | | 3 | Ratio of proven throughput to project throughput 0.25 to 0.5 (15,000 tpd - 30,000 tpd) | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 2 | Ratio of proven throughput to project throughput 0.05 to 0.25 (6,000 tpd - 15,000 tpd) | | | | |
| | | | 1 | Ratio of proven throughput to project throughput less than 0.05 (6000 tpd) | | | | |
| | | Tailings Delivery Complexity | | | 6 | 2 | 4 | 2 |
| | | | 6 | Gravity pipeline | | | | |
| | | | 5 | | | | | |
| | | | 4 | Pumped pipeline | | | | |
| | | | 3 | | | | | |
| | | | 2 | Automated conveyor and/or truck haul delivery | | | | |
| | | | 1 | | | | | |
| | | Tailings Placement Complexity | | | 5 | 3 | 4 | 3 |
| | | | 6 | No potential impacts to placement | | | | |
| | | | 5 | Placement affected to a minor degree by weather conditions | | | | |
| | | | 4 | | | | | |
| | | | 3 | Filtered tailings surface | | | | |
| | | | 2 | | | | | |
| | | | 1 | Filtered tailings surface with PAG waste rock placement | | | | |
| | | PAG Waste Rock Delivery and Placement | | | 2 | 3 | 1 | 5 |
| | | | 6 | No PAG waste rock | | | | |
| | | | 5 | Short haul, thick lifts | | | | |
| | | | 4 | Short haul, thin lifts | | | | |
| | | | 3 | Long haul, thick lifts | | | | |
| | | | 2 | Long haul, thick lifts, concurrent with other waste placement | | | | |
| | | | 1 | Long haul, thin lifts, concurrent with other waste placement | | | | |
| | | Operational Flexibility | | | 6 | 3 | 5 | 2 |
| | | | 6 | Full secondary facility for discharge of tailings as specified, < 24 hour production delay | | | | |
| | | | 5 | Secondary discharge point within primary facility, >1 day and < 1 week production delay | | | | |
| | | | 4 | | | | | |
| | | | 3 | Upset facility for out of specification tailings, > 1 week and < 1 month production delay | | | | |
| | | | 2 | | | | | |
| | | | 1 | No ability for secondary discharge, > 1 month production delay | | | | |
| | Closure | Closure concept - physical | | | 4 | 2 | 2 | 5 |
| | | | 6 | Pond stored in natural depression | | | | |
| | | | 5 | Pond not in waste storage facility | | | | |
| | | | 4 | | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 3 | Pond in waste storage facility, water away from dam | | | | |
| | | | 2 | | | | | |
| | | | 1 | Pond in waste storage facility, water against dam | | | | |
| | | Closure concept - geochemical | | | 6 | 4 | 5 | 1 |
| | | | 6 | Submerged and saturated PAG materials | | | | |
| | | | 5 | | | | | |
| | | | 4 | Submerged PAG waste rock and surface management of PAG | | | | |
| | | | 3 | | | | | |
| | | | 2 | | | | | |
| | | | 1 | Surface management of all PAG materials | | | | |
| | | Closure concept - active closure period | | | 4 | 2 | 4 | 2 |
| | | | 6 | Less than 5 years of active closure | | | | |
| | | | 5 | 5-10 years of active closure | | | | |
| | | | 4 | 10 - 20 years of active closure | | | | |
| | | | 3 | 20 - 30 years of active closure | | | | |
| | | | 2 | 30 - 40 years of active closure | | | | |
| | | | 1 | Greater than 40 years of active closure | | | | |
| | | Closure concept - long-term maintenance and monitoring | | | 5 | 3 | 4 | 1 |
| | | | 6 | No facilities of concern, cursory internal water quality monitoring, to confirm expectations | | | | |
| | | | 5 | | | | | |
| | | | 4 | One facility of concern | | | | |
| | | | 3 | | | | | |
| | | | 2 | Two facilities of concern, extensive internal site wide water quality monitoring, expected variances requiring correction | | | | |
| | | | 1 | | | | | |
| | | Concurrent closure and reclamation | | | 4 | 3 | 4 | 2 |
| | | | 6 | All facilities are actively reclaimed, limited surface area un- | | | | |
| | | | 5 | | | | | |
| | | | 4 | | | | | |
| | | | 3 | All facilities are actively reclaimed, large surface area un-reclaimed | | | | |
| | | | 2 | | | | | |
| | | | 1 | No facilities actively reclaimed | | | | |
| | | Premature closure | | | 3 | 2 | 2 | 1 |
| | | | 6 | Minimal surface area requiring reclamation | | | | |
| | | | 5 | | | | | |
| | | | 4 | | | | | |
| | | | 3 | Large surface area requiring reclamation, minimal earthworks for implementation of closure plan | | | | |
| | | | 2 | | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | Large surface area requiring reclamation, substantial earthworks for implementation of closure plan | | | | |
| Environmental | | | | | | | | |
| | Climate and air quality | Sensitivity to climate change | | | 5 | 4 | 4 | 2 |
| | | | 6 | Minimal sensitivity to climate change | | | | |
| | | | 5 | Low sensitivity to climate change | | | | |
| | | | 4 | Low to moderate sensitivity to climate change | | | | |
| | | | 3 | Moderate sensitivity to climate change | | | | |
| | | | 2 | Moderate to high sensitivity to climate change | | | | |
| | | | 1 | High sensitivity to climate change | | | | |
| | | Dust emissions | | | 5 | 3 | 4 | 2 |
| | | | 6 | Minimal potential | | | | |
| | | | 5 | Low potential | | | | |
| | | | 4 | Low to moderate potential | | | | |
| | | | 3 | Moderate potential | | | | |
| | | | 2 | Moderate to high potential | | | | |
| | | | 1 | High potential | | | | |
| | | Noise and vibration | | | 5 | 3 | 5 | 1 |
| | | | 6 | Minimal potential | | | | |
| | | | 5 | Low potential | | | | |
| | | | 4 | Low to moderate potential | | | | |
| | | | 3 | Moderate potential | | | | |
| | | | 2 | Moderate to high potential | | | | |
| | | | 1 | High potential | | | | |
| | Surface water quantity | Loss of catchment area | | | 2 | 3 | 2 | 4 |
| | | | 6 | < 10 $km^2$ | | | | |
| | | | 5 | ≥ 10 and < 20 $km^2$ | | | | |
| | | | 4 | ≥ 20 and < 30 $km^2$ | | | | |
| | | | 3 | ≥ 30 and < 40 $km^2$ | | | | |
| | | | 2 | ≥ 40 and < 50 $km^2$ | | | | |
| | | | 1 | ≥ 50 $km^2$ | | | | |
| | Surface water quality | Storage of PAG material | | | 5 | 3 | 4 | 1 |
| | | | 6 | | | | | |
| | | | 5 | Storage of tailings and PAG rock underwater | | | | |
| | | | 4 | Co-disposal of saturated tailings and PAG rock | | | | |
| | | | 3 | Storage of tailings on land and PAG rock underwater | | | | |
| | | | 2 | | | | | |
| | | | 1 | Storage of tailings and PAG rock on land | | | | |
| | | Dam embankment area | | | 1 | 4 | 3 | 6 |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 6 | Less than 25 ha | | | | |
| | | | 5 | From 26 to 50 ha | | | | |
| | | | 4 | From 51 to 75 ha | | | | |
| | | | 3 | From 76 to 100 ha | | | | |
| | | | 2 | From 101 to 125 ha | | | | |
| | | | 1 | From 126 to 150 ha | | | | |
| | | Seepage quantity | | | 5 | 1 | 1 | 3 |
| | | | 6 | Small pond with water not against dam | | | | |
| | | | 5 | Large pond with water not against dam | | | | |
| | | | 4 | | | | | |
| | | | 3 | Small pond with water against dam | | | | |
| | | | 2 | | | | | |
| | | | 1 | Large pond with water against dam | | | | |
| | | Operational discharge of treated water | | | 5 | 3 | 3 | 1 |
| | | | 6 | | | | | |
| | | | 5 | No operational discharge of treated water | | | | |
| | | | 4 | | | | | |
| | | | 3 | Some treatment and operational discharge likely | | | | |
| | | | 2 | | | | | |
| | | | 1 | Will require treatment and operational discharge; potentially more than one plant | | | | |
| | Groundwater | Groundwater quality | | | 5 | 3 | 4 | 1 |
| | | | 6 | Minimal risk to groundwater quality | | | | |
| | | | 5 | Minimal to low risk to groundwater quality | | | | |
| | | | 4 | Low to moderate risk to groundwater quality | | | | |
| | | | 3 | Moderate risk to groundwater quality | | | | |
| | | | 2 | Moderate to high risk to groundwater quality | | | | |
| | | | 1 | High risk to groundwater quality | | | | |
| | | Groundwater quantity (base flow to downstream creeks) | | | 2 | 3 | 2 | 4 |
| | | | 6 | diverted catchment < 10 $km^2$ | | | | |
| | | | 5 | diverted catchment ≥ 10 and < 20 $km^2$ | | | | |
| | | | 4 | diverted catchment ≥ 20 and < 30 $km^2$ | | | | |
| | | | 3 | diverted catchment ≥ 30 and < 40 $km^2$ | | | | |
| | | | 2 | diverted catchment ≥ 40 and < 50 $km^2$ | | | | |
| | | | 1 | diverted catchment ≥ 50 $km^2$ | | | | |
| | Terrain and soils | High Productivity Soils | | | 3 | 2 | 4 | 2 |
| | | | 6 | No high productivity soil affected | | | | |
| | | | 5 | < 20 ha affected | | | | |
| | | | 4 | ≥ 20 and < 40 ha affected | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 3 | ≥ 40 and < 60 ha affected | | | | |
| | | | 2 | ≥ 60 and < 80 ha affected | | | | |
| | | | 1 | ≥ 80 ha affected | | | | |
| | Fish, Fish Habitat and Aquatic Resources | Fish habitat | | | 3 | 2 | 2 | 4 |
| | | | 6 | Loss of < 5 km of known Rainbow Trout habitat and no critical spawning habitat | | | | |
| | | | 5 | Loss of 5 - 10 km of known Rainbow Trout habitat but no spawning habitat | | | | |
| | | | 4 | Loss of 5 - 10 km of known Rainbow Trout habitat including spawning habitat | | | | |
| | | | 3 | Loss of 10 - 15 km of known Rainbow Trout habitat but no spawning habitat | | | | |
| | | | 2 | Loss of 10 - 15 km of known Rainbow Trout habitat including spawning habitat | | | | |
| | | | 1 | Loss of > 15 km of known Rainbow Trout habitat including spawning habitat | | | | |
| | | Risks to non-CRA fish and aquatic resources | | | 6 | 4 | 5 | 3 |
| | | | 6 | Minimal to low risk | | | | |
| | | | 5 | Low risk | | | | |
| | | | 4 | Low to Moderate risk | | | | |
| | | | 3 | Moderate risk | | | | |
| | | | 2 | Moderate to high risk | | | | |
| | | | 1 | High risk | | | | |
| | Terrestrial ecosystems | Loss and risk to wetlands | | | 3 | 3 | 3 | 4 |
| | | | 6 | Loss < 100 ha and alteration risk < 20 ha | | | | |
| | | | 5 | Loss ≥ 100 and < 150 ha; and alteration risk ≥ 20 and < 30 ha | | | | |
| | | | 4 | Loss ≥ 150 and < 200 ha; and alteration risk ≥ 30 and < 40 ha | | | | |
| | | | 3 | Loss ≥ 200 and < 250 ha; and alteration risk ≥ 40 and < 50 ha | | | | |
| | | | 2 | Loss ≥ 250 and < 300 ha; and alteration risk ≥ 50 and < 60 ha | | | | |
| | | | 1 | Loss ≥ 300; and alteration risk ≥ 60 | | | | |
| | Wildlife | Loss of high-quality habitat for species of conservation concern | | | 2 | 2 | 3 | 5 |
| | | | 6 | < 500 ha loss | | | | |
| | | | 5 | ≥ 500 ha and < than 750 ha loss | | | | |
| | | | 4 | ≥ 750 ha and <1,000 loss | | | | |
| | | | 3 | ≥ 1,000 ha and < 1,250 ha loss | | | | |
| | | | 2 | ≥ 1,250 ha and < 1,500 ha | | | | |
| | | | 1 | ≥ 1,500 ha | | | | |
| | | Loss of high quality habitat for caribou | | | 3 | 3 | 3 | 4 |
| | | | 6 | No loss of high quality habitat | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 5 | < 150 ha | | | | |
| | | | 4 | ≥ 150 ha and < 300 ha | | | | |
| | | | 3 | ≥ 300 ha and < 450 ha | | | | |
| | | | 2 | ≥ 450 ha and < 600 ha | | | | |
| | | | 1 | ≥ 600 ha | | | | |
| | | Loss of high quality habitat for moose | | | 4 | 4 | 4 | 5 |
| | | | 6 | No loss of high quality habitat | | | | |
| | | | 5 | < 150 ha | | | | |
| | | | 4 | ≥ 150 ha and < 300 ha | | | | |
| | | | 3 | ≥ 300 ha and < 450 ha | | | | |
| | | | 2 | ≥ 450 ha and < 600 ha | | | | |
| | | | 1 | ≥ 600 ha | | | | |
| | | Toxicological risk to migratory birds, amphibians and bats | | | 5 | 3 | 4 | 2 |
| | | | 6 | Minimal toxicological risks | | | | |
| | | | 5 | Minimal to low toxicological risks | | | | |
| | | | 4 | Low toxicological risk | | | | |
| | | | 3 | Low to moderate toxicological risk | | | | |
| | | | 2 | Moderate toxicological risks | | | | |
| | | | 1 | Moderate to high toxicological risks | | | | |
| | | Toxicological risk to terrestrial wildlife species | | | 5 | 3 | 4 | 2 |
| | | | 6 | Minimal toxicological risks | | | | |
| | | | 5 | Minimal to low toxicological risks | | | | |
| | | | 4 | Low toxicological risk | | | | |
| | | | 3 | Low to moderate toxicological risk | | | | |
| | | | 2 | Moderate toxicological risks | | | | |
| | | | 1 | Moderate to high toxicological risks | | | | |
| Human Environment | | | | | | | | |
| | Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation | Availability (abundance and distribution) of resources harvested by Aboriginal people | | | 2 | 2 | 2 | 5 |
| | | | 6 | no overlap with high quality habitat or loss of fish habitat | | | | |
| | | | 5 | overlaps < 300 ha of high quality moose / caribou habitat and < 10 km of Rainbow Trout habitat | | | | |
| | | | 4 | overlaps < 300 ha of high quality moose / caribou habitat and < 20 km of Rainbow Trout habitat | | | | |
| | | | 3 | overlaps < 500 ha of high quality moose / caribou habitat and < 10 km of Rainbow Trout habitat | | | | |
| | | | 2 | overlaps < 500 ha of high quality moose / caribou habitat and < 20 km of Rainbow Trout habitat | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | overlaps ≥ 500 ha of high quality moose / caribou habitat and ≥ 10 km of Rainbow Trout habitat | | | | |
| | | Quality of resources harvested by Aboriginal people | | | 6 | 4 | 5 | 3 |
| | | | 6 | Minimal toxicological risk from dusting and downstream water quality | | | | |
| | | | 5 | Minimal to low toxicological risk from dusting and downstream water quality | | | | |
| | | | 4 | Low to moderate toxicological risk from dusting and downstream water quality | | | | |
| | | | 3 | Moderate toxicological risk from dusting and downstream water quality | | | | |
| | | | 2 | Moderate to high toxicological risk from dusting and downstream water quality | | | | |
| | | | 1 | High toxicological risk from dusting and downstream water quality | | | | |
| | | Quality of Aboriginal harvesters' experience | | | 6 | 3 | 4 | 2 |
| | | | 6 | Low dust potential and low noise | | | | |
| | | | 5 | Low dust potential and moderate noise | | | | |
| | | | 4 | Moderate dust potential and low noise | | | | |
| | | | 3 | Moderate dust potential and moderate noise | | | | |
| | | | 2 | High dust potential and moderate noise | | | | |
| | | | 1 | High dust potential and high noise | | | | |
| | Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | Availability (abundance and distribution) of resources harvested by Aboriginal people | | | 2 | 2 | 2 | 5 |
| | | | 6 | no overlap with high quality habitat or loss of fish habitat | | | | |
| | | | 5 | overlaps < 300 ha of high quality moose / caribou habitat and < 10 km of Rainbow Trout habitat | | | | |
| | | | 4 | overlaps < 300 ha of high quality moose / caribou habitat and < 20 km of Rainbow Trout habitat | | | | |
| | | | 3 | overlaps < 500 ha of high quality moose / caribou habitat and < 10 km of Rainbow Trout habitat | | | | |
| | | | 2 | overlaps < 500 ha of high quality moose / caribou habitat and < 20 km of Rainbow Trout habitat | | | | |
| | | | 1 | overlaps ≥ 500 ha of high quality moose / caribou habitat and ≥ 10 km of Rainbow Trout habitat | | | | |
| | | Quality of resources harvested by Aboriginal people | | | 6 | 4 | 5 | 3 |
| | | | 6 | Minimal toxicological risk from dusting and downstream water quality | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 5 | Minimal to low toxicological risk from dusting and downstream water quality | | | | |
| | | | 4 | Low to moderate toxicological risk from dusting and downstream water quality | | | | |
| | | | 3 | Moderate toxicological risk from dusting and downstream water quality | | | | |
| | | | 2 | Moderate to high toxicological risk from dusting and downstream water quality | | | | |
| | | | 1 | High toxicological risk from dusting and downstream water quality | | | | |
| | | Quality of Aboriginal harvesters' experience | | | 6 | 3 | 4 | 2 |
| | | | 6 | Low dust potential and low noise | | | | |
| | | | 5 | Low dust potential and moderate noise | | | | |
| | | | 4 | Moderate dust potential and low noise | | | | |
| | | | 3 | Moderate dust potential and moderate noise | | | | |
| | | | 2 | High dust potential and moderate noise | | | | |
| | | | 1 | High dust potential and high noise | | | | |
| | Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation | Availability (abundance and distribution) of resources harvested by Aboriginal people | | | 2 | 2 | 2 | 5 |
| | | | 6 | no overlap with high quality habitat or loss of fish habitat | | | | |
| | | | 5 | overlaps < 300 ha of high quality moose / caribou habitat and < 10 km of Rainbow Trout habitat | | | | |
| | | | 4 | overlaps < 300 ha of high quality moose / caribou habitat and < 20 km of Rainbow Trout habitat | | | | |
| | | | 3 | overlaps < 500 ha of high quality moose / caribou habitat and < 10 km of Rainbow Trout habitat | | | | |
| | | | 2 | overlaps < 500 ha of high quality moose / caribou habitat and < 20 km of Rainbow Trout habitat | | | | |
| | | | 1 | overlaps ≥ 500 ha of high quality moose / caribou habitat and ≥ 10 km of Rainbow Trout habitat | | | | |
| | | Quality of resources harvested by Aboriginal people | | | 6 | 4 | 5 | 3 |
| | | | 6 | Minimal toxicological risk from dusting and downstream water quality | | | | |
| | | | 5 | Minimal to low toxicological risk from dusting and downstream water quality | | | | |
| | | | 4 | Low to moderate toxicological risk from dusting and downstream water quality | | | | |
| | | | 3 | Moderate toxicological risk from dusting and downstream water quality | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 2 | Moderate to high toxicological risk from dusting and downstream water quality | | | | |
| | | | 1 | High toxicological risk from dusting and downstream water quality | | | | |
| | | Quality of Aboriginal harvesters' experience | | | 6 | 3 | 4 | 2 |
| | | | 6 | Low dust potential and low noise | | | | |
| | | | 5 | Low dust potential and moderate noise | | | | |
| | | | 4 | Moderate dust potential and low noise | | | | |
| | | | 3 | Moderate dust potential and moderate noise | | | | |
| | | | 2 | High dust potential and moderate noise | | | | |
| | | | 1 | High dust potential and high noise | | | | |
| | Non-traditional land use | Agricultural and range tenures | | | 4 | 4 | 4 | 6 |
| | | | 6 | No overlap with an agricultural or range tenure | | | | |
| | | | 5 | < 0.5% overlap of one tenure | | | | |
| | | | 4 | 0.5-1% overlap of tenure | | | | |
| | | | 3 | 1 - 2% overlap of one tenure | | | | |
| | | | 2 | 2 - 5% overlap of one tenure | | | | |
| | | | 1 | Overlap with more than one tenure | | | | |
| | | Registered trap lines | | | 2 | 2 | 2 | 4 |
| | | | 6 | No overlap with a trap line tenure | | | | |
| | | | 5 | 0 - 2% overlap of one trap line tenure | | | | |
| | | | 4 | 2 - 4% overlap of one trap line tenure | | | | |
| | | | 3 | 0 - 2% overlap of two trap line tenure | | | | |
| | | | 2 | 2 - 4% overlap of two trap line tenure | | | | |
| | | | 1 | > 4% overlap of more than two trap line tenure | | | | |
| | Public recreation | Overlap of areas with recreational sensitivity and significance | | | 2 | 2 | 2 | 5 |
| | | | 6 | < 250 ha | | | | |
| | | | 5 | ≥ 250 and < 500 ha | | | | |
| | | | 4 | ≥ 500 and < 750 ha | | | | |
| | | | 3 | ≥ 750 and < 1,000 Ha | | | | |
| | | | 2 | ≥ 1,000 and < 1,250 ha | | | | |
| | | | 1 | ≥ 1,250 ha | | | | |
| | Heritage | Known archaeological sites | | | 2 | 2 | 2 | 6 |
| | | | 6 | No anticipated impacts; Project components are over 1,000 m from known archaeological sites. | | | | |
| | | | 5 | Anticipated Project impacts within 500 to 1,000 m of known archaeological sites. | | | | |
| | | | 4 | Anticipated Project impacts within 50 to 500 m of known archaeological sites. | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | | 3 | Anticipated Project impacts within 0 to 50 m of known archaeological sites. | | | | |
| | | | 2 | Anticipated Project impacts known archaeological site within Project footprint. | | | | |
| | | | 1 | Anticipated Project impacts on more than one known archaeological site within Project footprint. | | | | |
| | Human Health | Potential health risks | | | 6 | 4 | 5 | 2 |
| | | | 6 | Minimal to low risk to air quality, drinking water quality and country foods | | | | |
| | | | 5 | Low risk to air quality, drinking water quality and country foods | | | | |
| | | | 4 | Low to moderate risk to air quality, drinking water quality and country foods | | | | |
| | | | 3 | Moderate risk to air quality, drinking water quality and country foods | | | | |
| | | | 2 | Moderate to high risk to air quality, drinking water quality and country foods | | | | |
| | | | 1 | High risk to air quality, drinking water quality and country foods | | | | |
| | Employment | Employment opportunities | | | 4 | 5 | 4 | 5 |
| | | | 6 | More than 600 people | | | | |
| | | | 5 | Between 550-600 people | | | | |
| | | | 4 | Between 500 -550 people | | | | |
| | | | 3 | Between 475-500 people | | | | |
| | | | 2 | Between 450 -475 people | | | | |
| | | | 1 | Less than 450 people | | | | |
| Project Economics | | | | | | | | |
| | Proponent costs | Initial capital costs | | | 6 | 2 | 5 | 3 |
| | | | 6 | < 100 M$ | | | | |
| | | | 5 | 100 - 124 M$ | | | | |
| | | | 4 | 125 - 149 M$ | | | | |
| | | | 3 | 150 - 174 M$ | | | | |
| | | | 2 | 175 - 200 M$ | | | | |
| | | | 1 | > 200 M$ | | | | |
| | | Sustaining capital and operating costs | | | 5 | 1 | 5 | 1 |
| | | | 6 | < 175 M$ (less than $0.50 per tonne of ore) | | | | |
| | | | 5 | 175 - 349 M$ ($0.50 - $1.00) | | | | |
| | | | 4 | 350 - 524 M$($1.00 - $1.50) | | | | |
| | | | 3 | 525 - 699 M$ ($1.50 - $2.00) | | | | |
| | | | 2 | 700 - 875 M$ ($2.00 - $2.50) | | | | |
| | | | 1 | > 875 M$ (Greater than $2.50 per tonne of ore) | | | | |

**Appendix A. Indicator Scoring Tables**

| Account | Sub-account | Indicator | Scalar Value | Unit/ Metric | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|
| | | Closure costs | | | 5 | 2 | 4 | 1 |
| | | | 6 | < 25 M$ | | | | |
| | | | 5 | 25 - 49 M$ | | | | |
| | | | 4 | 50 - 74 M$ | | | | |
| | | | 3 | 75 - 99 M$ | | | | |
| | | | 2 | 100 - 125 M$ | | | | |
| | | | 1 | > 125 M$ | | | | |
| | | Post-Closure costs | | | 6 | 3 | 5 | 1 |
| | | | 6 | No active management, periodic inspections | | | | |
| | | | 5 | Minor active management, periodic inspections | | | | |
| | | | 4 | Active management required, no water treatment, frequent inspections | | | | |
| | | | 3 | Active management required, water treatment for a decade, adjustments to closure plan | | | | |
| | | | 2 | Active management required, water treatment for several decades | | | | |
| | | | 1 | Water treatment in perpetuity | | | | |

# *Appendix B*

*Multiple Accounts Analysis Calculation Tables and Sensitivity Analyses*

**Appendix B.1. Base Case Calculations**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Discrimination Value (based on 30% diff) |
|---|---|---|---|---|---|---|---|---|---|---|
| Physical Stability | 6 | | | | | | | | | |
| | | Physical Stability | 6 | Location of water storage | 6 | 3 | 1 | 1 | 5 | 24 D |
| | | | | Tailings and waste rock interstitial water | 5 | 3 | 4 | 3 | 5 | 10 D |
| | | | | Normal operating pond volume | 6 | 4 | 5 | 5 | 6 | 12 D |
| | | | | Emergency water management - pumps (active) | 2 | 5 | 3 | 4 | 3 | 4 ND |
| | | | | Emergency water management - spillway (passive) | 4 | 4 | 4 | 4 | 6 | 8 ND |
| | | | | Design basis / regulatory requirement | 3 | 6 | 5 | 6 | 3 | 9 D |
| | | | | Tailings density | 5 | 3 | 5 | 3 | 5 | 10 D |
| | | | | Maximum dam height | 4 | 3 | 3 | 3 | 5 | 8 ND |
| | | | | Operational monitoring requirements - safety | 5 | 6 | 3 | 5 | 3 | 15 D |
| | | | | Sub-account merit score | | 158.0 | 145.0 | 145.0 | 190.0 | |
| | | | | Sub-account merit rating | | 4.0 | 3.6 | 3.6 | 4.8 | |
| | | Account merit score (S{SxW}) | | | | 24 | 22 | 22 | 29 | |
| | | Account merit rating (S{SxW}/SW) | | | | 4.0 | 3.6 | 3.6 | 4.8 | |
| Technical | 3 | | | | | | | | | |
| | | Containment Design | 6 | Style of Containment | 6 | 5 | 4 | 5 | 3 | 12 D |
| | | | | Number of dams | 5 | 2 | 5 | 3 | 6 | 20 D |
| | | | | Construction Volumes | 3 | 2 | 4 | 2 | 6 | 12 D |
| | | | | Tailings Initial Settled Density | 1 | 3 | 4 | 3 | 4 | 1 ND |
| | | | | Drainage Provisions | 4 | 5 | 2 | 4 | 1 | 16 D |
| | | | | Seepage Management - Physical | 3 | 4 | 3 | 3 | 2 | 6 ND |
| | | | | Seepage Management - Quality | 5 | 6 | 4 | 5 | 1 | 25 D |
| | | | | Sub-account merit score | | 111.0 | 102.0 | 104.0 | 85.0 | |
| | | | | Sub-account merit rating | | 4.1 | 3.8 | 3.9 | 3.1 | |
| | | Construction Requirements | 4 | Foundation Preparation for Tailings Storage Area (excludes dam) | 6 | 4 | 2 | 4 | 2 | 12 D |
| | | | | Tailings Infrastructure | 4 | 4 | 2 | 3 | 2 | 8 ND |
| | | | | Foundation Preparation for PAG Waste Rock Facility | 6 | 4 | 4 | 4 | 1 | 18 D |
| | | | | Initial Dam Construction | 6 | 4 | 3 | 3 | 6 | 18 D |
| | | | | Sustaining Construction (excludes waste delivery) | 4 | 2 | 4 | 3 | 6 | 16 D |
| | | | | Sub-account merit score | | 96.0 | 78.0 | 90.0 | 86.0 | |
| | | | | Sub-account merit rating | | 3.7 | 3.0 | 3.5 | 3.3 | |
| | | Water Management | 6 | Catchment Area | 3 | 2 | 3 | 2 | 4 | 6 ND |
| | | | | Flood Routing | 4 | 6 | 3 | 6 | 1 | 20 D |
| | | | | Water Balance - Surplus/Deficit/Balance | 6 | 5 | 2 | 4 | 4 | 18 D |
| | | | | Water Recycle Requirement | 2 | 3 | 5 | 4 | 5 | 4 ND |
| | | | | Water Treatment | 4 | 5 | 2 | 5 | 1 | 16 D |
| | | | | Surplus Water Management | 5 | 5 | 3 | 4 | 4 | 10 D |
| | | | | Operational monitoring requirements - internal site water management | 4 | 5 | 4 | 4 | 1 | 16 D |
| | | | | Sub-account merit score | | 131.0 | 82.0 | 118.0 | 78.0 | |
| | | | | Sub-account merit rating | | 4.7 | 3.4 | 4.9 | 3.3 | |

**Appendix B.1. Base Case Calculations**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Discrimination Value (based on 30% diff) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Execution | 6 | Technology Precedent - processing | 2 | 6 | 4 | 2 | 4 | 8 ND |
| | | | | Technology Precedent - storage | 4 | 6 | 1 | 1 | 1 | 20 D |
| | | | | Tailings Delivery Complexity | 6 | 6 | 2 | 4 | 2 | 24 D |
| | | | | Tailings Placement Complexity | 5 | 5 | 3 | 4 | 3 | 10 D |
| | | | | PAG Waste Rock Delivery and Placement | 4 | 2 | 3 | 1 | 5 | 16 D |
| | | | | Operational Flexibility | 5 | 6 | 3 | 5 | 2 | 20 D |
| | | | | Sub-account merit score | | 135.0 | 66.0 | 81.0 | 69.0 | |
| | | | | Sub-account merit rating | | 5.2 | 2.5 | 3.1 | 2.7 | |
| | | Closure | 6 | Closure concept - physical | 6 | 4 | 2 | 2 | 5 | 18 D |
| | | | | Closure concept - geochemical | 5 | 6 | 4 | 5 | 1 | 25 D |
| | | | | Closure concept - active closure period | 2 | 4 | 2 | 4 | 2 | 4 ND |
| | | | | Closure concept - long-term maintenance and monitoring | 5 | 5 | 3 | 4 | 1 | 20 D |
| | | | | Concurrent closure and reclamation | 1 | 4 | 3 | 4 | 4 | 1 ND |
| | | | | Premature closure | 4 | 4 | 3 | 4 | 2 | 8 ND |
| | | | | Sub-account merit score | | 107.0 | 66.0 | 85.0 | 56.0 | |
| | | | | Sub-account merit rating | | 4.7 | 2.9 | 3.7 | 2.4 | |
| | | Account merit score (S{SxW}) | | | | 127 | 88 | 107 | 82 | |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.1 | 3.8 | 2.9 | |
| Environmental | 6 | | | | | | | | | |
| | | Climate and air quality | 3 | Sensitivity to climate change | 3 | 5 | 4 | 4 | 2 | 9 D |
| | | | | Dust emissions | 5 | 5 | 3 | 4 | 2 | 15 D |
| | | | | Noise and vibration | 2 | 5 | 3 | 5 | 1 | 8 ND |
| | | | | Sub-account merit score | | 50 | 33 | 42 | 18 | |
| | | | | Sub-account merit rating | | 5.0 | 3.3 | 4.2 | 1.8 | |
| | | Surface water quantity | 4 | Loss of catchment area | 4 | 2 | 3 | 2 | 4 | 8 ND |
| | | | | Sub-account merit score | | 8 | 12 | 8 | 16 | |
| | | | | Sub-account merit rating | | 2.0 | 3.0 | 2.0 | 4.0 | |
| | | Surface water quality | 6 | Storage of PAG material | 6 | 5 | 3 | 4 | 1 | 24 D |
| | | | | Seepage quantity | 3 | 5 | 1 | 1 | 3 | 12 D |
| | | | | Dam embankment area | 2 | 1 | 4 | 3 | 6 | 10 D |
| | | | | Operational discharge of treated water | 5 | 5 | 3 | 3 | 1 | 20 D |
| | | | | Sub-account merit score | | 72 | 44 | 48 | 32 | |
| | | | | Sub-account merit rating | | 4.5 | 2.8 | 3.0 | 2.0 | |
| | | Groundwater | 3 | Groundwater quality | 5 | 5 | 3 | 4 | 1 | 20 D |
| | | | | Groundwater quantity (base flow to downstream creeks) | 3 | 2 | 3 | 2 | 4 | 6 ND |
| | | | | Sub-account merit score | | 31 | 24 | 26 | 17 | |
| | | | | Sub-account merit rating | | 3.9 | 3.0 | 3.3 | 2.1 | |
| | | Terrain and soils | 1 | High Productivity Soils | 1 | 3 | 2 | 4 | 2 | 2 ND |
| | | | | Sub-account merit score | | 3 | 2 | 4 | 2 | |
| | | | | Sub-account merit rating | | 3.0 | 2.0 | 4.0 | 2.0 | |
| | | Fish, Fish Habitat and Aqu | 6 | Fish habitat | 6 | 3 | 2 | 2 | 4 | 12 D |

**Appendix B.1. Base Case Calculations**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Discrimination Value (based on 30% diff) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Risks to non-CRA fish and aquatic resources | 1 | 6 | 4 | 5 | 3 | 3 ND |
| | | | | Sub-account merit score | | 24 | 16 | 17 | 27 | |
| | | | | Sub-account merit rating | | 3.4 | 2.3 | 2.4 | 3.9 | |
| | | Terrestrial ecosystems | 3 | Loss and risk to wetlands | 1 | 3 | 3 | 3 | 4 | 1 ND |
| | | | | Sub-account merit score | | 3 | 3 | 3 | 4 | |
| | | | | Sub-account merit rating | | 3.0 | 3.0 | 3.0 | 4.0 | |
| | | Wildlife | 5 | Loss of high-quality habitat for species of conservation concern | 3 | 2 | 3 | 3 | 5 | 9 D |
| | | | | Loss of high quality habitat for caribou | 6 | 3 | 3 | 3 | 4 | 6 ND |
| | | | | Loss of high quality habitat for moose | 2 | 4 | 4 | 4 | 5 | 2 ND |
| | | | | Toxicological risk to migratory birds, amphibians and bats | 6 | 5 | 3 | 4 | 2 | 18 D |
| | | | | Toxicological risk to terrestrial wildlife species | 4 | 5 | 3 | 4 | 2 | 12 D |
| | | | | Sub-account merit score | | 82.0 | 65.0 | 75.0 | 69.0 | |
| | | | | Sub-account merit rating | | 3.9 | 3.1 | 3.6 | 3.3 | |
| | | Account merit score (S{SxW}) | | | | 93 | 74 | 79 | 70 | |
| | | Account merit rating (S{SxW}/SW) | | | | 3.0 | 2.4 | 2.6 | 2.3 | |
| Human Environment | 3 | | | | | | | | | |
| | | Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 | 9 D |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 | 18 D |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 | 16 D |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 | |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 | |
| | | Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 | 9 D |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 | 18 D |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 | 16 D |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 | |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 | |
| | | Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 | 9 D |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 | 18 D |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 | 16 D |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 | |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 | |
| | | Non-traditional land use | 2 | Agricultural and range tenures | 2 | 4 | 4 | 4 | 6 | 4 ND |

**Appendix B.1. Base Case Calculations**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Discrimination Value (based on 30% diff) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Registered trap lines | 3 | 2 | 2 | 2 | 4 | 6 ND |
| | | | | Sub-account merit score | | 14.0 | 14.0 | 14.0 | 24.0 | |
| | | | | Sub-account merit rating | | 2.8 | 2.8 | 2.8 | 4.8 | |
| | | Public recreation | 2 | Overlap of areas with recreational sensitivity and significance | 1 | 2 | 2 | 2 | 5 | 3 ND |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 5.0 | |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 5.0 | |
| | | Heritage | 4 | Known archaeological sites | 1 | 2 | 2 | 2 | 6 | 4 ND |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 6.0 | |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 6.0 | |
| | | Human Health | 6 | Potential health risks | 1 | 6 | 4 | 5 | 2 | 4 ND |
| | | | | Sub-account merit score | | 6.0 | 4.0 | 5.0 | 2.0 | |
| | | | | Sub-account merit rating | | 6.0 | 4.0 | 5.0 | 2.0 | |
| | | Employment | 3 | Employment opportunities | 2 | 4 | 5 | 4 | 5 | 2 ND |
| | | | | Sub-account merit score | | 8.0 | 10.0 | 8.0 | 10.0 | |
| | | | | Sub-account merit rating | | 4.0 | 5.0 | 4.0 | 5.0 | |
| | | Account merit score (S{SxW}) | | | | 157 | 115 | 132 | 127 | |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.3 | 3.8 | 3.6 | |
| Project Economics | 1.5 | | | | | | | | | |
| | | Proponent costs | 1 | Initial capital costs | 1 | 6 | 2 | 5 | 3 | 4 ND |
| | | | | Sustaining capital and operating costs | 1 | 5 | 1 | 5 | 1 | 4 ND |
| | | | | Closure costs | 1 | 5 | 2 | 4 | 1 | 4 ND |
| | | | | Post-Closure costs | 1 | 6 | 3 | 5 | 1 | 5 ND |
| | | | | Sub-account merit score | | 22.0 | 8.0 | 19.0 | 6.0 | |
| | | | | Sub-account merit rating | | 5.5 | 2.0 | 4.8 | 1.5 | |
| | | Account merit score (S{SxW}) | | | | 6 | 2 | 5 | 2 | |
| | | Account merit rating (S{SxW}/SW) | | | | 5.5 | 2.0 | 4.8 | 1.5 | |
| MAA merit score | | | | | | 77 | 58 | 67 | 64 | |
| MAA merit rating | | | | | | 3.9 | 3.0 | 3.4 | 3.3 | |

**Appendix B.2. All Accounts have Equal Weighting**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| Physical Stability | 1 | | | | | | | | |
| | | Physical Stability | 6 | Location of water storage | 6 | 3 | 1 | 1 | 5 |
| | | | | Tailings and waste rock interstitial water | 5 | 3 | 4 | 3 | 5 |
| | | | | Normal operating pond volume | 6 | 4 | 5 | 5 | 6 |
| | | | | Emergency water management - pumps (active) | 2 | 5 | 3 | 4 | 3 |
| | | | | Emergency water management - spillway (passive) | 4 | 4 | 4 | 4 | 6 |
| | | | | Design basis / regulatory requirement | 3 | 6 | 5 | 6 | 3 |
| | | | | Tailings density | 5 | 3 | 5 | 3 | 5 |
| | | | | Maximum dam height | 4 | 3 | 3 | 3 | 5 |
| | | | | Operational monitoring requirements - safety | 5 | 6 | 3 | 5 | 3 |
| | | | | Sub-account merit score | | 158.0 | 145.0 | 145.0 | 190.0 |
| | | | | Sub-account merit rating | | 4.0 | 3.6 | 3.6 | 4.8 |
| | | Account merit score (S{SxW}) | | | | 4 | 4 | 4 | 5 |
| | | Account merit rating (S{SxW}/SW) | | | | 0.7 | 0.6 | 0.6 | 0.8 |
| Technical | 1 | | | | | | | | |
| | | Containment Design | 6 | Style of Containment | 6 | 5 | 4 | 5 | 3 |
| | | | | Number of dams | 5 | 2 | 5 | 3 | 6 |
| | | | | Construction Volumes | 3 | 2 | 4 | 2 | 6 |
| | | | | Tailings Initial Settled Density | 1 | 3 | 4 | 3 | 4 |
| | | | | Drainage Provisions | 4 | 5 | 2 | 4 | 1 |
| | | | | Seepage Management - Physical | 3 | 4 | 3 | 3 | 2 |
| | | | | Seepage Management - Quality | 5 | 6 | 4 | 5 | 1 |
| | | | | Sub-account merit score | | 111.0 | 102.0 | 104.0 | 85.0 |
| | | | | Sub-account merit rating | | 4.1 | 3.8 | 3.9 | 3.1 |
| | | Construction Requirements | 4 | Foundation Preparation for Tailings Storage Area (excludes dam) | 6 | 4 | 2 | 4 | 2 |
| | | | | Tailings Infrastructure | 4 | 4 | 2 | 3 | 2 |
| | | | | Foundation Preparation for PAG Waste Rock Facility | 6 | 4 | 4 | 4 | 1 |
| | | | | Initial Dam Construction | 6 | 4 | 3 | 3 | 6 |
| | | | | Sustaining Construction (excludes waste delivery) | 4 | 2 | 4 | 3 | 6 |
| | | | | Sub-account merit score | | 96.0 | 78.0 | 90.0 | 86.0 |
| | | | | Sub-account merit rating | | 3.7 | 3.0 | 3.5 | 3.3 |
| | | Water Management | 6 | Catchment Area | 3 | 2 | 3 | 2 | 4 |
| | | | | Flood Routing | 4 | 6 | 3 | 6 | 1 |
| | | | | Water Balance - Surplus/Deficit/Balance | 6 | 5 | 2 | 4 | 4 |
| | | | | Water Recycle Requirement | 2 | 3 | 5 | 4 | 5 |
| | | | | Water Treatment | 4 | 5 | 2 | 5 | 1 |
| | | | | Surplus Water Management | 5 | 5 | 3 | 4 | 4 |
| | | | | Operational monitoring requirements - internal site water management | 4 | 5 | 4 | 4 | 1 |
| | | | | Sub-account merit score | | 131.0 | 82.0 | 118.0 | 78.0 |

**Appendix B.2. All Accounts have Equal Weighting**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sub-account merit rating | | 4.7 | 3.4 | 4.9 | 3.3 |
| | | Execution | 6 | Technology Precedent - processing | 2 | 6 | 4 | 2 | 4 |
| | | | | Technology Precedent - storage | 4 | 6 | 1 | 1 | 1 |
| | | | | Tailings Delivery Complexity | 6 | 6 | 2 | 4 | 2 |
| | | | | Tailings Placement Complexity | 5 | 5 | 3 | 4 | 3 |
| | | | | PAG Waste Rock Delivery and Placement | 4 | 2 | 3 | 1 | 5 |
| | | | | Operational Flexibility | 5 | 6 | 3 | 5 | 2 |
| | | | | Sub-account merit score | | 135.0 | 66.0 | 81.0 | 69.0 |
| | | | | Sub-account merit rating | | 5.2 | 2.5 | 3.1 | 2.7 |
| | | Closure | 6 | Closure concept - physical | 6 | 4 | 2 | 2 | 5 |
| | | | | Closure concept - geochemical | 5 | 6 | 4 | 5 | 1 |
| | | | | Closure concept - active closure period | 2 | 4 | 2 | 4 | 2 |
| | | | | Closure concept - long-term maintenance and monitoring | 5 | 5 | 3 | 4 | 1 |
| | | | | Concurrent closure and reclamation | 1 | 4 | 3 | 4 | 4 |
| | | | | Premature closure | 4 | 4 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 107.0 | 66.0 | 85.0 | 56.0 |
| | | | | Sub-account merit rating | | 4.7 | 2.9 | 3.7 | 2.4 |
| | | Account merit score (S{SxW}) | | | | 127 | 88 | 107 | 82 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.1 | 3.8 | 2.9 |
| Environmental | 1 | | | | | | | | |
| | | Climate and air quality | 3 | Sensitivity to climate change | 3 | 5 | 4 | 4 | 2 |
| | | | | Dust emissions | 5 | 5 | 3 | 4 | 2 |
| | | | | Noise and vibration | 2 | 5 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 50 | 33 | 42 | 18 |
| | | | | Sub-account merit rating | | 5.0 | 3.3 | 4.2 | 1.8 |
| | | Surface water quantity | 4 | Loss of catchment area | 4 | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 8 | 12 | 8 | 16 |
| | | | | Sub-account merit rating | | 2.0 | 3.0 | 2.0 | 4.0 |
| | | Surface water quality | 6 | Storage of PAG material | 6 | 5 | 3 | 4 | 1 |
| | | | | Seepage quantity | 3 | 5 | 1 | 1 | 3 |
| | | | | Dam embankment area | 2 | 1 | 4 | 3 | 6 |
| | | | | Operational discharge of treated water | 5 | 5 | 3 | 3 | 1 |
| | | | | Sub-account merit score | | 72 | 44 | 48 | 32 |
| | | | | Sub-account merit rating | | 4.5 | 2.8 | 3.0 | 2.0 |
| | | Groundwater | 3 | Groundwater quality | 5 | 5 | 3 | 4 | 1 |
| | | | | Groundwater quantity (base flow to downstream creeks) | 3 | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 31 | 24 | 26 | 17 |
| | | | | Sub-account merit rating | | 3.9 | 3.0 | 3.3 | 2.1 |
| | | Terrain and soils | 1 | High Productivity Soils | 1 | 3 | 2 | 4 | 2 |
| | | | | Sub-account merit score | | 3 | 2 | 4 | 2 |

**Appendix B.2. All Accounts have Equal Weighting**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sub-account merit rating | | 3.0 | 2.0 | 4.0 | 2.0 |
| | | Fish, Fish Habitat and Aquatic Resources | 6 | Fish habitat | 6 | 3 | 2 | 2 | 4 |
| | | | | Risks to non-CRA fish and aquatic resources | 1 | 6 | 4 | 5 | 3 |
| | | | | Sub-account merit score | | 24 | 16 | 17 | 27 |
| | | | | Sub-account merit rating | | 3.4 | 2.3 | 2.4 | 3.9 |
| | | Terrestrial ecosystems | 3 | Loss and risk to wetlands | 1 | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit score | | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit rating | | 3.0 | 3.0 | 3.0 | 4.0 |
| | | Wildlife | 5 | Loss of high-quality habitat for species of conservation concern | 3 | 2 | 3 | 3 | 5 |
| | | | | Loss of high quality habitat for caribou | 6 | 3 | 3 | 3 | 4 |
| | | | | Loss of high quality habitat for moose | 2 | 4 | 4 | 4 | 5 |
| | | | | Toxicological risk to migratory birds, amphibians and bats | 6 | 5 | 3 | 4 | 2 |
| | | | | Toxicological risk to terrestrial wildlife species | 4 | 5 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 82.0 | 65.0 | 75.0 | 69.0 |
| | | | | Sub-account merit rating | | 3.9 | 3.1 | 3.6 | 3.3 |
| | | Account merit score (S{SxW}) | | | | 93 | 74 | 79 | 70 |
| | | Account merit rating (S{SxW}/SW) | | | | 3.0 | 2.4 | 2.6 | 2.3 |
| Human Environment | 1 | | | | | | | | |
| | | Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |

**Appendix B.2. All Accounts have Equal Weighting**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Non-traditional land use | 2 | Agricultural and range tenures | 2 | 4 | 4 | 4 | 6 |
| | | | | Registered trap lines | 3 | 2 | 2 | 2 | 4 |
| | | | | Sub-account merit score | | 14.0 | 14.0 | 14.0 | 24.0 |
| | | | | Sub-account merit rating | | 2.8 | 2.8 | 2.8 | 4.8 |
| | | Public recreation | 2 | Overlap of areas with recreational sensitivity and significance | 1 | 2 | 2 | 2 | 5 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | Heritage | 4 | Known archaeological sites | 1 | 2 | 2 | 2 | 6 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | Human Health | 6 | Potential health risks | 1 | 6 | 4 | 5 | 2 |
| | | | | Sub-account merit score | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | | | Sub-account merit rating | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | Employment | 3 | Employment opportunities | 2 | 4 | 5 | 4 | 5 |
| | | | | Sub-account merit score | | 8.0 | 10.0 | 8.0 | 10.0 |
| | | | | Sub-account merit rating | | 4.0 | 5.0 | 4.0 | 5.0 |
| | | Account merit score (S{SxW}) | | | | 157 | 115 | 132 | 127 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.3 | 3.8 | 3.6 |
| Project Economics | 1 | | | | | | | | |
| | | Proponent costs | 1 | Initial capital costs | 1 | 6 | 2 | 5 | 3 |
| | | | | Sustaining capital and operating costs | 1 | 5 | 1 | 5 | 1 |
| | | | | Closure costs | 1 | 5 | 2 | 4 | 1 |
| | | | | Post-Closure costs | 1 | 6 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 22.0 | 8.0 | 19.0 | 6.0 |
| | | | | Sub-account merit rating | | 5.5 | 2.0 | 4.8 | 1.5 |
| | | Account merit score (S{SxW}) | | | | 6 | 2 | 5 | 2 |
| | | Account merit rating (S{SxW}/SW) | | | | 5.5 | 2.0 | 4.8 | 1.5 |
| MAA merit score | | | | | | 18 | 11 | 16 | 11 |
| MAA merit rating | | | | | | 3.6 | 2.3 | 3.1 | 2.2 |

**Appendix B.3. All Accounts and Sub-Accounts Weighted Equally**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| Physical Stability | 1 | | | | | | | | |
| | | Physical Stability | 1 | Location of water storage | 6 | 3 | 1 | 1 | 5 |
| | | | | Tailings and waste rock interstitial water | 5 | 3 | 4 | 3 | 5 |
| | | | | Normal operating pond volume | 6 | 4 | 5 | 5 | 6 |
| | | | | Emergency water management - pumps (active) | 2 | 5 | 3 | 4 | 3 |
| | | | | Emergency water management - spillway (passive) | 4 | 4 | 4 | 4 | 6 |
| | | | | Design basis / regulatory requirement | 3 | 6 | 5 | 6 | 3 |
| | | | | Tailings density | 5 | 3 | 5 | 3 | 5 |
| | | | | Maximum dam height | 4 | 3 | 3 | 3 | 5 |
| | | | | Operational monitoring requirements - safety | 5 | 6 | 3 | 5 | 3 |
| | | | | Sub-account merit score | | 158.0 | 145.0 | 145.0 | 190.0 |
| | | | | Sub-account merit rating | | 4.0 | 3.6 | 3.6 | 4.8 |
| | | Account merit score (S{SxW}) | | | | 4 | 4 | 4 | 5 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.0 | 3.6 | 3.6 | 4.8 |
| Technical | 1 | | | | | | | | |
| | | Containment Design | 1 | Style of Containment | 6 | 5 | 4 | 5 | 3 |
| | | | | Number of dams | 5 | 2 | 5 | 3 | 6 |
| | | | | Construction Volumes | 3 | 2 | 4 | 2 | 6 |
| | | | | Tailings Initial Settled Density | 1 | 3 | 4 | 3 | 4 |
| | | | | Drainage Provisions | 4 | 5 | 2 | 4 | 1 |
| | | | | Seepage Management - Physical | 3 | 4 | 3 | 3 | 2 |
| | | | | Seepage Management - Quality | 5 | 6 | 4 | 5 | 1 |
| | | | | Sub-account merit score | | 111.0 | 102.0 | 104.0 | 85.0 |
| | | | | Sub-account merit rating | | 4.1 | 3.8 | 3.9 | 3.1 |
| | | Construction Requirements | 1 | Foundation Preparation for Tailings Storage Area (excludes dam) | 6 | 4 | 2 | 4 | 2 |
| | | | | Tailings Infrastructure | 4 | 4 | 2 | 3 | 2 |
| | | | | Foundation Preparation for PAG Waste Rock Facility | 6 | 4 | 4 | 4 | 1 |
| | | | | Initial Dam Construction | 6 | 4 | 3 | 3 | 6 |
| | | | | Sustaining Construction (excludes waste delivery) | 4 | 2 | 4 | 3 | 6 |
| | | | | Sub-account merit score | | 96.0 | 78.0 | 90.0 | 86.0 |
| | | | | Sub-account merit rating | | 3.7 | 3.0 | 3.5 | 3.3 |
| | | Water Management | 1 | Catchment Area | 3 | 2 | 3 | 2 | 4 |
| | | | | Flood Routing | 4 | 6 | 3 | 6 | 1 |
| | | | | Water Balance - Surplus/Deficit/Balance | 6 | 5 | 2 | 4 | 4 |
| | | | | Water Recycle Requirement | 2 | 3 | 5 | 4 | 5 |
| | | | | Water Treatment | 4 | 5 | 2 | 5 | 1 |
| | | | | Surplus Water Management | 5 | 5 | 3 | 4 | 4 |
| | | | | Operational monitoring requirements - internal site water management | 4 | 5 | 4 | 4 | 1 |
| | | | | Sub-account merit score | | 131.0 | 82.0 | 118.0 | 78.0 |
| | | | | Sub-account merit rating | | 4.7 | 3.4 | 4.9 | 3.3 |

**Appendix B.3. All Accounts and Sub-Accounts Weighted Equally**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | Execution | 1 | Technology Precedent - processing | 2 | 6 | 4 | 2 | 4 |
| | | | | Technology Precedent - storage | 4 | 6 | 1 | 1 | 1 |
| | | | | Tailings Delivery Complexity | 6 | 6 | 2 | 4 | 2 |
| | | | | Tailings Placement Complexity | 5 | 5 | 3 | 4 | 3 |
| | | | | PAG Waste Rock Delivery and Placement | 4 | 2 | 3 | 1 | 5 |
| | | | | Operational Flexibility | 5 | 6 | 3 | 5 | 2 |
| | | | | Sub-account merit score | | 135.0 | 66.0 | 81.0 | 69.0 |
| | | | | Sub-account merit rating | | 5.2 | 2.5 | 3.1 | 2.7 |
| | | Closure | 1 | Closure concept - physical | 6 | 4 | 2 | 2 | 5 |
| | | | | Closure concept - geochemical | 5 | 6 | 4 | 5 | 1 |
| | | | | Closure concept - active closure period | 2 | 4 | 2 | 4 | 2 |
| | | | | Closure concept - long-term maintenance and monitoring | 5 | 5 | 3 | 4 | 1 |
| | | | | Concurrent closure and reclamation | 1 | 4 | 3 | 4 | 4 |
| | | | | Premature closure | 4 | 4 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 107.0 | 66.0 | 85.0 | 56.0 |
| | | | | Sub-account merit rating | | 4.7 | 2.9 | 3.7 | 2.4 |
| | | Account merit score (S{SxW}) | | | | 22 | 16 | 19 | 15 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.1 | 3.8 | 3.0 |
| Environmental | 1 | | | | | | | | |
| | | Climate and air quality | 1 | Sensitivity to climate change | 3 | 5 | 4 | 4 | 2 |
| | | | | Dust emissions | 5 | 5 | 3 | 4 | 2 |
| | | | | Noise and vibration | 2 | 5 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 50 | 33 | 42 | 18 |
| | | | | Sub-account merit rating | | 5.0 | 3.3 | 4.2 | 1.8 |
| | | Surface water quantity | 1 | Loss of catchment area | 4 | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 8 | 12 | 8 | 16 |
| | | | | Sub-account merit rating | | 2.0 | 3.0 | 2.0 | 4.0 |
| | | Surface water quality | 1 | Storage of PAG material | 6 | 5 | 3 | 4 | 1 |
| | | | | Seepage quantity | 3 | 5 | 1 | 1 | 3 |
| | | | | Dam embankment area | 2 | 1 | 4 | 3 | 6 |
| | | | | Operational discharge of treated water | 5 | 5 | 3 | 3 | 1 |
| | | | | Sub-account merit score | | 72 | 44 | 48 | 32 |
| | | | | Sub-account merit rating | | 4.5 | 2.8 | 3.0 | 2.0 |
| | | Groundwater | 1 | Groundwater quality | 5 | 5 | 3 | 4 | 1 |
| | | | | Groundwater quantity (base flow to downstream creeks) | 3 | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 31 | 24 | 26 | 17 |
| | | | | Sub-account merit rating | | 3.9 | 3.0 | 3.3 | 2.1 |
| | | Terrain and soils | 1 | High Productivity Soils | 1 | 3 | 2 | 4 | 2 |
| | | | | Sub-account merit score | | 3 | 2 | 4 | 2 |
| | | | | Sub-account merit rating | | 3.0 | 2.0 | 4.0 | 2.0 |

**Appendix B.3. All Accounts and Sub-Accounts Weighted Equally**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | Fish, Fish Habitat and Aquatic Resources | 1 | Fish habitat | 6 | 3 | 2 | 2 | 4 |
| | | | | Risks to non-CRA fish and aquatic resources | 1 | 6 | 4 | 5 | 3 |
| | | | | Sub-account merit score | | 24 | 16 | 17 | 27 |
| | | | | Sub-account merit rating | | 3.4 | 2.3 | 2.4 | 3.9 |
| | | Terrestrial ecosystems | 1 | Loss and risk to wetlands | 1 | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit score | | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit rating | | 3.0 | 3.0 | 3.0 | 4.0 |
| | | Wildlife | 1 | Loss of high-quality habitat for species of conservation concern | 3 | 2 | 3 | 3 | 5 |
| | | | | Loss of high quality habitat for caribou | 6 | 3 | 3 | 3 | 4 |
| | | | | Loss of high quality habitat for moose | 2 | 4 | 4 | 4 | 5 |
| | | | | Toxicological risk to migratory birds, amphibians and bats | 6 | 5 | 3 | 4 | 2 |
| | | | | Toxicological risk to terrestrial wildlife species | 4 | 5 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 82.0 | 65.0 | 75.0 | 69.0 |
| | | | | Sub-account merit rating | | 3.9 | 3.1 | 3.6 | 3.3 |
| | | Account merit score (S{SxW}) | | | | 25 | 20 | 23 | 19 |
| | | Account merit rating (S{SxW}/SW) | | | | 3.2 | 2.5 | 2.9 | 2.4 |
| Human Environment | 1 | | | | | | | | |
| | | Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation | 1 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation | 1 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | 1 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |

**Appendix B.3. All Accounts and Sub-Accounts Weighted Equally**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Non-traditional land use | 1 | Agricultural and range tenures | 2 | 4 | 4 | 4 | 6 |
| | | | | Registered trap lines | 3 | 2 | 2 | 2 | 4 |
| | | | | Sub-account merit score | | 14.0 | 14.0 | 14.0 | 24.0 |
| | | | | Sub-account merit rating | | 2.8 | 2.8 | 2.8 | 4.8 |
| | | Public recreation | 1 | Overlap of areas with recreational sensitivity and significance | 1 | 2 | 2 | 2 | 5 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | Heritage | 1 | Known archaeological sites | 1 | 2 | 2 | 2 | 6 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | Human Health | 1 | Potential health risks | 1 | 6 | 4 | 5 | 2 |
| | | | | Sub-account merit score | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | | | Sub-account merit rating | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | Employment | 1 | Employment opportunities | 2 | 4 | 5 | 4 | 5 |
| | | | | Sub-account merit score | | 8.0 | 10.0 | 8.0 | 10.0 |
| | | | | Sub-account merit rating | | 4.0 | 5.0 | 4.0 | 5.0 |
| | | Account merit score (S{SxW}) | | | | 32 | 25 | 28 | 32 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.0 | 3.2 | 3.5 | 4.0 |
| Project Economics | 1 | | | | | | | | |
| | | Proponent costs | 1 | Initial capital costs | 1 | 6 | 2 | 5 | 3 |
| | | | | Sustaining capital and operating costs | 1 | 5 | 1 | 5 | 1 |
| | | | | Closure costs | 1 | 5 | 2 | 4 | 1 |
| | | | | Post-Closure costs | 1 | 6 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 22.0 | 8.0 | 19.0 | 6.0 |
| | | | | Sub-account merit rating | | 5.5 | 2.0 | 4.8 | 1.5 |
| | | Account merit score (S{SxW}) | | | | 6 | 2 | 5 | 2 |
| | | Account merit rating (S{SxW}/SW) | | | | 5.5 | 2.0 | 4.8 | 1.5 |
| MAA merit score | | | | | | 21 | 14 | 19 | 16 |
| MAA merit rating | | | | | | 4.2 | 2.9 | 3.7 | 3.1 |

**Appendix B.4. Project Economics Weighted toward Net Present Value**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| Physical Stability | 6 | | | | | | | | |
| | | Physical Stability | 6 | Location of water storage | 6 | 3 | 1 | 1 | 5 |
| | | | | Tailings and waste rock interstitial water | 5 | 3 | 4 | 3 | 5 |
| | | | | Normal operating pond volume | 6 | 4 | 5 | 5 | 6 |
| | | | | Emergency water management - pumps (active) | 2 | 5 | 3 | 4 | 3 |
| | | | | Emergency water management - spillway (passive) | 4 | 4 | 4 | 4 | 6 |
| | | | | Design basis / regulatory requirement | 3 | 6 | 5 | 6 | 3 |
| | | | | Tailings density | 5 | 3 | 5 | 3 | 5 |
| | | | | Maximum dam height | 4 | 3 | 3 | 3 | 5 |
| | | | | Operational monitoring requirements - safety | 5 | 6 | 3 | 5 | 3 |
| | | | | Sub-account merit score | | 158.0 | 145.0 | 145.0 | 190.0 |
| | | | | Sub-account merit rating | | 4.0 | 3.6 | 3.6 | 4.8 |
| | | Account merit score (S{SxW}) | | | | 24 | 22 | 22 | 29 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.0 | 3.6 | 3.6 | 4.8 |
| Technical | 3 | | | | | | | | |
| | | Containment Design | 6 | Style of Containment | 6 | 5 | 4 | 5 | 3 |
| | | | | Number of dams | 5 | 2 | 5 | 3 | 6 |
| | | | | Construction Volumes | 3 | 2 | 4 | 2 | 6 |
| | | | | Tailings Initial Settled Density | 1 | 3 | 4 | 3 | 4 |
| | | | | Drainage Provisions | 4 | 5 | 2 | 4 | 1 |
| | | | | Seepage Management - Physical | 3 | 4 | 3 | 3 | 2 |
| | | | | Seepage Management - Quality | 5 | 6 | 4 | 5 | 1 |
| | | | | Sub-account merit score | | 111.0 | 102.0 | 104.0 | 85.0 |
| | | | | Sub-account merit rating | | 4.1 | 3.8 | 3.9 | 3.1 |
| | | Construction Requirements | 4 | Foundation Preparation for Tailings Storage Area (excludes dam) | 6 | 4 | 2 | 4 | 2 |
| | | | | Tailings Infrastructure | 4 | 4 | 2 | 3 | 2 |
| | | | | Foundation Preparation for PAG Waste Rock Facility | 6 | 4 | 4 | 4 | 1 |
| | | | | Initial Dam Construction | 6 | 4 | 3 | 3 | 6 |
| | | | | Sustaining Construction (excludes waste delivery) | 4 | 2 | 4 | 3 | 6 |
| | | | | Sub-account merit score | | 96.0 | 78.0 | 90.0 | 86.0 |
| | | | | Sub-account merit rating | | 3.7 | 3.0 | 3.5 | 3.3 |
| | | Water Management | 6 | Catchment Area | 3 | 2 | 3 | 2 | 4 |
| | | | | Flood Routing | 4 | 6 | 3 | 6 | 1 |
| | | | | Water Balance - Surplus/Deficit/Balance | 6 | 5 | 2 | 4 | 4 |
| | | | | Water Recycle Requirement | 2 | 3 | 5 | 4 | 5 |
| | | | | Water Treatment | 4 | 5 | 2 | 5 | 1 |
| | | | | Surplus Water Management | 5 | 5 | 3 | 4 | 4 |
| | | | | Operational monitoring requirements - internal site water management | 4 | 5 | 4 | 4 | 1 |
| | | | | Sub-account merit score | | 131.0 | 82.0 | 118.0 | 78.0 |

**Appendix B.4. Project Economics Weighted toward Net Present Value**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sub-account merit rating | | 4.7 | 3.4 | 4.9 | 3.3 |
| | | Execution | 6 | Technology Precedent - processing | 2 | 6 | 4 | 2 | 4 |
| | | | | Technology Precedent - storage | 4 | 6 | 1 | 1 | 1 |
| | | | | Tailings Delivery Complexity | 6 | 6 | 2 | 4 | 2 |
| | | | | Tailings Placement Complexity | 5 | 5 | 3 | 4 | 3 |
| | | | | PAG Waste Rock Delivery and Placement | 4 | 2 | 3 | 1 | 5 |
| | | | | Operational Flexibility | 5 | 6 | 3 | 5 | 2 |
| | | | | Sub-account merit score | | 135.0 | 66.0 | 81.0 | 69.0 |
| | | | | Sub-account merit rating | | 5.2 | 2.5 | 3.1 | 2.7 |
| | | Closure | 6 | Closure concept - physical | 6 | 4 | 2 | 2 | 5 |
| | | | | Closure concept - geochemical | 5 | 6 | 4 | 5 | 1 |
| | | | | Closure concept - active closure period | 2 | 4 | 2 | 4 | 2 |
| | | | | Closure concept - long-term maintenance and monitoring | 5 | 5 | 3 | 4 | 1 |
| | | | | Concurrent closure and reclamation | 1 | 4 | 3 | 4 | 4 |
| | | | | Premature closure | 4 | 4 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 107.0 | 66.0 | 85.0 | 56.0 |
| | | | | Sub-account merit rating | | 4.7 | 2.9 | 3.7 | 2.4 |
| | | Account merit score (S{SxW}) | | | | 127 | 88 | 107 | 82 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.1 | 3.8 | 2.9 |
| Environmental | 6 | | | | | | | | |
| | | Climate and air quality | 3 | Sensitivity to climate change | 3 | 5 | 4 | 4 | 2 |
| | | | | Dust emissions | 5 | 5 | 3 | 4 | 2 |
| | | | | Noise and vibration | 2 | 5 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 50 | 33 | 42 | 18 |
| | | | | Sub-account merit rating | | 5.0 | 3.3 | 4.2 | 1.8 |
| | | Surface water quantity | 4 | Loss of catchment area | 4 | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 8 | 12 | 8 | 16 |
| | | | | Sub-account merit rating | | 2.0 | 3.0 | 2.0 | 4.0 |
| | | Surface water quality | 6 | Storage of PAG material | 6 | 5 | 3 | 4 | 1 |
| | | | | Seepage quantity | 3 | 5 | 1 | 1 | 3 |
| | | | | Dam embankment area | 2 | 1 | 4 | 3 | 6 |
| | | | | Operational discharge of treated water | 5 | 5 | 3 | 3 | 1 |
| | | | | Sub-account merit score | | 72 | 44 | 48 | 32 |
| | | | | Sub-account merit rating | | 4.5 | 2.8 | 3.0 | 2.0 |
| | | Groundwater | 3 | Groundwater quality | 5 | 5 | 3 | 4 | 1 |
| | | | | Groundwater quantity (base flow to downstream creeks) | 3 | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 31 | 24 | 26 | 17 |
| | | | | Sub-account merit rating | | 3.9 | 3.0 | 3.3 | 2.1 |
| | | Terrain and soils | 1 | High Productivity Soils | 1 | 3 | 2 | 4 | 2 |
| | | | | Sub-account merit score | | 3 | 2 | 4 | 2 |

**Appendix B.4. Project Economics Weighted toward Net Present Value**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sub-account merit rating | | 3.0 | 2.0 | 4.0 | 2.0 |
| | | Fish, Fish Habitat and Aquatic Resources | 6 | Fish habitat | 6 | 3 | 2 | 2 | 4 |
| | | | | Risks to non-CRA fish and aquatic resources | 1 | 6 | 4 | 5 | 3 |
| | | | | Sub-account merit score | | 24 | 16 | 17 | 27 |
| | | | | Sub-account merit rating | | 3.4 | 2.3 | 2.4 | 3.9 |
| | | Terrestrial ecosystems | 3 | Loss and risk to wetlands | 1 | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit score | | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit rating | | 3.0 | 3.0 | 3.0 | 4.0 |
| | | Wildlife | 5 | Loss of high-quality habitat for species of conservation concern | 3 | 2 | 3 | 3 | 5 |
| | | | | Loss of high quality habitat for caribou | 6 | 3 | 3 | 3 | 4 |
| | | | | Loss of high quality habitat for moose | 2 | 4 | 4 | 4 | 5 |
| | | | | Toxicological risk to migratory birds, amphibians and bats | 6 | 5 | 3 | 4 | 2 |
| | | | | Toxicological risk to terrestrial wildlife species | 4 | 5 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 82.0 | 65.0 | 75.0 | 69.0 |
| | | | | Sub-account merit rating | | 3.9 | 3.1 | 3.6 | 3.3 |
| | | Account merit score (S{SxW}) | | | | 93 | 74 | 79 | 70 |
| | | Account merit rating (S{SxW}/SW) | | | | 3.0 | 2.4 | 2.6 | 2.3 |
| Human Environment | 3 | | | | | | | | |
| | | Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |

**Appendix B.4. Project Economics Weighted toward Net Present Value**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Non-traditional land use | 2 | Agricultural and range tenures | 2 | 4 | 4 | 4 | 6 |
| | | | | Registered trap lines | 3 | 2 | 2 | 2 | 4 |
| | | | | Sub-account merit score | | 14.0 | 14.0 | 14.0 | 24.0 |
| | | | | Sub-account merit rating | | 2.8 | 2.8 | 2.8 | 4.8 |
| | | Public recreation | 2 | Overlap of areas with recreational sensitivity and significance | 1 | 2 | 2 | 2 | 5 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | Heritage | 4 | Known archaeological sites | 1 | 2 | 2 | 2 | 6 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | Human Health | 6 | Potential health risks | 1 | 6 | 4 | 5 | 2 |
| | | | | Sub-account merit score | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | | | Sub-account merit rating | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | Employment | 3 | Employment opportunities | 2 | 4 | 5 | 4 | 5 |
| | | | | Sub-account merit score | | 8.0 | 10.0 | 8.0 | 10.0 |
| | | | | Sub-account merit rating | | 4.0 | 5.0 | 4.0 | 5.0 |
| | | Account merit score (S{SxW}) | | | | 157 | 115 | 132 | 127 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.3 | 3.8 | 3.6 |
| Project Economics | 1.5 | | | | | | | | |
| | | Proponent costs | 1 | Initial capital costs | 6 | 6 | 2 | 5 | 3 |
| | | | | Sustaining capital and operating costs | 4 | 5 | 1 | 5 | 1 |
| | | | | Closure costs | 2 | 5 | 2 | 4 | 1 |
| | | | | Post-Closure costs | 1 | 6 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 72.0 | 23.0 | 63.0 | 25.0 |
| | | | | Sub-account merit rating | | 5.5 | 1.8 | 4.8 | 1.9 |
| | | Account merit score (S{SxW}) | | | | 6 | 2 | 5 | 2 |
| | | Account merit rating (S{SxW}/SW) | | | | 5.5 | 1.8 | 4.8 | 1.9 |
| MAA merit score | | | | | | 77 | 58 | 67 | 65 |
| MAA merit rating | | | | | | 4.0 | 3.0 | 3.4 | 3.3 |

**Appendix B.5. Project Economics Removed from Analysis**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| Physical Stability | 6 | | | | | | | | |
| | | Physical Stability | 6 | Location of water storage | 6 | 3 | 1 | 1 | 5 |
| | | | | Tailings and waste rock interstitial water | 5 | 3 | 4 | 3 | 5 |
| | | | | Normal operating pond volume | 6 | 4 | 5 | 5 | 6 |
| | | | | Emergency water management - pumps (active) | 2 | 5 | 3 | 4 | 3 |
| | | | | Emergency water management - spillway (passive) | 4 | 4 | 4 | 4 | 6 |
| | | | | Design basis / regulatory requirement | 3 | 6 | 5 | 6 | 3 |
| | | | | Tailings density | 5 | 3 | 5 | 3 | 5 |
| | | | | Maximum dam height | 4 | 3 | 3 | 3 | 5 |
| | | | | Operational monitoring requirements - safety | 5 | 6 | 3 | 5 | 3 |
| | | | | Sub-account merit score | | 158.0 | 145.0 | 145.0 | 190.0 |
| | | | | Sub-account merit rating | | 4.0 | 3.6 | 3.6 | 4.8 |
| | | Account merit score (S{SxW}) | | | | 24 | 22 | 22 | 29 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.0 | 3.6 | 3.6 | 4.8 |
| Technical | 3 | | | | | | | | |
| | | Containment Design | 6 | Style of Containment | 6 | 5 | 4 | 5 | 3 |
| | | | | Number of dams | 5 | 2 | 5 | 3 | 6 |
| | | | | Construction Volumes | 3 | 2 | 4 | 2 | 6 |
| | | | | Tailings Initial Settled Density | 1 | 3 | 4 | 3 | 4 |
| | | | | Drainage Provisions | 4 | 5 | 2 | 4 | 1 |
| | | | | Seepage Management - Physical | 3 | 4 | 3 | 3 | 2 |
| | | | | Seepage Management - Quality | 5 | 6 | 4 | 5 | 1 |
| | | | | Sub-account merit score | | 111.0 | 102.0 | 104.0 | 85.0 |
| | | | | Sub-account merit rating | | 4.1 | 3.8 | 3.9 | 3.1 |
| | | Construction Requirements | 4 | Foundation Preparation for Tailings Storage Area (excludes dam) | 6 | 4 | 2 | 4 | 2 |
| | | | | Tailings Infrastructure | 4 | 4 | 2 | 3 | 2 |
| | | | | Foundation Preparation for PAG Waste Rock Facility | 6 | 4 | 4 | 4 | 1 |
| | | | | Initial Dam Construction | 6 | 4 | 3 | 3 | 6 |
| | | | | Sustaining Construction (excludes waste delivery) | 4 | 2 | 4 | 3 | 6 |
| | | | | Sub-account merit score | | 96.0 | 78.0 | 90.0 | 86.0 |
| | | | | Sub-account merit rating | | 3.7 | 3.0 | 3.5 | 3.3 |
| | | Water Management | 6 | Catchment Area | 3 | 2 | 3 | 2 | 4 |
| | | | | Flood Routing | 4 | 6 | 3 | 6 | 1 |
| | | | | Water Balance - Surplus/Deficit/Balance | 6 | 5 | 2 | 4 | 4 |
| | | | | Water Recycle Requirement | 2 | 3 | 5 | 4 | 5 |
| | | | | Water Treatment | 4 | 5 | 2 | 5 | 1 |
| | | | | Surplus Water Management | 5 | 5 | 3 | 4 | 4 |
| | | | | Operational monitoring requirements - internal site water management | 4 | 5 | 4 | 4 | 1 |
| | | | | Sub-account merit score | | 131.0 | 82.0 | 118.0 | 78.0 |
| | | | | Sub-account merit rating | | 4.7 | 3.4 | 4.9 | 3.3 |

**Appendix B.5. Project Economics Removed from Analysis**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | Execution | 6 | Technology Precedent - processing | 2 | 6 | 4 | 2 | 4 |
| | | | | Technology Precedent - storage | 4 | 6 | 1 | 1 | 1 |
| | | | | Tailings Delivery Complexity | 6 | 6 | 2 | 4 | 2 |
| | | | | Tailings Placement Complexity | 5 | 5 | 3 | 4 | 3 |
| | | | | PAG Waste Rock Delivery and Placement | 4 | 2 | 3 | 1 | 5 |
| | | | | Operational Flexibility | 5 | 6 | 3 | 5 | 2 |
| | | | | Sub-account merit score | | 135.0 | 66.0 | 81.0 | 69.0 |
| | | | | Sub-account merit rating | | 5.2 | 2.5 | 3.1 | 2.7 |
| | | Closure | 6 | Closure concept - physical | 6 | 4 | 2 | 2 | 5 |
| | | | | Closure concept - geochemical | 5 | 6 | 4 | 5 | 1 |
| | | | | Closure concept - active closure period | 2 | 4 | 2 | 4 | 2 |
| | | | | Closure concept - long-term maintenance and monitoring | 5 | 5 | 3 | 4 | 1 |
| | | | | Concurrent closure and reclamation | 1 | 4 | 3 | 4 | 4 |
| | | | | Premature closure | 4 | 4 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 107.0 | 66.0 | 85.0 | 56.0 |
| | | | | Sub-account merit rating | | 4.7 | 2.9 | 3.7 | 2.4 |
| | | Account merit score (S{SxW}) | | | | 127 | 88 | 107 | 82 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.1 | 3.8 | 2.9 |
| Environmental | 6 | | | | | | | | |
| | | Climate and air quality | 3 | Sensitivity to climate change | 3 | 5 | 4 | 4 | 2 |
| | | | | Dust emissions | 5 | 5 | 3 | 4 | 2 |
| | | | | Noise and vibration | 2 | 5 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 50 | 33 | 42 | 18 |
| | | | | Sub-account merit rating | | 5.0 | 3.3 | 4.2 | 1.8 |
| | | Surface water quantity | 4 | Loss of catchment area | 4 | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 8 | 12 | 8 | 16 |
| | | | | Sub-account merit rating | | 2.0 | 3.0 | 2.0 | 4.0 |
| | | Surface water quality | 6 | Storage of PAG material | 6 | 5 | 3 | 4 | 1 |
| | | | | Seepage quantity | 3 | 5 | 1 | 1 | 3 |
| | | | | Dam embankment area | 2 | 1 | 4 | 3 | 6 |
| | | | | Operational discharge of treated water | 5 | 5 | 3 | 3 | 1 |
| | | | | Sub-account merit score | | 72 | 44 | 48 | 32 |
| | | | | Sub-account merit rating | | 4.5 | 2.8 | 3.0 | 2.0 |
| | | Groundwater | 3 | Groundwater quality | 5 | 5 | 3 | 4 | 1 |
| | | | | Groundwater quantity (base flow to downstream creeks) | 3 | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 31 | 24 | 26 | 17 |
| | | | | Sub-account merit rating | | 3.9 | 3.0 | 3.3 | 2.1 |
| | | Terrain and soils | 1 | High Productivity Soils | 1 | 3 | 2 | 4 | 2 |
| | | | | Sub-account merit score | | 3 | 2 | 4 | 2 |
| | | | | Sub-account merit rating | | 3.0 | 2.0 | 4.0 | 2.0 |

**Appendix B.5. Project Economics Removed from Analysis**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | Fish, Fish Habitat and Aquatic Resources | 6 | Fish habitat | 6 | 3 | 2 | 2 | 4 |
| | | | | Risks to non-CRA fish and aquatic resources | 1 | 6 | 4 | 5 | 3 |
| | | | | Sub-account merit score | | 24 | 16 | 17 | 27 |
| | | | | Sub-account merit rating | | 3.4 | 2.3 | 2.4 | 3.9 |
| | | Terrestrial ecosystems | 3 | Loss and risk to wetlands | 1 | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit score | | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit rating | | 3.0 | 3.0 | 3.0 | 4.0 |
| | | Wildlife | 5 | Loss of high-quality habitat for species of conservation concern | 3 | 2 | 3 | 3 | 5 |
| | | | | Loss of high quality habitat for caribou | 6 | 3 | 3 | 3 | 4 |
| | | | | Loss of high quality habitat for moose | 2 | 4 | 4 | 4 | 5 |
| | | | | Toxicological risk to migratory birds, amphibians and bats | 6 | 5 | 3 | 4 | 2 |
| | | | | Toxicological risk to terrestrial wildlife species | 4 | 5 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 82.0 | 65.0 | 75.0 | 69.0 |
| | | | | Sub-account merit rating | | 3.9 | 3.1 | 3.6 | 3.3 |
| | | Account merit score (S{SxW}) | | | | 93 | 74 | 79 | 70 |
| | | Account merit rating (S{SxW}/SW) | | | | 3.0 | 2.4 | 2.6 | 2.3 |
| Human Environment | 3 | | | | | | | | |
| | | Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |

**Appendix B.5. Project Economics Removed from Analysis**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Non-traditional land use | 2 | Agricultural and range tenures | 2 | 4 | 4 | 4 | 6 |
| | | | | Registered trap lines | 3 | 2 | 2 | 2 | 4 |
| | | | | Sub-account merit score | | 14.0 | 14.0 | 14.0 | 24.0 |
| | | | | Sub-account merit rating | | 2.8 | 2.8 | 2.8 | 4.8 |
| | | Public recreation | 2 | Overlap of areas with recreational sensitivity and significance | 1 | 2 | 2 | 2 | 5 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | Heritage | 4 | Known archaeological sites | 1 | 2 | 2 | 2 | 6 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | Human Health | 6 | Potential health risks | 1 | 6 | 4 | 5 | 2 |
| | | | | Sub-account merit score | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | | | Sub-account merit rating | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | Employment | 3 | Employment opportunities | 2 | 4 | 5 | 4 | 5 |
| | | | | Sub-account merit score | | 8.0 | 10.0 | 8.0 | 10.0 |
| | | | | Sub-account merit rating | | 4.0 | 5.0 | 4.0 | 5.0 |
| | | Account merit score (S{SxW}) | | | | 157 | 115 | 132 | 127 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.3 | 3.8 | 3.6 |
| Project Economics | 0 | | | | | | | | |
| | | Proponent costs | 1 | Initial capital costs | 1 | 6 | 2 | 5 | 3 |
| | | | | Sustaining capital and operating costs | 1 | 5 | 1 | 5 | 1 |
| | | | | Closure costs | 1 | 5 | 2 | 4 | 1 |
| | | | | Post-Closure costs | 1 | 6 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 22.0 | 8.0 | 19.0 | 6.0 |
| | | | | Sub-account merit rating | | 5.5 | 2.0 | 4.8 | 1.5 |
| | | Account merit score (S{SxW}) | | | | 6 | 2 | 5 | 2 |
| | | Account merit rating (S{SxW}/SW) | | | | 5.5 | 2.0 | 4.8 | 1.5 |
| MAA merit score | | | | | | 69 | 55 | 60 | 62 |
| MAA merit rating | | | | | | 3.8 | 3.1 | 3.3 | 3.4 |

**Appendix B.6. Sensitivity Analysis - Physical Stability Incorporated into Technical Account**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| Technical | 3 | | | | | | | | |
| | | Physical Stability | 6 | Location of water storage | 6 | 3 | 1 | 1 | 5 |
| | | | | Tailings and waste rock interstitial water | 5 | 3 | 4 | 3 | 5 |
| | | | | Normal operating pond volume | 6 | 4 | 5 | 5 | 6 |
| | | | | Emergency water management - pumps (active) | 2 | 5 | 3 | 4 | 3 |
| | | | | Emergency water management - spillway (passive) | 4 | 4 | 4 | 4 | 6 |
| | | | | Design basis / regulatory requirement | 3 | 6 | 5 | 6 | 3 |
| | | | | Tailings density | 5 | 3 | 5 | 3 | 5 |
| | | | | Maximum dam height | 4 | 3 | 3 | 3 | 5 |
| | | | | Operational monitoring requirements - safety | 5 | 6 | 3 | 5 | 3 |
| | | | | Sub-account merit score | | 158.0 | 145.0 | 145.0 | 190.0 |
| | | | | Sub-account merit rating | | 4.0 | 3.6 | 3.6 | 4.8 |
| | | Containment Design | 6 | Style of Containment | 6 | 5 | 4 | 5 | 3 |
| | | | | Number of dams | 5 | 2 | 5 | 3 | 6 |
| | | | | Construction Volumes | 3 | 2 | 4 | 2 | 6 |
| | | | | Tailings Initial Settled Density | 1 | 3 | 4 | 3 | 4 |
| | | | | Drainage Provisions | 4 | 5 | 2 | 4 | 1 |
| | | | | Seepage Management - Physical | 3 | 4 | 3 | 3 | 2 |
| | | | | Seepage Management - Quality | 5 | 6 | 4 | 5 | 1 |
| | | | | Sub-account merit score | | 111.0 | 102.0 | 104.0 | 85.0 |
| | | | | Sub-account merit rating | | 4.1 | 3.8 | 3.9 | 3.1 |
| | | Construction Requirements | 4 | Foundation Preparation for Tailings Storage Area (excludes dam) | 6 | 4 | 2 | 4 | 2 |
| | | | | Tailings Infrastructure | 4 | 4 | 2 | 3 | 2 |
| | | | | Foundation Preparation for PAG Waste Rock Facility | 6 | 4 | 4 | 4 | 1 |
| | | | | Initial Dam Construction | 6 | 4 | 3 | 3 | 6 |
| | | | | Sustaining Construction (excludes waste delivery) | 4 | 2 | 4 | 3 | 6 |
| | | | | Sub-account merit score | | 96.0 | 78.0 | 90.0 | 86.0 |
| | | | | Sub-account merit rating | | 3.7 | 3.0 | 3.5 | 3.3 |
| | | Water Management | 6 | Catchment Area | 3 | 2 | 3 | 2 | 4 |
| | | | | Flood Routing | 4 | 6 | 3 | 6 | 1 |
| | | | | Water Balance - Surplus/Deficit/Balance | 6 | 5 | 2 | 4 | 4 |
| | | | | Water Recycle Requirement | 2 | 3 | 5 | 4 | 5 |
| | | | | Water Treatment | 4 | 5 | 2 | 5 | 1 |
| | | | | Surplus Water Management | 5 | 5 | 3 | 4 | 4 |
| | | | | Operational monitoring requirements - internal site water management | 4 | 5 | 4 | 4 | 1 |
| | | | | Sub-account merit score | | 131.0 | 82.0 | 118.0 | 78.0 |
| | | | | Sub-account merit rating | | 4.7 | 3.4 | 4.9 | 3.3 |
| | | Execution | 6 | Technology Precedent - processing | 2 | 6 | 4 | 2 | 4 |
| | | | | Technology Precedent - storage | 4 | 6 | 1 | 1 | 1 |

**Appendix B.6. Sensitivity Analysis - Physical Stability Incorporated into Technical Account**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Tailings Delivery Complexity | **6** | 6 | 2 | 4 | 2 |
| | | | | Tailings Placement Complexity | **5** | 5 | 3 | 4 | 3 |
| | | | | PAG Waste Rock Delivery and Placement | **4** | 2 | 3 | 1 | 5 |
| | | | | Operational Flexibility | **5** | 6 | 3 | 5 | 2 |
| | | | | Sub-account merit score | | 135.0 | 66.0 | 81.0 | 69.0 |
| | | | | Sub-account merit rating | | 5.2 | 2.5 | 3.1 | 2.7 |
| | | Closure | **6** | Closure concept - physical | **6** | 4 | 2 | 2 | 5 |
| | | | | Closure concept - geochemical | **5** | 6 | 4 | 5 | 1 |
| | | | | Closure concept - active closure period | **2** | 4 | 2 | 4 | 2 |
| | | | | Closure concept - long-term maintenance and monitoring | **5** | 5 | 3 | 4 | 1 |
| | | | | Concurrent closure and reclamation | **1** | 4 | 3 | 4 | 4 |
| | | | | Premature closure | **4** | 4 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 107.0 | 66.0 | 85.0 | 56.0 |
| | | | | Sub-account merit rating | | 4.7 | 2.9 | 3.7 | 2.4 |
| | | Account merit score (S{SxW}) | | | | 150 | 109 | 129 | 111 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.4 | 3.2 | 3.8 | 3.3 |
| Environmental | **6** | | | | | | | | |
| | | Climate and air quality | **3** | Sensitivity to climate change | **3** | 5 | 4 | 4 | 2 |
| | | | | Dust emissions | **5** | 5 | 3 | 4 | 2 |
| | | | | Noise and vibration | **2** | 5 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 50 | 33 | 42 | 18 |
| | | | | Sub-account merit rating | | 5.0 | 3.3 | 4.2 | 1.8 |
| | | Surface water quantity | **4** | Loss of catchment area | **4** | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 8 | 12 | 8 | 16 |
| | | | | Sub-account merit rating | | 2.0 | 3.0 | 2.0 | 4.0 |
| | | Surface water quality | **6** | Storage of PAG material | **6** | 5 | 3 | 4 | 1 |
| | | | | Seepage quantity | **3** | 5 | 1 | 1 | 3 |
| | | | | Dam embankment area | **2** | 1 | 4 | 3 | 6 |
| | | | | Operational discharge of treated water | **5** | 5 | 3 | 3 | 1 |
| | | | | Sub-account merit score | | 72 | 44 | 48 | 32 |
| | | | | Sub-account merit rating | | 4.5 | 2.8 | 3.0 | 2.0 |
| | | Groundwater | **3** | Groundwater quality | **5** | 5 | 3 | 4 | 1 |
| | | | | Groundwater quantity (base flow to downstream creeks) | **3** | 2 | 3 | 2 | 4 |
| | | | | Sub-account merit score | | 31 | 24 | 26 | 17 |
| | | | | Sub-account merit rating | | 3.9 | 3.0 | 3.3 | 2.1 |
| | | Terrain and soils | **1** | High Productivity Soils | **1** | 3 | 2 | 4 | 2 |
| | | | | Sub-account merit score | | 3 | 2 | 4 | 2 |
| | | | | Sub-account merit rating | | 3.0 | 2.0 | 4.0 | 2.0 |
| | | Fish, Fish Habitat and Aquatic Resources | **6** | Fish habitat | **6** | 3 | 2 | 2 | 4 |

**Appendix B.6. Sensitivity Analysis - Physical Stability Incorporated into Technical Account**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Risks to non-CRA fish and aquatic resources | 1 | 6 | 4 | 5 | 3 |
| | | | | Sub-account merit score | | 24 | 16 | 17 | 27 |
| | | | | Sub-account merit rating | | 3.4 | 2.3 | 2.4 | 3.9 |
| | | Terrestrial ecosystems | 3 | Loss and risk to wetlands | 1 | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit score | | 3 | 3 | 3 | 4 |
| | | | | Sub-account merit rating | | 3.0 | 3.0 | 3.0 | 4.0 |
| | | Wildlife | 5 | Loss of high-quality habitat for species of conservation concern | 3 | 2 | 3 | 3 | 5 |
| | | | | Loss of high quality habitat for caribou | 6 | 3 | 3 | 3 | 4 |
| | | | | Loss of high quality habitat for moose | 2 | 4 | 4 | 4 | 5 |
| | | | | Toxicological risk to migratory birds, amphibians and bats | 6 | 5 | 3 | 4 | 2 |
| | | | | Toxicological risk to terrestrial wildlife species | 4 | 5 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 82.0 | 65.0 | 75.0 | 69.0 |
| | | | | Sub-account merit rating | | 3.9 | 3.1 | 3.6 | 3.3 |
| | | Account merit score (S{SxW}) | | | | 93 | 74 | 79 | 70 |
| | | Account merit rating (S{SxW}/SW) | | | | 3.0 | 2.4 | 2.6 | 2.3 |
| Human Environment | 3 | | | | | | | | |
| | | Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |

**Appendix B.6. Sensitivity Analysis - Physical Stability Incorporated into Technical Account**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| | | Non-traditional land use | 2 | Agricultural and range tenures | 2 | 4 | 4 | 4 | 6 |
| | | | | Registered trap lines | 3 | 2 | 2 | 2 | 4 |
| | | | | Sub-account merit score | | 14.0 | 14.0 | 14.0 | 24.0 |
| | | | | Sub-account merit rating | | 2.8 | 2.8 | 2.8 | 4.8 |
| | | Public recreation | 2 | Overlap of areas with recreational sensitivity and significance | 1 | 2 | 2 | 2 | 5 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 5.0 |
| | | Heritage | 4 | Known archaeological sites | 1 | 2 | 2 | 2 | 6 |
| | | | | Sub-account merit score | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | | | Sub-account merit rating | | 2.0 | 2.0 | 2.0 | 6.0 |
| | | Human Health | 6 | Potential health risks | 1 | 6 | 4 | 5 | 2 |
| | | | | Sub-account merit score | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | | | Sub-account merit rating | | 6.0 | 4.0 | 5.0 | 2.0 |
| | | Employment | 3 | Employment opportunities | 2 | 4 | 5 | 4 | 5 |
| | | | | Sub-account merit score | | 8.0 | 10.0 | 8.0 | 10.0 |
| | | | | Sub-account merit rating | | 4.0 | 5.0 | 4.0 | 5.0 |
| | | Account merit score (S{SxW}) | | | | 157 | 115 | 132 | 127 |
| | | Account merit rating (S{SxW}/SW) | | | | 4.5 | 3.3 | 3.8 | 3.6 |
| Project Economics | 1.5 | | | | | | | | |
| | | Proponent costs | 1 | Initial capital costs | 1 | 6 | 2 | 5 | 3 |
| | | | | Sustaining capital and operating costs | 1 | 5 | 1 | 5 | 1 |
| | | | | Closure costs | 1 | 5 | 2 | 4 | 1 |
| | | | | Post-Closure costs | 1 | 6 | 3 | 5 | 1 |
| | | | | Sub-account merit score | | 22.0 | 8.0 | 19.0 | 6.0 |
| | | | | Sub-account merit rating | | 5.5 | 2.0 | 4.8 | 1.5 |
| | | Account merit score (S{SxW}) | | | | 6 | 2 | 5 | 2 |
| | | Account merit rating (S{SxW}/SW) | | | | 5.5 | 2.0 | 4.8 | 1.5 |
| MAA merit score | | | | | | 53 | 37 | 45 | 37 |
| MAA merit rating | | | | | | 3.9 | 2.7 | 3.3 | 2.7 |

**Appendix B.7. Sensitivity Analysis - Only Current Use of Lands and Resources for Traditional Purposes Considered**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 |
|---|---|---|---|---|---|---|---|---|---|
| Human Environment | 6 | | | | | | | | |
| | | Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 |
| | | Account merit score (S{SxW}) | | | | 91 | 58 | 72 | 57 |
| | | Account merit rating (S{SxW}/SW) | | | | 5.1 | 3.2 | 4.0 | 3.2 |

**Appendix B.8. Sensitivity Analysis - Only Differentiating Indicators Considered**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Discrimination Value (based on 30% diff) |
|---|---|---|---|---|---|---|---|---|---|---|
| Physical Stability | 6 | | | | | | | | | |
| | | Physical Stability | 6 | Location of water storage | 6 | 3 | 1 | 1 | 5 | 24 D |
| | | | | Tailings and waste rock interstitial water | 5 | 3 | 4 | 3 | 5 | 10 D |
| | | | | Normal operating pond volume | 6 | 4 | 5 | 5 | 6 | 12 D |
| | | | | Emergency water management - pumps (active) | 0 | 5 | 3 | 4 | 3 | 0 ND |
| | | | | Emergency water management - spillway (passive) | 0 | 4 | 4 | 4 | 6 | 0 ND |
| | | | | Design basis / regulatory requirement | 3 | 6 | 5 | 6 | 3 | 9 D |
| | | | | Tailings density | 5 | 3 | 5 | 3 | 5 | 10 D |
| | | | | Maximum dam height | 0 | 3 | 3 | 3 | 5 | 0 ND |
| | | | | Operational monitoring requirements - safety | 5 | 6 | 3 | 5 | 3 | 15 D |
| | | | | Sub-account merit score | | 120.0 | 111.0 | 109.0 | 140.0 | |
| | | | | Sub-account merit rating | | 4.0 | 3.7 | 3.6 | 4.7 | |
| | | Account merit score (S{SxW}) | | | | 24 | 22 | 22 | 28 | |
| | | Account merit rating (S{SxW}/SW) | | | | 4.0 | 3.7 | 3.6 | 4.7 | |
| Technical | 3 | | | | | | | | | |
| | | Containment Design | 6 | Style of Containment | 6 | 5 | 4 | 5 | 3 | 12 D |
| | | | | Number of dams | 5 | 2 | 5 | 3 | 6 | 20 D |
| | | | | Construction Volumes | 3 | 2 | 4 | 2 | 6 | 12 D |
| | | | | Tailings Initial Settled Density | 0 | 3 | 4 | 3 | 4 | 0 ND |
| | | | | Drainage Provisions | 4 | 5 | 2 | 4 | 1 | 16 D |
| | | | | Seepage Management - Physical | 0 | 4 | 3 | 3 | 2 | 0 ND |
| | | | | Seepage Management - Quality | 5 | 6 | 4 | 5 | 1 | 25 D |
| | | | | Sub-account merit score | | 96.0 | 89.0 | 92.0 | 75.0 | |
| | | | | Sub-account merit rating | | 4.2 | 3.9 | 4.0 | 3.3 | |
| | | Construction Requirements | 4 | Foundation Preparation for Tailings Storage Area (excludes dam) | 6 | 4 | 2 | 4 | 2 | 12 D |
| | | | | Tailings Infrastructure | 0 | 4 | 2 | 3 | 2 | 0 ND |
| | | | | Foundation Preparation for PAG Waste Rock Facility | 6 | 4 | 4 | 4 | 1 | 18 D |
| | | | | Initial Dam Construction | 6 | 4 | 3 | 3 | 6 | 18 D |
| | | | | Sustaining Construction (excludes waste delivery) | 4 | 2 | 4 | 3 | 6 | 16 D |
| | | | | Sub-account merit score | | 80.0 | 70.0 | 78.0 | 78.0 | |
| | | | | Sub-account merit rating | | 3.6 | 3.2 | 3.5 | 3.5 | |
| | | Water Management | 6 | Catchment Area | 0 | 2 | 3 | 2 | 4 | 0 ND |
| | | | | Flood Routing | 4 | 6 | 3 | 6 | 1 | 20 D |
| | | | | Water Balance - Surplus/Deficit/Balance | 6 | 5 | 2 | 4 | 4 | 18 D |
| | | | | Water Recycle Requirement | 0 | 3 | 5 | 4 | 5 | 0 ND |
| | | | | Water Treatment | 4 | 5 | 2 | 5 | 1 | 16 D |
| | | | | Surplus Water Management | 5 | 5 | 3 | 4 | 4 | 10 D |
| | | | | Operational monitoring requirements - internal site water management | 4 | 5 | 4 | 4 | 1 | 16 D |
| | | | | Sub-account merit score | | 119.0 | 63.0 | 104.0 | 56.0 | |
| | | | | Sub-account merit rating | | 5.2 | 3.3 | 5.5 | 2.9 | |

**Appendix B.8. Sensitivity Analysis - Only Differentiating Indicators Considered**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Discrimination Value (based on 30% diff) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Execution | 6 | Technology Precedent - processing | 0 | 6 | 4 | 2 | 4 | 0 ND |
| | | | | Technology Precedent - storage | 4 | 6 | 1 | 1 | 1 | 20 D |
| | | | | Tailings Delivery Complexity | 6 | 6 | 2 | 4 | 2 | 24 D |
| | | | | Tailings Placement Complexity | 5 | 5 | 3 | 4 | 3 | 10 D |
| | | | | PAG Waste Rock Delivery and Placement | 4 | 2 | 3 | 1 | 5 | 16 D |
| | | | | Operational Flexibility | 5 | 6 | 3 | 5 | 2 | 20 D |
| | | | | Sub-account merit score | | 123.0 | 58.0 | 77.0 | 61.0 | |
| | | | | Sub-account merit rating | | 5.1 | 2.4 | 3.2 | 2.5 | |
| | | Closure | 6 | Closure concept - physical | 6 | 4 | 2 | 2 | 5 | 18 D |
| | | | | Closure concept - geochemical | 5 | 6 | 4 | 5 | 1 | 25 D |
| | | | | Closure concept - active closure period | 0 | 4 | 2 | 4 | 2 | 0 ND |
| | | | | Closure concept - long-term maintenance and monitoring | 5 | 5 | 3 | 4 | 1 | 20 D |
| | | | | Concurrent closure and reclamation | 0 | 4 | 3 | 4 | 4 | 0 ND |
| | | | | Premature closure | 0 | 4 | 3 | 4 | 2 | 0 ND |
| | | | | Sub-account merit score | | 79.0 | 47.0 | 57.0 | 40.0 | |
| | | | | Sub-account merit rating | | 4.9 | 2.9 | 3.6 | 2.5 | |
| | | Account merit score (S{SxW}) | | | | 131 | 88 | 112 | 82 | |
| | | Account merit rating (S{SxW}/SW) | | | | 4.7 | 3.1 | 4.0 | 2.9 | |
| Environmental | 6 | | | | | | | | | |
| | | Climate and air quality | 3 | Sensitivity to climate change | 3 | 5 | 4 | 4 | 2 | 9 D |
| | | | | Dust emissions | 5 | 5 | 3 | 4 | 2 | 15 D |
| | | | | Noise and vibration | 0 | 5 | 3 | 5 | 1 | 0 ND |
| | | | | Sub-account merit score | | 40 | 27 | 32 | 16 | |
| | | | | Sub-account merit rating | | 5.0 | 3.4 | 4.0 | 2.0 | |
| | | Surface water quantity | 4 | Loss of catchment area | 0 | 2 | 3 | 2 | 4 | 0 ND |
| | | | | Sub-account merit score | | 0 | 0 | 0 | 0 | |
| | | | | Sub-account merit rating | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | Surface water quality | 6 | Storage of PAG material | 6 | 5 | 3 | 4 | 1 | 24 D |
| | | | | Seepage quantity | 3 | 5 | 1 | 1 | 3 | 12 D |
| | | | | Dam embankment area | 2 | 1 | 4 | 3 | 6 | 10 D |
| | | | | Operational discharge of treated water | 5 | 5 | 3 | 3 | 1 | 20 D |
| | | | | Sub-account merit score | | 72 | 44 | 48 | 32 | |
| | | | | Sub-account merit rating | | 4.5 | 2.8 | 3.0 | 2.0 | |
| | | Groundwater | 3 | Groundwater quality | 5 | 5 | 3 | 4 | 1 | 20 D |
| | | | | Groundwater quantity (base flow to downstream creeks) | 0 | 2 | 3 | 2 | 4 | 0 ND |
| | | | | Sub-account merit score | | 25 | 15 | 20 | 5 | |
| | | | | Sub-account merit rating | | 5.0 | 3.0 | 4.0 | 1.0 | |
| | | Terrain and soils | 1 | High Productivity Soils | 0 | 3 | 2 | 4 | 2 | 0 ND |
| | | | | Sub-account merit score | | 0 | 0 | 0 | 0 | |
| | | | | Sub-account merit rating | | 0.0 | 0.0 | 0.0 | 0.0 | |

**Appendix B.8. Sensitivity Analysis - Only Differentiating Indicators Considered**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Discrimination Value (based on 30% diff) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Fish, Fish Habitat and Aquatic Resources | 6 | Fish habitat | 6 | 3 | 2 | 2 | 4 | 12 D |
| | | | | Risks to non-CRA fish and aquatic resources | 0 | 6 | 4 | 5 | 3 | 0 ND |
| | | | | Sub-account merit score | | 18 | 12 | 12 | 24 | |
| | | | | Sub-account merit rating | | 3.0 | 2.0 | 2.0 | 4.0 | |
| | | Terrestrial ecosystems | 3 | Loss and risk to wetlands | 0 | 3 | 3 | 3 | 4 | 0 ND |
| | | | | Sub-account merit score | | 0 | 0 | 0 | 0 | |
| | | | | Sub-account merit rating | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | Wildlife | 5 | Loss of high-quality habitat for species of conservation concern | 3 | 2 | 3 | 3 | 5 | 9 D |
| | | | | Loss of high quality habitat for caribou | 0 | 3 | 3 | 3 | 4 | 0 ND |
| | | | | Loss of high quality habitat for moose | 0 | 4 | 4 | 4 | 5 | 0 ND |
| | | | | Toxicological risk to migratory birds, amphibians and bats | 6 | 5 | 3 | 4 | 2 | 18 D |
| | | | | Toxicological risk to terrestrial wildlife species | 4 | 5 | 3 | 4 | 2 | 12 D |
| | | | | Sub-account merit score | | 56.0 | 39.0 | 49.0 | 35.0 | |
| | | | | Sub-account merit rating | | 4.3 | 3.0 | 3.8 | 2.7 | |
| | | Account merit score (S{SxW}) | | | | 79 | 51 | 61 | 34 | |
| | | Account merit rating (S{SxW}/SW) | | | | 2.5 | 1.6 | 2.0 | 1.1 | |
| Human Environment | 3 | | | | | | | | | |
| | | Current Use of Lands and Resources for Traditional Purposes - Ulkatcho First Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 | 9 D |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 | 18 D |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 | 16 D |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 | |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 | |
| | | Current Use of Lands and Resources for Traditional Purposes - Lhoosk'uz Dene Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 | 9 D |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 | 18 D |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 | 16 D |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 | |
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 | |
| | | Current Use of Lands and Resources for Traditional Purposes - Skin Tyee Nation | 6 | Availability (abundance and distribution) of resources harvested by Aboriginal people | 3 | 2 | 2 | 2 | 5 | 9 D |
| | | | | Quality of resources harvested by Aboriginal people | 6 | 6 | 4 | 5 | 3 | 18 D |
| | | | | Quality of Aboriginal harvesters' experience | 4 | 6 | 3 | 4 | 2 | 16 D |
| | | | | Sub-account merit score | | 66.0 | 42.0 | 52.0 | 41.0 | |

**Appendix B.8. Sensitivity Analysis - Only Differentiating Indicators Considered**

| Account | W | Sub-account | W | Indicator | W | Candidate 1 | Candidate 7 | Candidate 10 | Candidate 22 | Discrimination Value (based on 30% diff) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sub-account merit rating | | 5.1 | 3.2 | 4.0 | 3.2 | |
| | | Non-traditional land use | 2 | Agricultural and range tenures | 0 | 4 | 4 | 4 | 6 | 0 ND |
| | | | | Registered trap lines | 0 | 2 | 2 | 2 | 4 | 0 ND |
| | | | | Sub-account merit score | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sub-account merit rating | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | Public recreation | 2 | Overlap of areas with recreational sensitivity and significance | 0 | 2 | 2 | 2 | 5 | 0 ND |
| | | | | Sub-account merit score | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sub-account merit rating | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | Heritage | 4 | Known archaeological sites | 0 | 2 | 2 | 2 | 6 | 0 ND |
| | | | | Sub-account merit score | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sub-account merit rating | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | Human Health | 6 | Potential health risks | 0 | 6 | 4 | 5 | 2 | 0 ND |
| | | | | Sub-account merit score | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sub-account merit rating | | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| | | Employment | 3 | Employment opportunities | 0 | 4 | 5 | 4 | 5 | 0 ND |
| | | | | Sub-account merit score | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sub-account merit rating | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | Account merit score (S{SxW}) | | | | 91 | 58 | 72 | 57 | |
| | | Account merit rating (S{SxW}/SW) | | | | 2.6 | 1.7 | 2.1 | 1.6 | |
| Project Economics | 1.5 | | | | | | | | | |
| | | Proponent costs | 1 | Initial capital costs | 0 | 6 | 2 | 5 | 3 | 0 ND |
| | | | | Sustaining capital and operating costs | 0 | 5 | 1 | 5 | 1 | 0 ND |
| | | | | Closure costs | 0 | 5 | 2 | 4 | 1 | 0 ND |
| | | | | Post-Closure costs | 0 | 6 | 3 | 5 | 1 | 0 ND |
| | | | | Sub-account merit score | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sub-account merit rating | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | Account merit score (S{SxW}) | | | | 0 | 0 | 0 | 0 | |
| | | Account merit rating (S{SxW}/SW) | | | | 0.0 | 0.0 | 0.0 | 0.0 | |
| MAA merit score | | | | | | 61 | 46 | 52 | 48 | |
| MAA merit rating | | | | | | 3.1 | 2.4 | 2.7 | 2.5 | |

# *Appendix F*

*Tailings Storage Facility Failure Modes Effects Assessment Report and Risk Management Opportunities*

**NEW GOLD INC.**
**BLACKWATER GOLD PROJECT**





# TAILINGS STORAGE FACILITY FAILURE MODES AND EFFECTS ASSESSMENT REPORT

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VA101-457/15-2
Rev 0
December 9, 2015

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FS 64925
EMS 550121
OHS 550122

# NEW GOLD INC.
# BLACKWATER GOLD PROJECT

## TAILINGS STORAGE FACILITY FAILURE MODES AND EFFECTS ASSESSMENT REPORT
## VA101-457/15-2

| Rev | Description | Date |
|---|---|---|
| 0 | Issued in Final | December 9, 2015 |

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## EXECUTIVE SUMMARY

A Failure Modes and Effects Assessment (FMEA) was completed to identify and characterize risks to the TSF. The FMEA evaluated risk management practices outlined in the project design, and those expected to be applied during permitting. The FMEA evaluated risks specific to the TSF concept identified to be the best available technology for the Blackwater Project (ERM, 2015).

The FMEA demonstrated that the majority of risks to the TSF are mitigated through measures in place in the current design and measures to be applied during permitting. The risk rating process did not identify any high or very high hazards. The two highest rated risks (medium) identified were as follows:

- Excess water causing encroachment on freeboard allowance of the TSF, and
- No recognition/response to site changes resulting in insufficient storage capacity of the TSF.

The opportunity to enhance safety and reduce project risk through improvement in water management practices was evaluated during the risk assessment process. Several opportunities for improved water management became apparent during this review. These opportunities include consideration of the physical location of water storage, active management of undisturbed runoff contributing to the water balance, emergency removal of water from the pond, and dam safety in extreme conditions.

The FMEA process identified several measures that reduce risk, with four additional measures providing the most benefit in risk reduction. These opportunities were grouped into two categories: mitigations and contingencies. The mitigations and contingencies work together to reduce overall project risk by managing likelihood and consequence of potential hazards.

The mitigations were:

- Installation of optional diversions upstream of TSF Site D (northern diversion) and upstream of the mine facilities south of the TSF (southern diversion) to convey any excess water around rather than into the tailings facility, and
- Transfer and storage of the majority of tailings pond supernatant in TSF Site C to minimize water in TSF Site D and maximize the beach width.

The contingencies were:

- Establishment of interim emergency overflow channels around the Site D Main Dam during operations to ensure that the incremental increase in runoff from the Probable Maximum Flood (PMF) during operations is safely transmitted around the dam in a controlled manner.
- Emergency water storage in the open pit in the event that excessive water is encountered in the TSF that causes a violation of freeboard requirements and water levels need to be lowered. Use of the emergency pit storage will lead to a suspension of operations.

These additional practices combined with the design measures and practices already in place in the project design comprise the best available practices for the project TSF. The FMEA created a catalogue of potential hazards to the proposed TSF and documents the best available practices to mitigate the risk of each hazard. The FMEA is considered to be a living document that will be updated periodically during subsequent stages of design, operations, and during closure of the TSF.

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Appendix A Failure Modes and Effects Assessment – Table 1
Appendix B Northern Diversion
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Appendix D Site C Water Storage
Appendix E Interim Emergency Overflow Channels
Appendix F Emergency Water Storage in Open Pit

## ABBREVIATIONS

| | |
|---|---|
| AR | Aqua Regia |
| ARD | Acid Rock Drainage |
| BC EAO | British Columbia Environmental Assessment Office |
| BMP | Best Management Practice |
| CEAA | Canadian Environmental Assessment Agency |
| CDA | Canadian Dam Association |
| COT | Cut-Off Trench |
| ECD | Environmental Control Dam |
| EDGM | Earthquake Design Ground Motion |
| EIS | Environmental Impact Statement |
| EOR | Engineer of Record |
| FMEA | Failure Modes and Effects Assessment |
| FS | Feasibility Study |
| ICP | Inductivity Coupled Plasma |
| IDF | Inflow Design Flood |
| KP | Knight Piésold Ltd. |
| MAA | Multiple Accounts Analysis |
| MCE | Maximum Credible Earthquake |
| ML | Metal Leaching |
| NAG | Non Acid Generating |
| New Gold | New Gold Inc. |
| NPR | Neutralization Potential Ratio |
| OMS | Operation Maintenance and Surveillance |
| PAG | Potentially Acid Generating |
| PEA | Preliminary Economic Assessment |
| PGA | Peak Ground Acceleration |
| PMF | Probable Maximum Flood |
| PMP | Probable Maximum Precipitation |
| Richfield | Richfield Ventures Ltd. |
| SCP | Sediment Control Pond |
| the Panel | Mt. Polley Independent Investigation and Review Panel |
| the Project | Blackwater Gold Project |
| TPD | Tonnes Per Day |
| TSF | Tailings Storage Facility |
| TSS | Total Suspended Solids |

# 1 – INTRODUCTION

## 1.1 BACKGROUND

The Blackwater project area was actively explored by Richfield Ventures Corp. (Richfield) starting in 2009. New Gold Inc. (New Gold) obtained the Blackwater property through the acquisition of Richfield in June 2011. Knight Piésold Ltd. (KP) was retained in early 2011 to complete a preliminary mine development assessment desktop study for the project. This was followed by a series of alternative mine waste and water management concept assessments for the project from the middle of 2011 through early 2012. A Preliminary Economic Assessment (PEA) of the project was completed in the third quarter of 2012 with a Feasibility Study (FS) following in the fourth quarter of 2013. The acceptance of the Environmental Impact Statement (EIS) / Application into the review process is pending as of the writing of this report.

An alternatives assessment was initiated in early 2015 in response to a request provided in a letter (dated March 19, 2015) from the British Columbia Environmental Assessment Office (BC EAO) to consider the implications of the Mt. Polley Independent Expert Engineering Investigation and Review Panel (the Panel) report findings and recommendations (IEEIRP, 2015). The BC EAO request required that proposed mining projects that have new proposed tailings dams provide information on the alternative means of undertaking the project. A subsequent letter provided by the Canadian Environmental Assessment Agency (dated June 3, 2015) requested that environmental effects, as defined in section 5 of Canadian Environmental Assessment Act (2012), be included in the alternatives assessment.

The alternatives assessment study evaluated tailings disposal locations further from the deposit area and considered the use of alternative tailings production and storage technologies. The results of the study identified that the best available technology for the development of a Tailings Storage Facility (TSF) for the Project was to co-dispose thickened-slurry tailings with PAG/NAG3 waste rock in the Davidson Creek valley (ERM, 2015). The design summary of the TSF concept was presented in the Mine Waste and Water Management Design Report (KP, 2014).

The BC EAO letter requested that proponents consider:

- options for managing water balance to enhance safety and reduce risk (likelihood and consequence) of a tailings dam failure during all phases of mine life (construction, operations, closure, post-closure)
- for the project design option selected, consider the potential risks and implications of that option, and have a technically and economically feasible plan to address the potential risks and implications, and
- provide a clear and transparent rationale for the selected option(s).

A Failure Modes and Effects Assessment (FMEA) was completed to identify and characterize risks to the TSF. The FMEA evaluated risk management practices outlined in the EA, those expected to be applied during permitting and identified areas where additional mitigations and contingencies could be implemented to minimize the identified risks. This report summarizes the methodology used to evaluate these risks, and the outcomes of the assessment.

## 1.2 REFERENCE REPORTS

Information available in the following KP subject matter reports was used to prepare this study:

- TSF Design Report – KP report, Mine Waste and Water Management Design Report, Ref. No. VA101-457/6-11 Rev. 2 dated September 12, 2014.
- Alternatives Assessment – KP Report, Alternative Technology Options Study, Ref. No. VA101-457/15-1 Rev. 0 dated November 2015.

A general arrangement for the project is shown on Figure 1.1.

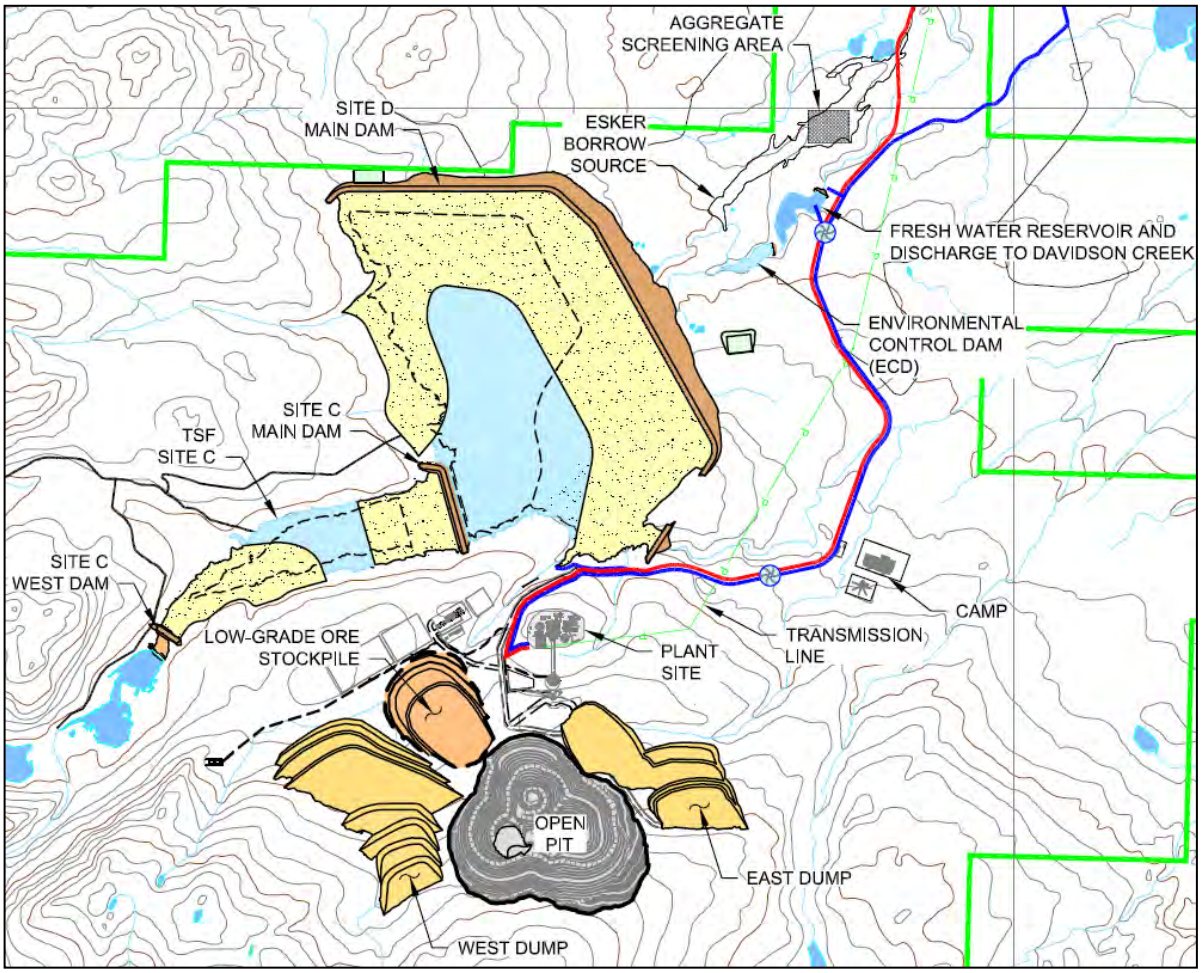



**Figure 1.1 Project General Arrangement**

## 1.3 RISK

The FMEA defines risk as the product of the likelihood of an event occurring and the consequences of the event:

risk = likelihood x consequence

## 1.4 DEFINITIONS

Definitions were developed for likelihood and consequence in order to provide consistent rating of risk for all aspects of the TSF. The likelihood and consequence were ranked on a scale from 1 to 5, with 1 representing the lowest likelihood or consequence, and 5 representing the highest.

Likelihood and consequence were evaluated qualitatively. The definitions for the five levels of likelihood are shown in Table 1.1 and the definitions for the five levels of consequence are shown in Table 1.2. Combined overall risk ratings and colour coding schemes are shown in Table 1.3.

**Table 1.1 Likelihood**

| Score | Descriptor | Frequency |
|---|---|---|
| 1 | Very Rare | Less than one event per 1000 years |
| 2 | Unlikely | Less than one event per 100 years |
| 3 | Possible | Less than one event per 20 years |
| 4 | Likely | Less than one event per year |
| 5 | Almost Certain | More than one event per year |

**Table 1.2 Consequence**

| CONSEQUENCE SCORE | DESCRIPTOR | ENVIRONMENT | ABORIGINAL RIGHTS AND TITLE | BUSINESS | DAMAGE / LOSS |
|---|---|---|---|---|---|
| 1 | Insignificant | Limited short-term effect in small or previously disturbed area | There is no change to the abundance of resources (e.g., wildlife, birds, vegetation) or to the availability of land typically accessed for the purpose of undertaking traditional Aboriginal land use activities. | < 6 hour production delay | < $0.5 Million |
| 2 | Minor | Small short-term effect on part of ecosystem | Lands and resources typically accessed to support traditional Aboriginal land use activities experience minor reductions or other effects in the short term, but access or harvesting is not compromised. | > 6 hour < 24 hour production delay | $0.5- $2 Million |
| 3 | Moderate | Moderate short-term effects, affecting part of ecosystem (i.e biological or physical environment) | An area of land (including waterbodies) or a natural resource typically accessed by an Aboriginal group for the purpose of pursuing traditional land use activities (for subsistence or other purposes) is unavailable in the short-to medium-term. | >1 day and < 1 week production delay | $2 - $10 Million |
| 4 | Major | Serious medium-term environmental impact, affecting whole ecosystem | An area of land (including waterbodies) or a natural resource typically accessed by an Aboriginal group for the purpose of pursuing traditional land use activities (for subsistence or other purposes) is unavailable for an extended period of time. | > 1 week and < 1 month production delay | $10 - $50 Million |
| 5 | Catastrophic | Irreparable damage, very serious long term impairment, affecting whole ecosystem | An area of land (including waterbodies) or a natural resource typically accessed by an Aboriginal group for the purpose of pursuing traditional land use activities (for subsistence or other purposes) is unavailable for the foreseeable future. | > 1 month production delay | > $50 Million |

**Table 1.3 Risk Classification**

| Score (Likelihood x Consequence) | Descriptor |
|---|---|
| 1 to 3 | Very Low |
| 4 to 6 | Low |
| 7 to 12 | Medium |
| 13 to 20 | High |
| 21 to 25 | Very High |

## 1.5 PROJECT COMPONENTS

The FMEA focused on the main components of the TSF, outlined as follows:

- Cofferdams
- Diversion and Collection Ditches
- Sediment Control Ponds
- TSF (General)
- TSF Site C Dams
- TSF Site D Main Dam, and
- Environmental Control Dam (ECD).

In order to capture hazards which may increase or decrease over the life of the Project, three phases of development were considered:

- C – Construction including commissioning
- O – Operations, and
- CL – Closure and decommissioning.

# 2 – RISK ANALYSIS

## 2.1 RISK MITIGATION BY DESIGN

The TSF design incorporates design measures and operational practices that lead to an overall low risk profile. A list of key defensive measures incorporated in the TSF design for each specific hazard is shown in Table 1 of Appendix A. The following sections provide a summary of the key measures included in the project design that reduce the potential risk and enhance safety of the facility; full description of the project facilities is available in the Mine Waste and Water Management Design Report (KP, 2014).

### 2.1.1 Cofferdams

Two temporary cofferdams (the Site C cofferdam and the Site D cofferdam) are planned for the early construction phase of the tailings facility dams.

The Site C cofferdam will be constructed first and has an estimated exposure period of three months during construction of Stage 1A of the Site C Main Dam. Construction will commence following the freshet season during the summer low flow period. The cofferdam was designed to store the 1 in 10 year 24-hour storm event and the 1 in 10 year wet August, September, and October. A temporary bypass diversion pumping system was also included to direct inflows around the work area during cofferdam construction. The cofferdam will eventually become part of the upstream footprint of the Site C Main Dam.

The Site D cofferdam will be constructed after the Site C cofferdam during construction of Stage 1A of the Site C Main Dam. The cofferdam was designed to store the 1 in 10 year 24-hour storm event and the 1 in 10 year wet October, November, and December. A temporary bypass diversion pumping system was also included to direct inflows around the work area during cofferdam construction. The Site D cofferdam has an estimated exposure period of over a year and must provide protection for downstream cut-off trench excavation and backfill in the year following its construction. Two additional design measures were included to manage this additional risk; a spillway and a freshet pumpback system. The spillway was designed to safely pass the peak flow from the 1 in 200 year 24-hour storm event. The freshet pumpback system was designed to pump 1,500 cubic metres per hour ($m^3$/hr) enabling the system to capture a large portion of the spring and summer freshet flows, and convey the water to the Site C Main Dam for storage for operations start up. Water behind the cofferdam will accumulate at a slower rate during lower flow times of year and will be pumped down as required. The spillway will pass flows that exceed the available storage and design pumping capacity of the system. The cofferdam will eventually become part of the upstream footprint of the Site D Main Dam during the first year of operations.

The cofferdams were designed as water retaining embankments with a 10 m crest width and 2H:1V upstream and downstream slopes. A sediment control pond is positioned downstream to manage sediment laden runoff from the work areas.

### 2.1.2 Diversion and Collection Ditches

Temporary collection and diversion ditches were included in the construction and operations phases of the TSF to control water and minimize erosion in areas disturbed by construction. All ditches were designed to manage sediment with erosion control best management practices (BMPs) and will be

armoured to prevent erosion. Ditches were designed to manage the 1 in 10 year 24-hour storm event. All ditches will be accompanied by silt fence installed downslope of the ditch to prevent potential residual sediment movement along undisturbed slopes. Regular monitoring and maintenance of the implemented BMPs will confirm success of the sediment control plan.

### 2.1.3 Sediment Control Ponds

Surface water sediment mobilization and erosion will be managed throughout the site using BMPs at the source of the sediment as the first step towards controlling erosion and sedimentation during construction. All temporary sediment and erosion control features will require maintenance and inspection after a significant rainfall.

A sediment control pond (SCP) has been designed for each major disturbance area and will be constructed prior to disturbance at the sites. The SCPs were designed based on the Guidelines for Assessing the Design, Size and Operation of Sedimentation Ponds Used in Mining (BC MOELP 2001). The ponds were designed to accommodate a live storage equal to the 1 in 10 year 24-hour storm event with a half meter of freeboard, and to settle out sediment 0.01 mm sized particles (and larger), while providing a retention time of at least 24 hours. Each pond and pond outlet spillway was designed to withstand a 1 in 200 year 24-hour storm event, in accordance with the aforementioned guidelines.

AMEC conducted studies (AMEC, 2014) on overburden samples from the project site to identify an appropriate flocculent to aid sediment settling, if required.

### 2.1.4 TSF (General)

A technical bulletin was released by the Canadian Dam Association in 2014 (CDA, 2014), entitled Application of Dam Safety Guidelines to Mining Dams. The final technical bulletin was pre-dated by draft versions that were used in the feasibility design and there are minor differences in the suggested design levels compared to the final document that will be accommodated in detailed design. The CDA guidelines were used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the tailings dams. The following suggested design levels were adopted from the CDA guidelines for the construction and operations phases of the project:

- IDF – 2/3 between 1 in 1,000 year return period and PMF
- EDGM – 1 in 5,000 year event

The guidelines suggest that a mining dam with a dam safety classification of VERY HIGH should be designed for the PMF and Maximum Credible Earthquake (MCE) in the closure phase. The following design flood and earthquake levels were adopted for the closure phase:

- IDF – PMF
- EDGM – MCE (1 in 10,000 year event)

The PMF was calculated deterministically as a combination of the 24-hour Probable Maximum Precipitation (PMP) combined with the complete melt of a snowpack equivalent to a 1 in 100 year return period without consideration for rate of snowmelt and assuming 100% runoff.

The tailings facility will manage the IDF during operations by including storm storage freeboard above the normal operating pond allowance. Additional freeboard is available above the storm storage for wave run-up. The IDF was based on capturing runoff from an event of 681 mm assuming

all diversions fail. The applicable IDF volumes for the design of the facility during operations were as follows:

- TSF Site C = 5 $Mm^3$
- TSF Site D = 28 $Mm^3$

The seismic hazard for the project was defined using probabilistic methods of analysis. Historical earthquake data and regional tectonics were examined to identify potential seismic sources and maximum earthquake magnitude for each source. A design earthquake magnitude 8.5 was selected for earthquake return periods of 5,000 and 10,000 years, based on the review of regional tectonics and historical seismicity. This represents large magnitude earthquakes occurring along the Queen Charlotte fault system and Cascadia subduction zone. The potential for shallow crustal earthquakes occurring closer to the project site was also considered for longer return period events of 5,000 and 10,000 years, representing earthquakes of up to about Magnitude 7.5 along coastal B.C. Mean Peak Ground Acceleration (PGA) values of 0.08g and 0.11g were determined for return periods of 5,000 and 10,000 years, respectively.

Site investigations were conducted in 2012 and 2013 in a series of phases to evaluate geotechnical and hydrogeological conditions for the proposed TSF and waste dumps. The site investigation programs collected substantial amounts of data to characterize the geology, hydrogeology and geotechnical conditions at the Project site. A stand-alone geotechnical characterization report (KP, 2013) was prepared to present the compilation and assessment of the findings from the 2012 and 2013 site investigation data along with other relevant data from the Project area. The findings were summarized in the design report (KP, 2014). The numbers of test pits and drillholes completed for the tailings storage facility are summarized in Table 2.1, and shown on Figures 2.1 and 2.2.

**Table 2.1 Summary of TSF Data Collection**

| Infrastructure Components | | Drillholes | Test Pits | PSD[2] | Hydrometer Test | Atterberg Limits | Natural Moisture Content |
|---|---|---|---|---|---|---|---|
| Environmental Control Dam | | 6 | - | 61 | 61 | 61 | 52 |
| Site D | Downstream Site D | 13 | 41 | 91 | 93 | 86 | 56 |
| | Site D Main Dam | 24 | 24 | 54 | 61 | 56 | 52 |
| | Site D Basin | 17 | 68 | 106 | 94 | 94 | 91 |
| Site C | Site C Main Dam | 11 | 8 | 47 | 46 | 46 | 44 |
| | Site C Basin | 1 | 9 | 3 | 3 | 3 | 1 |
| | Site C West Dam | 3 | 8 | 8 | 8 | 6 | 1 |

**NOTES:**

1. TABLE IS AN ABRIDGED VERSION MODIFIED FROM TABLE 4.1 OF MINE WASTE AND WATER MANAGEMENT DESIGN REPORT (KP, 2014).
2. PSD PARTICLE SIZE DISTRIBUTION ANALYSIS.

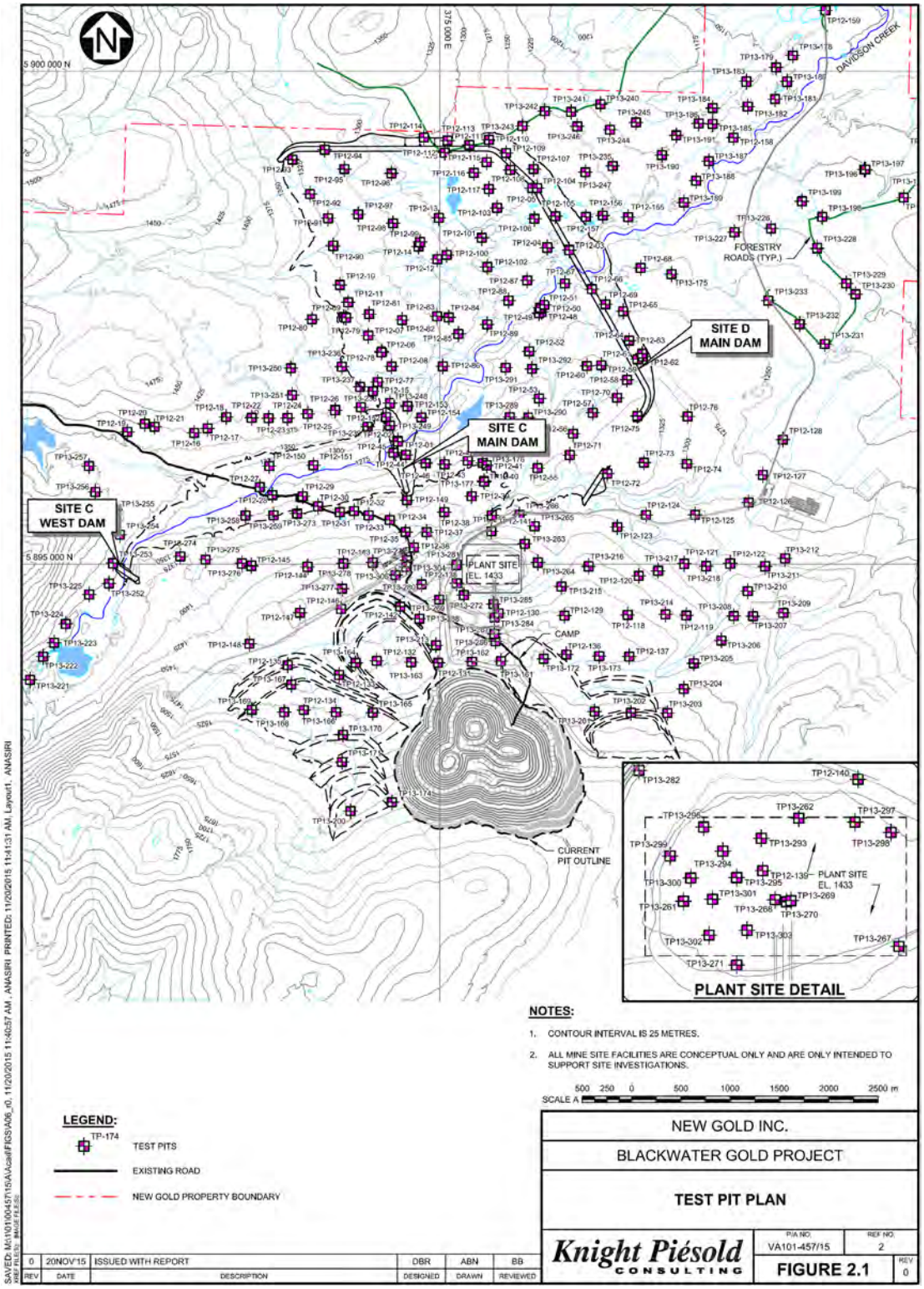



**Figure 2.1 Test Pit Plan**

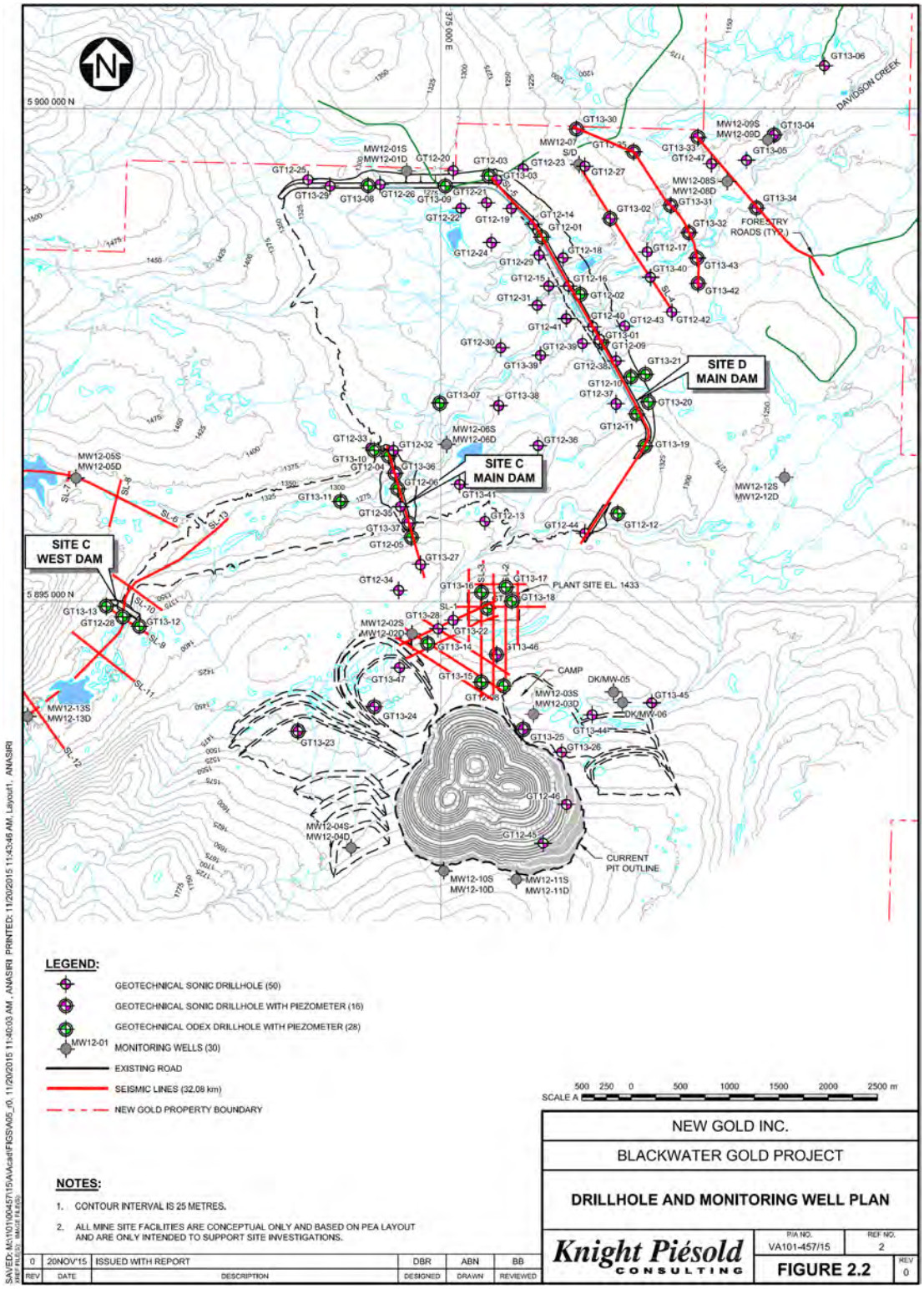



**Figure 2.2 Drillhole and Monitoring Well Plan**

The PAG and NAG3 waste rock disposal area (referred to as the PAG disposal area) within the TSF footprint will be developed as part of preproduction construction to provide a location for PAG disposal from the pit stripping to expose the orebody. The PAG disposal area will be developed at the same or similar rate of rise as TSF filling level but will be several metres higher to provide a dry, stable placement surface for truck traffic. The design objective for the PAG area is to flood the waste rock within one year of placement. The maximum elevation of the waste storage area will remain at an elevation where it can be flooded by the supernatant pond in the case of premature closure. The surface of the PAG disposal area will be progressively covered by tailings and the supernatant pond between Year 15 and 17 during low-grade ore processing when waste rock production has ceased with the end of active mining in the open pit. At closure, this waste storage area will be covered by 0.3 m of overburden and submerged below the final closure tailings elevation.

A ML/ARD program was conducted in three phases and included both static and kinetic testing. Sulphur and metal assays (inductively coupled plasma (ICP) assay following aqua regia (AR) digestion) were completed as part of the exploration geological program on every meter of exploration drill core. This database provides extensive coverage of the project applicable to the ML/ARD assessment and includes over 250,000 sulphur and zinc assays.

Mine waste was classified based on whether it is predicted to be potentially acid generating (PAG) or non-acid generating (NAG) as shown by the calculated Neutralization Potential Ratio (NPR). NAG waste rock was further classified as to its metal leaching potential based on zinc concentration. Classification criteria are as follows:

- Ore and Tailings (PAG)
- Low-Grade Ore (PAG)
- Overburden (NAG)
- Waste Rock:
  - PAG1 – NPR ≤ 1.0 (PAG)
  - PAG2 – 1.0 ≤ NPR ≤ 2.0 (PAG)
  - NAG3 – NPR ≥ 2.0 and Zn ≥ 1,000 ppm (NAG)
  - NAG4 – NPR ≥ 2.0 and 600 ≤ Zn ≤1,000 ppm (NAG)
  - NAG5 – NPR ≥ 2.0 and Zn ≤ 600 ppm (NAG)

Oxide ore contains very low sulphur; significantly less than transitional and sulphide ore types, and most of the sulphur is expected to be non-acid generating sulphate sulphur. Zinc, cadmium and arsenic are also lower in the oxide ore compared to transitional and sulphide ore types. Lead is higher in oxide ore but has low mobility at the neutral pH expected in the TSF. Oxide ore tailings could be placed as the final lift over transitional and sulphide ore tailings in the TSF to reduce the potential for ARD and metal leaching.

The project will use a conventional ore crushing, grinding and leaching process to produce a gold-silver doré. The tailings will report to three cyanide destruction vessels using the SO2/Air process before being discharge to the TSF as a single stream.

Waste management concepts for the various classifications of waste rock are outlined below:

- NAG4 and NAG5 waste rock and overburden:
  - Used to construct the TSF embankments.
  - Surplus and unsuitable materials disposed of in one of two waste dumps on-land (East and West) near the pit.

  - Progressive reclamation of the West waste rock dump during operations and final revegetation of both dumps at closure.
- NAG3 waste rock (potentially metal leaching):
  - Used to construct the upstream zone of the TSF embankments.
  - Surplus co-disposed of within the TSF in such a manner that it is flooded within 3-5 years by the supernatant pond.
- PAG1 and PAG2 waste rock:
  - Co-disposed of within the TSF in such a manner that it is saturated within 1 year by the supernatant pond to prevent oxidation and subsequent acid generation.

A monthly operational and closure water balance was developed for the Blackwater Project using the GoldSim© software package. The model estimated the magnitude and extent of any water surplus and/or deficit conditions in the TSF based on a range of possible climatic conditions. The model included one year of pre-production (Year -1) and 17 years of operations at a nominal milling rate of 60,000 TPD dry, and 18 years of closure until the TSF discharges to Davidson Creek. The model incorporated the following major project components:

- Open pit
- Mill
- LGO Stockpile
- TSF Site D
- TSF Site C, and
- East and West Dumps.

The facilities are in a balance or surplus condition throughout operations as shown on Figure 2.3. The water accumulated within the supernatant ponds in TSF Sites C and D will satisfy the mill process requirements under average precipitation conditions. The volume of water stored within the TSF Site C pond is expected to fluctuate between 3 to 4 $Mm^3$ and 8 to 11 $Mm^3$ for TSF Site D, increasing after Year 11. The total pond volume would vary throughout the year between roughly 11 and 14 $Mm^3$.

The surplus condition was predicted to develop beginning in Year 11 due to increasing runoff from the expanding disturbed areas of the mine facilities, and also from the decreases in waste rock production and corresponding decreases of water storage in waste rock voids for mine rock stored within TSF Site D. This was identified as a desirable condition during the Feasibility Study (KP, 2014) with this surplus water used to accelerate open pit filling and limit the onset of acid rock drainage conditions in the pit walls. It was also identified as a surplus condition that was easily manageable with additional fresh water diversions.

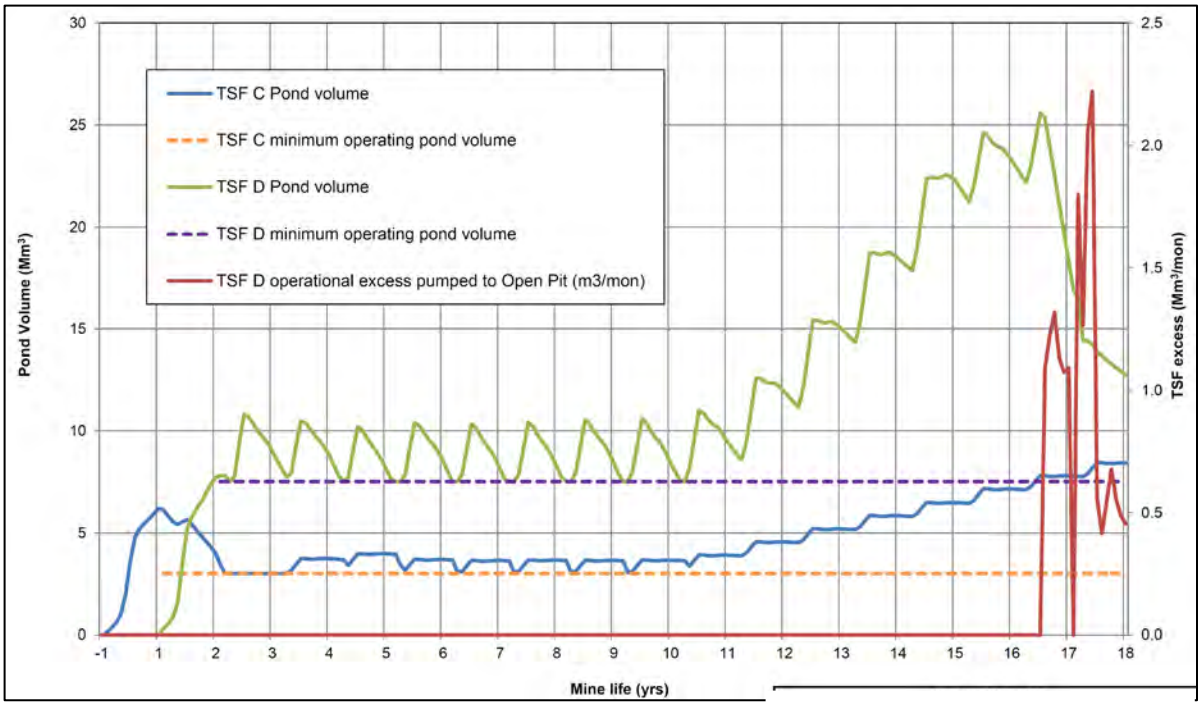



**Figure 2.3 Predicted Pond Volumes - Average Conditions**

A stochastic analysis was completed to analyze the range of possible cumulative pond volumes in TSF Site C and TSF Site D over the mine life without intervention, as defined by the 95$^{th}$ percentile wet and dry values (5% and 95% chance of being equalled or exceeded in any month, respectively). The stochastic water balance highlights the sensitivity of the TSF pond volumes to the assumed climatic inputs and pond minimum/maximum operating capacities.

The stochastic results indicated that for extreme wet conditions (95$^{th}$ percentile) the facility will operate in a surplus condition of roughly 1 Mm$^3$ per year, increasing after Year 11. The facility under these conditions and without surplus water management intervention will require larger operating pond allowances of 4 to 10 Mm$^3$ for TSF Site C and 16 to 25 Mm$^3$ for TSF Site D during the first ten years of mine life. The increased volumes in TSF Site C are manageable with the current design capacity. TSF Site D would require additional normal operating freeboard in each stage to manage these very unlikely climate conditions.

The stochastic results indicated that for extreme dry conditions (5$^{th}$ percentile) the accumulated TSF ponds, open pit and associated contributing catchments are not able to supply enough water to meet the process water requirements until Year 11, and the system will operate in a deficit condition until that time. The results indicated that under extreme dry conditions the supplemental make-up water requirement to support operation of the mine is less than 3 Mm$^3$ per year. The fresh water supply system has enough design capacity to augment this very unlikely worst case deficit. The planned normal operating pond volumes under average conditions have sufficient capacity to manage more than one severe dry year without impacting operation of the mill.

The TSF operational pond capacity is sufficient to manage a reasonable range of climate conditions. Water levels will be monitored to confirm that the water balance assumptions are accurate and that an operational surface water discharge from the TSF will not occur until closure. As a contingency,

non-contact surface water diversions will be created to divert runoff away from the TSF and the TSF dams can be raised more frequently, if required.

### 2.1.5 TSF Site C Dams

TSF Site C will be constructed first to provide storage capacity for start-up of the mill. The facility was designed to contain the first two years of tailings, PAG/NAG3 waste rock and may provide water storage for later years.

The Site C Main Dam will be constructed in four stages by downstream method. It was designed as a water retaining earthfill faced rockfill dam with an appropriately graded two stage filter and transition zone between the earthfill face and rockfill shell. The embankment foundations will be cleared and stripped in preparation for fill placement for each stage. The dam will have a minimum crest width of 30 m during the initial stage, and a crest width of 50 m for subsequent stages and the ultimate dam. The upstream and downstream slopes will be 2H:1V. The dam will be approximately 90 m high in the maximum section and will have a crest length of 900 m.

Construction of the Stage 1B raise will commence immediately following completion of Stage 1A. The dam will be raised to elevation 1,325 m to provide sufficient capacity to impound PAG/NAG3 waste rock generated during pre-production pit stripping and a start-up pond up to 10 $Mm^3$ with additional capacity to contain the IDF. Construction of Stage 2 will commence thereafter and will be completed by operations start-up. The dam will be raised to elevation 1,340 m, providing additional capacity required to contain the first year of tailings and PAG waste rock.

A single operational lift (Stage 3) will be completed on the Site C Main Dam during the first year of operations. The Site C West Dam will also be constructed during the first year of operations in a single stage. An instrumentation monitoring plan was designed for both dams and includes movement monuments on the dam crest and vibrating wire piezometers within the foundation and fill materials. The Site C Main Dam will be progressively buttressed on the downstream side by the PAG/NAG3 waste rock disposal area, which will be approximately 65 m thick in the dowstream area of the dam.

The tailings distribution pipeline will initially extend along a service road to the Site C Main Dam where tailings will be deposited during the first two years of operations. Spigot locations will be placed every 150 m along the dam crest. A large tailings beach will be developed that provides a low permeability transition zone between the coarse, permeable waste rock in the center of the TSF and the tailings embankments providing seepage control. The tailings beach width will be greater than 200 m throughout operations, and at times may exceed 1,000 m in width.

The maximum supernatant pond elevation will be passively controlled by a spillway connecting TSF Site C and TSF Site D. The spillway will be constructed around the north abutment of the Site C Main Dam with the spillway invert at EL. 1,346 m. The spillway invert elevation was selected to maintain a hydraulic barrier on the west of the impoundment by establishing a fresh water seepage hydraulic gradient towards the TSF.

The spillway will be constructed following cessation of tailings discharge in TSF Site C, and will be designed to manage the peak flow from the Probable Maximum Flood (PMF) without consideration for attenuation provided by the tailings facility pond or storage available below the invert of the spillway.

The filling plan for TSF Site C leaves approximately 14 $Mm^3$ of storage capacity available for water storage below EL. 1,346 m. The water balance modelling for the project indicated that a pond volume between 3 and 8 $Mm^3$ will be expected throughout operations (KP, 2014), and the pond will eventually fill in closure. The storage capacity in TSF Site C is underutilized in the present design and there is an opportunity to use this capacity to minimize storage requirements in TSF Site D.

### 2.1.6 TSF Site D Main Dam

TSF Site D will be constructed to manage tailings and mine waste for the remainder of the operational life of the project (Years 3 to 17). The embankment foundations will be cleared and stripped in preparation for fill placement for each stage. A cut-off trench (COT) will be excavated through the surficial sands and gravels and keyed into the low permeability subgrade. The facility was designed to contain tailings, PAG/NAG3 waste rock, and an operational supernatant pond of at least 10 $Mm^3$ with additional capacity to contain the IDF.

The tailings dam will be raised annually to maintain the storage capacity of the TSF. Each raise is designed to meet the projected design storage requirements for the next year following construction.

The Site D Main Dam will be constructed in fifteen stages by centreline method. It was designed as a water retaining earthfill core rockfill dam with an appropriately graded two stage filter and transition zone between the earthfill core and downstream rockfill shell. The core zone was offset downstream of centre for trafficability and constructability purposes, and the upstream zone will be comprised of waste rock from the open pit. The impoundment area adjacent to the dam will be comprised of hydraulically placed tailings sand with an approximate subaerial beach slope of 1% towards the supernatant pond. The dam will have a minimum crest width of 50 m throughout all operational raises and for the ultimate dam at closure. The downstream slopes will be 2H:1V. The dam will be approximately 140 m high in the maximum section and will have a crest length of 6,500 m.

The expansion of the dam will consist of two major work areas – downstream step-outs and crest raises. Downstream step-outs of the main dam shell zone will be constructed in sections at least 40 m-wide using NAG5 waste rock and overburden from the open pit. Each step-out will support one or more vertical dam crest raises. Crest raises, constructed on an annual basis, provide storage for the upcoming year. The dam raise was scheduled for construction the year preceding when it was needed. The height of the annual raise varies from 11 m to 2 m depending on storage characteristics of the TSF and the volume of waste to be managed in the upcoming year.

The FS mine plan included scheduling of material delivery to support dam construction. Material delivery was accelerated based on availability of the various open pit materials throughout the life of the mine resulting in a mine plan that was fully integrated with dam construction material requirements. The integrated mine plan and dam construction material plan included:

- Quarterly scheduling of material delivery for 1.25 years during construction
- Monthly scheduling of material delivery during the first year of operations
- Quarterly scheduling of material for Years 2 to 5 of operations, and
- Annual scheduling thereafter.

Figure 2.4 shows the annual and cumulative design requirements for construction of the Site D Main Dam, and the respective delivery scheduling included in the mine plan. The peaks in annual requirements are related to the construction of downstream step-outs. The figure demonstrates that

the dam will be overbuilt during Years 1 through 9 in order to meet the construction material requirements for the final downstream step-out in Year 9. The overall downstream slope angle for the dam during these years will be flatter than the design requirements as a result.

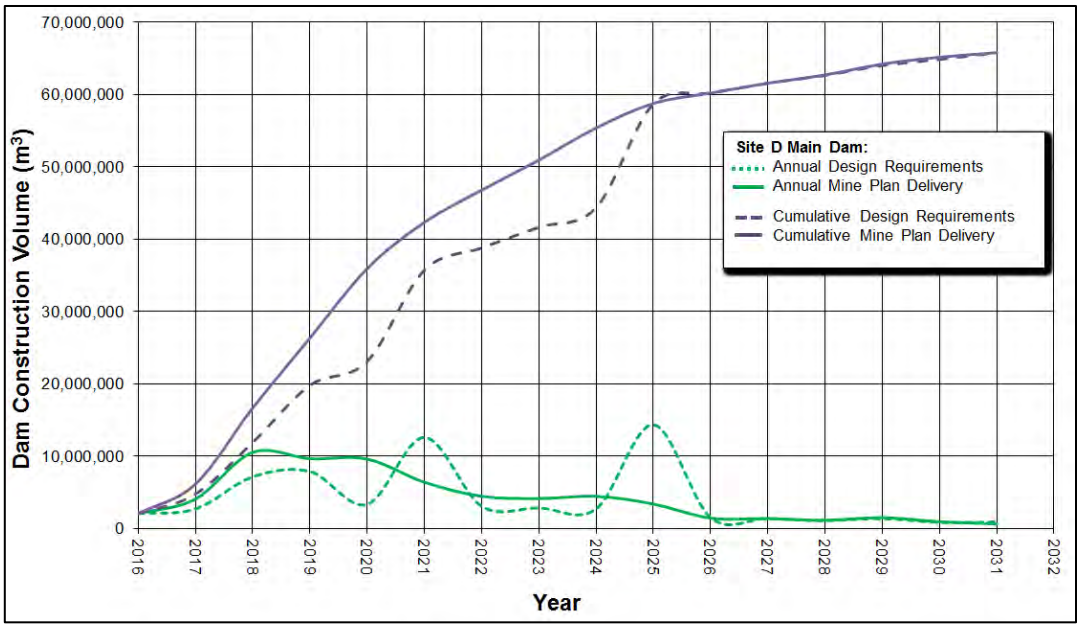



**Figure 2.4 Site D Main Dam Construction Integrated with Mine Planning**

An instrumentation monitoring plan was designed for the dam and includes movement monuments on the dam crest, vibrating wire piezometers within the foundation and fill materials, and slope inclinometers. Five instrumentation sections were included in the design along the Site D Main Dam. Instrumentation monitoring will be routinely completed during construction and operations. Measurements during construction will be taken and analysed on a routine basis to monitor the response of the embankment fill and the foundation from the loading of the embankment fill. The frequency of monitoring for the piezometers and inclinometers may be decreased once the effects of initial construction have dissipated. An Operations Maintenance and Surveillance (OMS) Manual will be prepared following initial construction and prior to commissioning of the TSF to provide comprehensive operating instructions for the TSF and related facilities.

The tailings distribution pipeline will extend along a service road to the Site D Main Dam where tailings will be deposited during the remainder of operations. Spigot locations will be placed every 150 m along the dam crest. The dam crest elevation will reach 1300 m in Year 5 of operations and the tailings pipeline will be extended fully around TSF Site D, to allow for deposition along the majority of the perimeter. A large tailings beach will be developed that provides a low permeability transition zone between the coarse, permeable waste rock in the center of the TSF and the tailings embankments providing seepage control. The tailings beach width will be greater than 400 m throughout operations.

Seepage will primarily be controlled by the low-permeability core zone constructed prior to the development of the tailings beach, the cut-off trenches, and the low-permeability subgrade materials. Special design provisions incorporated into the tailings dam design to minimize seepage losses include the development of extensive tailings beaches (which isolate the supernatant pond from the

dam), hydraulic barriers, embankment drainage collection systems, and toe drains at the downstream toe of the dams to reduce seepage gradients. Additional seepage collection ditches constructed along the toe of the embankments will collect seepage and surface runoff, and direct the flow to the pumpback systems.

A closure spillway will be constructed following cessation of tailings discharge in TSF Site D, and will be designed to manage the peak flow from the PMF without consideration for attenuation provided by the tailings facility ponds or storage available below the invert of the spillway.

### 2.1.7 Environmental Control Dam

The primary seepage collection point downstream of the TSF was located approximately 1 km downstream at a topographic low point in Davidson Creek. A collection pond will be created by constructing a 12 m high water retaining dam (ECD) across Davidson Creek. The dam was designed to contain continuous seepage and runoff from events up to the 1 in 100 year 24-hour storm. The spillway was designed to pass the 1 in 200 year 24-hour storm.

The ECD was designed as a water retaining earthfill core rockfill dam with an appropriately graded two stage filter and transition zone between the earthfill core and upstream and downstream rockfill shell zones. The upstream filter zone was included to protect against internal erosion during rapid dewatering. The core zone will be at least 6 m wide at the narrowest point with 2 m wide filter and transition zones on either side. The overall crest width will be 14 m.

Two seepage interception trenches (one on each side of Davidson Creek) will be excavated through the surficial sand and gravel terraces downstream of the Site D Main Dam and will report to the ECD pond. The seepage interception trenches (North and South) were located based on the results of geotechnical drilling along the proposed alignments. The trenches will be excavated and keyed into the low-permeability subgrade and will be approximately 3.3 km long with a depth ranging from 5 to 15 m.

The primary pumpback system at the ECD was designed to maintain the pond at a minimum water level to reduce the potential for seepage under the ECD. The intake is a concrete structure equipped with a trash rack set at elevation 1170 m. The pumpback system is comprised of four 375 kW vertical turbine pumps (3 operating and 1 installed spare) and requires at least 2 m submergence to operate. The system was designed to pump a maximum of 1,080 $m^3$/hr to the TSF through an 18 inch standard steel pipeline. The design flow rate is equivalent to a 10 day pump-out of the ECD pond following the 1 in 100 year design storm. The pumping system will normally operate intermittently as the ECD pond exceeds the minimum operating depth of 2 m, and at less than maximum capacity using one or more pumps.

The ECD will have an embankment drainage system, seepage collection sump with a flow monitoring device, and pumpback system to collect and recycle seepage back into the ECD impoundment.

This location of the ECD was established based on a hydrogeology assessment where potential seepage paths were projected to daylight. A pumpback system will manage seepage and storm water inflows. Recovered water will be pumped to the TSF Site D and the collection pond will be maintained in a dewatered condition to the maximum extent practical. Seepage through this dam will be captured in an embankment drain system and sump, and pumped back to the ECD pond.

The seepage modeling found a negligible amount of seepage will pass from the foundation of the Site D Main Dam beyond the ECD. Virtually all of the seepage was predicted to daylight to surface or within the surficial sand and gravel zone upstream of the ECD.

## 2.2 RISK ASSESSMENT

### 2.2.1 Preliminary Risk Classification

A working table was developed to outline hazard category, phase of development, description of risk, key defensive measures in place, key defensive measures to be applied in permitting and the risk rating. The hazard descriptions and rankings were developed during short group meetings over multiple days, with input from the engineering consultants involved with the Project. The following participants are acknowledged for their contributions:

- Keith Ferguson, P.Eng., Sustainability Engineering
- Bruno Borntraeger, P.Eng., KP

A total of 39 hazards were identified and catalogued in Table 1 of Appendix A. Preliminary classification of each risk is shown on Figure 2.5 and a summary of the risk description and risk rating is included in Table 2.2. The classifications were completed based on the design measures and operational practices included in the TSF design. The classifications included:

- 2 medium risk ratings
- 17 low risk ratings, and
- 20 very low risk ratings.

| Likelihood | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | | | | | |
| | 4 | | | | | |
| | 3 | 4, 5, 10, 11, 16, 17,24,33,34 | | 20, 21 | | |
| | 2 | 2,39 | 1, 3,22,26,27,32, 36,37 | 18, 31 | | |
| | 1 | | 19, 25, 30, 35, 38 | 7, 15,28,29 | 6, 8, 23 | 9, 12, 13, 14 |
| | | 1 | 2 | 3 | 4 | 5 |
| | | Consequence | | | | |

**Figure 2.5 Preliminary Risk Classification**

## Table 2.2 Risk Description and Preliminary Rating Summary

| Risk ID | Phase [2] | Risk Description | Rating |
|---|---|---|---|
| 1 | C | Extreme precipitation or runoff event: Overtop of cofferdam resulting in loss of dam fill material and sediment loading to receiving streams | Low |
| 2 | C | Failure of pumping system for cofferdam: cofferdam overflows resulting in discharge of suspended solids and sediment loading to receiving streams | Very Low |
| 3 | C | Cofferdam failure due to any mechanism leading to loss of containment with loss of dam contents (water and sediment) and dam materials to receiving streams | Low |
| 4 | C/O | Erosion of construction diversion ditches: high suspended solids and sediment loading to receiving streams | Very Low |
| 5 | C/O | Excessive erosion or high flows from construction areas including borrow sites during runoff events: high suspended solids and sediment loading from SCP's to receiving streams | Very Low |
| 6 | C | Too rapid rate of initial construction and filling of TSF dam: high pore pressures, foundation movement causing instability and TSF dam failure | Low |
| 7 | O/CL | TSF dam foundation failure: foundation movement resulting in collapse of Site C tailings dam | Very Low |
| 8 | C | Too rapid rate of initial construction and filling of TSF dam: high pore pressures, foundation movement causing instability and TSF dam failure | Low |
| 9 | O/CL | TSF dam foundation failure: foundation movement resulting in collapse of Site D tailings dam | Low |
| 10 | O/CL | Ponding on tailings dam crest or downstream shell: erosion of dam fill leading to localized scour of slopes (flows to ECD) | Very Low |
| 11 | O/CL | Inclusion of ice or snow in tailings dam fill: settlement of dam resulting in deformation but not loss of containment | Very Low |
| 12 | O/CL | Extreme precipitation or runoff event: overtop of Site D Main Dam resulting in failure of dam | Low |
| 13 | O/CL | Failure of TSF Site D Main Dam filter zone resulting in excessive internal erosion, leading to piping and collapse of dam | Low |
| 14 | O/CL | Embankment deformation resulting in overtopping and discharge of supernatant pond | Low |
| 15 | O/CL | Embankment deformation resulting in slumping of tailings | Very Low |
| 16 | O/CL | PAG or NAG3 waste rock used in Site D tailings dam downstream shell: contamination of runoff and seepage to ECD | Very Low |
| 17 | O/CL | Unexpected metal or nitrogen leaching from NAG waste rock and/or overburden used in TSF Site D dam shell construction: contamination of surface runoff and seepage to ECD | Very Low |
| 18 | O/CL | Failure of TSF Site D cut-off trench resulting in increased seepage | Low |
| 19 | O/CL | Landslide or avalanche into TSF Site D resulting in supernatant pond wave and/or additional material in TSF | Very Low |
| 20 | O | Failure to follow staged construction plan to meet filling requirements or storage of excess water leading to design freeboard violation | Medium |
| 21 | O | Inadequate tailings pond capacity or excessive water resulting in need to discharge tailings pond supernatant to receiving streams | Medium |
| 22 | O | Incorrect water balance modelling resulting in unexpected surplus or deficit of water | Low |
| 23 | O/CL | Extreme seismic activity: large earthquake resulting in embankment deformation and/or tailings liquefaction | Low |

| | | | |
|---|---|---|---|
| 24 | O | High sediment loading to ECD reducing pond capacity | Very Low |
| 25 | O | Failure of recycle water pump or pipeline from ECD to tailings pond resulting in excessive water in ECD | Very Low |
| 26 | O | Seepage or runoff exceeds pumping capacity of ECD resulting in discharge from ECD to receiving streams | Low |
| 27 | C/O | Unforeseen capital costs for TSF construction | Low |
| 28 | O/CL | Unforeseen seepage or run-off resulting in overtopping of ECD | Very Low |
| 29 | O/CL | Failure of ECD due to piping | Very Low |
| 30 | O/CL | Blockage of the spillway in ECD by debris | Very Low |
| 31 | O/CL | Unexpected metal or nitrogen leaching from NAG waste rock and/or overburden used in ECD dam construction: contamination of water reservoir and discharge to receiving streams | Low |
| 32 | O/CL | Excessive metals or increase in unrecoverable seepage to receiving streams during operations and closure | Low |
| 33 | O | Failure of tailings distribution line on tailings dam resulting in discharge of tailings outside of impoundment footprint | Very Low |
| 34 | CL | Blockage of TSF spillways by debris | Very Low |
| 35 | CL | Inadequate capacity of spillways to convey flows | Very Low |
| 36 | CL | Excessive metals in tailings pond supernatant and seepage discharge to receiving streams during closure | Low |
| 37 | CL | Incorrect water balance modelling resulting in unexpected surplus or deficit of water | Low |
| 38 | CL | Extreme drought: inadequate water cover resulting in acid generation from the tailings or PAG waste rock contaminating seepage and tailings pond supernatant discharge to receiving streams | Very Low |
| 39 | CL | Settlement of tailings leading to formation of depression on the tailings surface and inability to meet closure objectives including location of closure water pond. | Very Low |

**NOTES:**
1. THIS TABLE IS AN ABRIDGED VERSION OF APPENDIX A TABLE 1.
2. PROJECT PHASE ABBREVIATIONS ARE SHOWN IN SECTION 1.5.

### 2.2.2 Improvements to Current Practices

The key measures included in the project design that reduce the potential risk and enhance safety of the facility were described in the preceding sections and documented in Table 1 of Appendix A. These measures are deemed best practices; however, it is prudent to consider if there are additional design measures or operational practices that will further reduce the potential risk of the facility and enhance safety.

The risk items shown in Table 2.2 with ‘low’ and ‘medium’ risk ratings are generally affected by water management, with potential consequences of failure improved or worsened by water management strategies. The Panel Report (IEEIRP, 2015) provided suggestions for improvement of tailings physical stability through measures that:

- Eliminate surface water from the impoundment
- Promote unsaturated conditions in the tailings with drainage provisions, and
- Increase tailings deposit strength.

These suggestions highlight that effective management and control of water enhances the physical stability of a tailings impoundment and may reduce overall project risk.

This is consistent with the BC EAO letter, which provided a request that proponents consider:

- Options for managing water balance to enhance safety and reduce risk (likelihood and consequence) of a tailings dam failure during all phases of mine life, and
- For the project design option selected, consider the potential risks and implications of that option, and have a technically and economically feasible plan to address the potential risks and implications.

The opportunity to enhance safety and reduce project risk through improvement in water management practices was evaluated during the risk assessment process. Several opportunities for improved water management became apparent during this review. These opportunities include consideration of the physical location of water storage, active management of undisturbed runoff contributing to the water balance, emergency removal of water from the pond, and dam safety in extreme conditions.

The storage capacity in TSF Site C is underutilized in the present design and there is an opportunity to use this capacity to minimize storage requirements in TSF Site D. The volume of water stored within the TSF Site C pond is shown to fluctuate between 3 to 4 $Mm^3$ and between 8 to 11 $Mm^3$ for TSF Site D, increasing after Year 11, with the total pond volume (including both ponds) varying throughout the year between roughly 11 and 14 $Mm^3$. The filling plan for TSF Site C leaves approximately 14 $Mm^3$ of storage capacity available for water storage below the spillway invert EL. 1346 m. The vast majority of water could be stored within TSF Site C during operations.

A surplus condition was predicted to develop beginning in Year 11 due to increasing runoff from the expanding disturbed areas of the mine facilities. The stochastic results indicated that for extreme wet conditions ($95^{th}$ percentile) the facility will operate in a surplus condition of roughly 1 $Mm^3$ per year, increasing after Year 11. The tailings facility in either of these conditions and without surplus water management intervention will require larger operating pond allowances. TSF Site D will require additional normal operating freeboard to manage the additional water volumes or the surplus condition could be managed with additional fresh water diversions.

The design recognized that the need to increase the dam freeboard or construct fresh water diversions were contingencies that could be implemented reactively later in response to observed conditions. There is an opportunity to include these fresh water diversions as part of the overall water management plan, and actively manage inflows to the tailings facility based on observed conditions on an inter-annual basis to maintain the pond volumes in the preferred operating range. This will provide a proactive water management strategy, rather than reactive.

The evaluation further recognized that as a zero operational surface water discharge (or closed circuit) facility there is no available means to remove mine impacted water from the water balance. The classification as a closed circuit facility cannot be a reason to encroach on storm freeboard allowances and potentially adversely affect the safety of the facility. The ability to remove water from the tailings facility in a freeboard violation scenario was considered an improvement to the water management plan.

The tailings facility was designed to manage a very large design storm event by including storm storage freeboard above the normal operating pond allowance. Additional freeboard is available

above the storm storage for wave run-up. There is a period of exposure to risk during operations before construction of the closure spillway where the tailings facility relies on climate predictions and storm storage to prevent a release of mine water to the environment. The downside of designing a tailings facility to contain a large flood to protect the environment from release of mine water is that the storage of large volumes of water has the potential to exacerbate the consequences of failure. A very unlikely uncontrolled release of the impoundment can be limited to a small controlled release by including interim emergency overflow channels in the staged development of the facility. The overflow channels will operate in the additional freeboard for wave run-up and therefore will not impact the storm storage characteristics of the facility.

The following section summarizes the technical details of the opportunities that were developed to improve the current practices, enhance safety and reduce overall risk of the facility.

# 3 – ADDITIONAL MITIGATION AND CONTINGENCY MEASURES

## 3.1 GENERAL

The opportunity to enhance safety and reduce project risk through improvement in water management practices was evaluated. The FMEA process identified several measures that reduce risk, with four additional measures providing the most benefit in risk reduction. These opportunities were grouped into two categories: mitigations and contingencies. Mitigations are the design measures that will be put in place and actively used to reduce the risk (likelihood and consequences) of certain potential hazards occurring. Contingencies are design measures that provide a final layer of additional protection to manage unexpected conditions, but are not expected to be used except for extreme circumstances. Contingencies also reduce risk by managing the likelihood and consequence of potential hazards. The mitigations and contingencies work together to reduce overall project risk.

The mitigations are:

- Installation of optional diversions upstream of TSF Site D (northern diversion) and upstream of the mine facilities south of the TSF (southern diversion) to convey any excess water around rather than into the tailings facility, and
- Transfer and storage of the majority of tailings pond supernatant in TSF Site C to minimize water in TSF Site D and maximize the beach width.

The contingencies are:

- Establishment of interim emergency overflow channels around the Site D Main Dam during operations to ensure that the incremental increase in runoff from the Probable Maximum Flood (PMF) during operations is safely transmitted around the dam in a controlled manner, and
- Emergency water storage in the open pit in the event that excessive water is encountered in the TSF that causes a violation of freeboard requirements and water levels need to be lowered. Use of the emergency pit storage will lead to a suspension of operations.

## 3.2 MITIGATIONS

### 3.2.1 Northern and Southern Diversions

The water balance model results indicated that the TSF will be in a balance under average precipitation conditions throughout the first ten years of operations. A surplus condition was predicted to begin in Year 11 and was expected to increase steadily over time until the end of mining. A portion of the upstream contributing catchment can be diverted around the facility to Davidson Creek to actively manage the volume of water reporting to the TSF. The diversion structures will be constructed during the early years of project development to provide water management features to control the accumulation of the supernatant pond in the TSF during and/or in response to wetter than average years.

Two diversions will be constructed and operated to actively manage inflows to the tailings facility based on observed conditions on an inter-annual basis, and to maintain the pond volumes in the preferred operating range. The Northern Diversion was designed to convey runoff for an area of approximately 10 $km^2$ northwest of TSF Site D and the Southern Diversion was designed to convey runoff from an area of 5 $km^2$ southwest of the open pit and west dump. Together these catchment

areas comprise roughly one third of the overall catchment area contributing to the TSF water balance. Complete design details are included in Appendix B and Appendix C for the Northern and Southern Diversions, respectively.

The Northern Diversion structure will consist of a 3.5 m high concrete structure to provide submergence to the water conveyance pipeline. The 16-inch diameter HDPE water conveyance pipeline was sized to convey the estimated maximum mean monthly flow of 0.2 $m^3$/s (200 L/s). The northern diversion structure will include a gated sluice pipe to clean out sediment accumulation. Flow from the water conveyance pipe will enter the Freshwater Reservoir, via an energy dissipation structure, prior to release to Davidson Creek.

The northern diversion structure spillway was designed to convey a 200 year return period design peak flow of 6.5 $m^3$/s; assuming the water conveyance pipeline and gated sluice pipe are inoperable. The spillway will consist of a 5 m wide broad crested weir capable of passing the design storm while maintaining 0.5 m of freeboard between the maximum water level and the crest of the structure.

The collection ditches were designed with sufficient capacity to convey the runoff and withstand erosive forces from the 10 year design peak flow of 0.5 and 0.6 $m^3$/s, respectively. Ditches will typically be at least 1 m-deep and trapezoidal shaped with a 1 m-base width and 2H:1V slopes. Erosion resistant material will be placed over a non-woven geotextile, which will help prevent erosion of fine underlying soils.

The Southern Diversion structure will consist of a 3.5 m high concrete structure to provide submergence to the water conveyance pipeline. The 10-inch diameter HDPE water conveyance pipeline is sized to convey the estimated maximum mean monthly flow of 0.1 $m^3$/s (100 L/s). The southern diversion structure will include a gated sluice pipe to clean out sediment accumulation. Flow from the water conveyance pipe will enter the Freshwater Reservoir, via an energy dissipation structure, prior to release to Davidson Creek.

The southern diversion structure spillway design conveys a 200 year design peak flow of 4.1 $m^3$/s; assuming the water conveyance pipeline and gated sluice pipe are inoperable. The spillway will consist of a 3 m wide broad crested weir capable of passing the design storm while maintaining 0.5 m of freeboard between the maximum water level and the crest of the structure.

The collection ditch was designed with sufficient capacity to convey the runoff and withstand erosive forces from the 10 year design peak flow of 1.3 $m^3$/s. Ditches will typically be at least 1 m-deep and trapezoidal shaped with a 1 m-base width and 2H:1V slopes. Erosion resistant material will be placed over a non-woven geotextile, which will help prevent erosion of fine underlying soils.

The total combined conveyance capacity of the two pipelines is 300 L/s or approximately 9.5 $Mm^3$ per year. The conveyance capacity of each was based on the maximum mean monthly flow for the catchment. The diversions will typically divert a combined 3 $Mm^3$ per year under mean monthly flow conditions when they are active.

### 3.2.2 Site C Water Storage

The relocation of water storage to Site C from Site D reduces overall risk of the TSF by several means. Water storage relocated from the impoundment undergoing active construction to the inactive impoundment reduces one variable of impoundment filling. It simplifies mine waste disposal planning within the active impoundment and increases flexibility to actively manage the location

where the tailings beach meets the co-disposed PAG/NAG3 waste rock platform thereby improving the ability to meet closure plan objectives. The reduction in the supernatant pond will increase subaerial beach length, which is an indicator of improved dam safety. The storage of water outside of the active impoundment decreases the likelihood and consequences of containment loss in the event of embankment deformation.

The reclaim water system, as described in the Mine Waste and Water Management Design Report (KP, 2014), will initially utilize a barge-mounted pump station sized to deliver 3,200 $m^3$/hr of process water from TSF Site C to the reclaim water tank at the Mill. The reclaim barge will be located in TSF Site C during Years 1 and 2 of operations, and then moved to TSF Site D late in Year 2 for the remainder of mine operations and closure. A reclaim structure was planned for TSF Site C in Year 2 to reclaim water during the relocation of the barge. The reclaim structure will also support the remaining years of operations to regulate the water level within TSF Site C and/or to support the barge-mounted pump station with reclaim to the mill.

The water management strategy for Years 1 and 2 will remain unchanged and utilize a barge-mounted pump station in TSF Site C. However, the barge-mounted pump station will remain in TSF Site C throughout the life of mine and reclaim water will be transferred from TSF Site D to TSF Site C, utilizing the freshet pumpback system originally designed for construction water management at the Site D cofferdam (see Section 2.1.1). The volume of water maintained within TSF Site D will be only the amount required to maintain PAG/NAG3 materials in a saturated state with an allowance for annual operational fluctuation.

The effects on the project water balance due to the changes are shown on Figure 3.1. The majority of the supernatant pond volume will be stored in TSF Site C. The TSF Site C pond is located upstream of the TSF Site C Main Dam, and will be connected to TSF Site D by a closure spillway for passive management of the maximum Site C operating pond level.

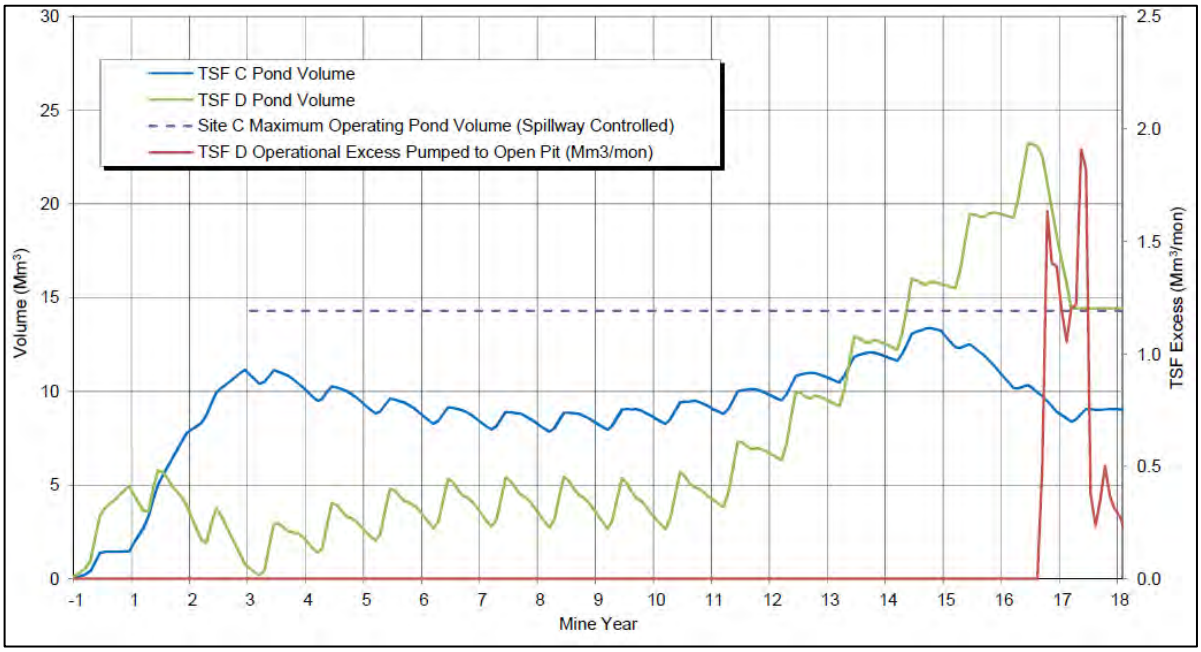



**Figure 3.1 Revised Pond Volumes - Average Conditions**

The pump rates from TSF Site D to TSF Site C required to achieve the pond volumes presented on Figure 3.1 were:

- 1,000 $m^3$/hr (mine Years 1 and 2)
- 1,900 $m^3$/hr (mine Years 3 through 17) during the winter season (October through March), and
- 2,050 $m^3$/hr (mine Years 3 through 17) during the summer season (April through September).

The TSF Site C pond volume will fluctuate between approximately 8 $Mm^3$ and 10 $Mm^3$ for the majority of the mine life, with an increase to 13 $Mm^3$ at the end of Year 14. TSF Site C can store up to 14 $Mm^3$ of water based on a spillway invert elevation of 1346 m. The TSF Site D pond volume will fluctuate between approximately 1 $Mm^3$ and 5 $Mm^3$ of water for the majority of the mine life. The overall water balance condition is unchanged and the total pond volume varies throughout the year between roughly 11 $Mm^3$ and 14 $Mm^3$; however, the location of water storage was adjusted. The optional diversions were not considered here, but will be combined with the revised water management strategy in subsequent water balance modelling to support permitting.

## 3.3 CONTINGENCIES

### 3.3.1 Interim Emergency Overflow Channels

The purpose of the interim overflow channel is to ensure the TSF Site D dam is protected during a very unlikely extreme runoff event. The TSF design incorporated a spillway at closure, whereas this design change adds a contingency interim overflow channel during operations. The overflow channel will not be used during normal operation of the facility, and was added to the design to prevent the possibility of overtopping for dam safety purposes. It is a contingency for extreme conditions coupled with the malfunction of management plans for the project.

The Interim Emergency Overflow Channel was designed to pass the peak flow from the PMF flood event without consideration of attenuation provided by tailings facilities ponds or storage that will be maintained below the invert of the channel. It was assumed that the diversion ditches were damaged and not functioning at the time of the flood as this represented the worst case condition. The routing evaluation, using HydroCAD, determined the peak inflow to be approximately 355 $m^3$/s. The channel, approximately 2 m wide by 4 m deep, will be excavated in bedrock to provide erosion protection.

The channel will be located on the right (south) abutment of each stage of the TSF Site D Main Dam. The channel will convey the design flood past the right abutment and downstream of the TSF Site D embankment to a plunge pool for energy dissipation prior to release to Davidson Creek via the South Interception Trench and Environmental Control Dam. The plunge pool design will be completed during detailed design based on precise channel alignments, slopes, and flow characteristics. Additional design details are included in Appendix E.

### 3.3.2 Emergency Water Storage in the Open Pit

The TSF was planned as a zero operational surface water discharge (or closed circuit) facility. There is no available means to remove mine impacted water from the water balance. The classification as a closed circuit facility should not be a reason to encroach on storm freeboard allowances and potentially adversely affect the safety of the facility. The ability to remove water from the tailings facility in a freeboard violation scenario was considered an improvement to the water management plan.

The transfer of water from the TSF to the Open Pit for storage could be accomplished by one of the following alternatives:

1. **Early Installation of the TSF Closure Dewatering Pipeline** - The closure plan for the Blackwater Project includes pumping the tailings supernatant pond to the Open Pit to expedite pit filling and submergence of the majority of PAG rock in the exposed Open Pit walls. The planned pumping system to complete pit filling in closure would utilize the reclaim barge and/or structure and reclaim pipeline(s), with an extension of the reclaim pipeline from the Mill to the Open Pit. The closure pit filling system would maintain the operative reclaim capacity of 3,200 $m^3$/hr.
2. **Utilizing the Pit Dewatering System** – The current Open Pit dewatering system consists of a series of wells and skid-mounted diesel drive pumps conveying flows through a 16" pipeline, designed to pump approximately 700 $m^3$/hr of water from the Open Pit to the Mill. It is assumed that in an emergency situation, in which the water level in the TSF exceeded maximum capacity, all operations, including processing and pit dewatering would be suspended; it is therefore reasonable to assume the TSF could be dewatered using the reclaim system in combination with the pit dewatering system pipeline. This alternative would maintain the pit dewatering capacity of 700 $m^3$/hr and tie the Open Pit dewatering pipeline into a blind flange for the reclaim water system pipeline at the Mill.

Table 3.1 summarizes the estimated rate of drawdown for each of the facilities, for each alterative, and were based on approximate pond areas of 100 and 500 hectares for TSF Site C and TSF Site D, respectively.

**Table 3.1 Approximate Drawdown Rates**

| Pumping System | Pumping Capacity ($m^3$/hr) | TSF C (mm/day) | TSF D (mm/day) |
|---|---|---|---|
| Alternative 1 | 3,200 | 77 | 15 |
| Alternative 2 | 700 | 17 | 3 |

The alternative implemented will reflect where the majority of water is stored within the TSF. Alternative 1 was considered to be the most robust option for the current design. If the water management strategy is modified to manage the majority of the water in TSF Site C, with TSF Site D only containing enough water to submerge the PAG/NAG3 waste rock, it may be suitable to defer the closure pipeline installation until closure and use the pit dewatering system during operations. Additional design details are included in Appendix F.

## 3.4 EFFECTS ON PRELIMINARY RISK CLASSIFICATION

The opportunity to enhance safety and reduce project risk through improvement in water management practices was evaluated during the risk assessment process. Several opportunities for improved water management were implemented as a result of the FMEA. These opportunities include relocation of the physical location of water storage, active management of undisturbed runoff contributing to the water balance, allowance for emergency removal of water from the pond, and dam safety protection in extreme flooding conditions.

The above noted measures reduce project risk by enhancing physical stability through effective management and control of water. Several of the preliminary risk rankings were improved by adopting these additional design measures, operational practices, and contingencies. A summary of the final risk classifications after application of the additional mitigation and contingency measures is shown in Table 3.2.

**Table 3.2 Summary of Risk Ranking Improvements**

| Risk ID | Risk Description | Preliminary Rating | Mitigation/Contingency Measures | Final Rating |
|---|---|---|---|---|
| 1 | Extreme precipitation or runoff event: Overtop of cofferdam resulting in loss of dam fill material and sediment loading to receiving streams | Low | • maintain low spot during construction of dam as preferential emergency swale | Very Low |
| 3 | Cofferdam failure due to any mechanism leading to loss of containment with loss of dam contents (water and sediment) and dam materials to receiving streams | Low | • maintain low spot during construction of dam as preferential emergency swale | Very Low |
| 9 | TSF dam foundation failure: foundation movement resulting in collapse of Site D tailings dam | Low | • relocate water storage to Site C throughout operations and only manage minimal water within Site D | Very Low |
| 12 | Extreme precipitation or runoff event: overtop of Site D Main Dam resulting in failure of dam | Low | • establish interim emergency overflow channel for TSF after each major construction lift | Very Low |
| 13 | Failure of TSF Site D Main Dam filter zone resulting in excessive piping and collapse of dam | Low | • relocate water storage to Site C throughout operations and manage minimal water volume within Site D | Very Low |
| 14 | Embankment deformation resulting in overtopping and discharge of supernatant pond | Low | • relocate water storage to Site C throughout operations and manage minimal water volume within Site D | Very Low |
| 15 | Embankment deformation resulting in slumping of tailings | Very Low | • relocate water storage to Site C throughout operations and manage minimal water volume within Site D<br>• monitor and maintain extensive subaerial tailings beach during operations separating the supernatant pond from the tailings dam | Very Low |
| 20 | Failure to follow staged construction plan to meet filling requirements or storage of excess water leading to design freeboard violation | Medium | • establish extension of reclaim water system to open pit for emergency drawdown of the TSF pond<br>• establish interim emergency overflow channel for TSF after each major construction lift | Very Low |
| 21 | Inadequate tailings pond capacity or excessive water resulting in need to discharge tailings pond supernatant to receiving streams | Medium | • establish extension of reclaim water system to open pit for emergency drawdown of the TSF pond | Very Low |
| 22 | Incorrect water balance modelling resulting in unexpected surplus or deficit of water | Low | • install diversion systems in areas upslope of TSF Site D (northern diversion) and upslope of mine facilities (southern diversion) for optional diversion of these catchment areas | Very Low |

## 3.5 FINAL RISK CLASSIFICATION

A total of 39 hazards were identified and catalogued in Table 1 of Appendix A. The preliminary classification of each risk was shown on Figure 2.5. The preliminary classifications were completed based on the design measures and operational practices included in the TSF design, and included:

- 2 medium risk ratings
- 17 low risk ratings, and
- 20 very low risk ratings.

The improvements to the risk classifications were evaluated based on the additional mitigations and contingencies that were adopted as a result of the FMEA. Final classification of each risk is shown on Figure 3.3. The final classifications include:

- 10 low risk ratings, and
- 29 very low risk ratings.

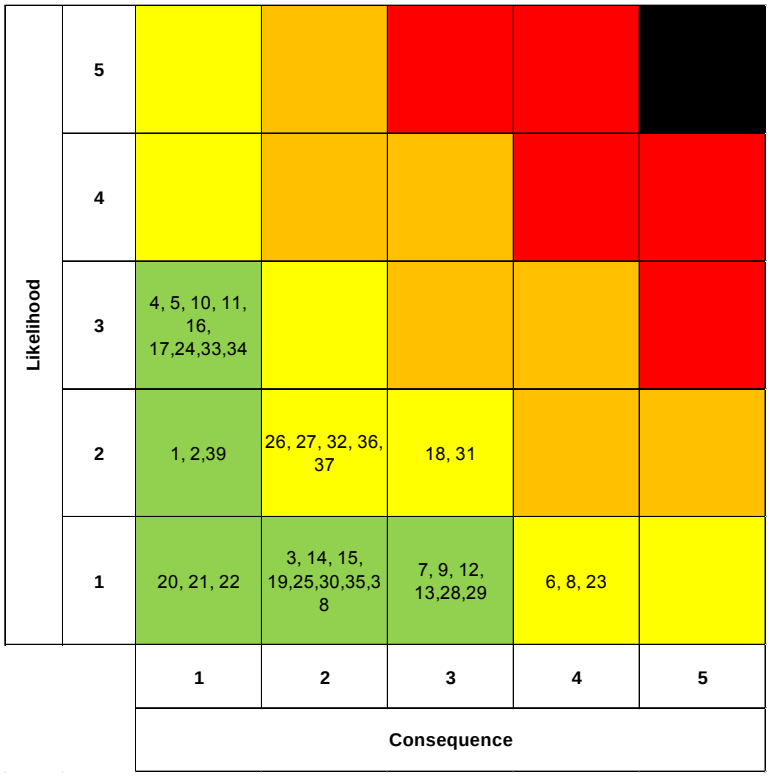



**Figure 3.2 Final Risk Classification**

# 4 – RESIDUAL RISKS TO WATER MANAGEMENT

## 4.1 TEMPORARY SHUTDOWNS

Temporary shutdowns have the potential to occur due to unforeseen financial conditions (e.g. severe drop in gold price) or extreme climate conditions (e.g. major forest fires, flooding, etc.). Facilities will be secured and maintained in a condition such that they can be rapidly restarted. The following measures will be evaluated and as appropriate, initiated to secure and maintain the TSF facilities:

- Tanks that have a risk of sanding with ore or tailings slurry within the mill and tailings delivery system will be drained with their contents treated by the $SO_2$/air treatment system and discharged to the TSF via the tailings pipeline.
- The Northern and Southern Diversions will be used to divert fresh water to the fresh water reservoir and hence to Davidson Creek in order to maintain a low inventory of water in the TSF.
- Water from Tatelkuz Lake will continue to be pumped and discharged to Davidson Creek to augment the flows from the diversions and maintain flows required for downstream aquatic resources as per the site water management plan.
- Opportunities for temporary diversion of other water sources meeting discharge standards will be investigated (e.g. East Dump drainage and ECD).
- Drainage from the temporary ore and low grade ore stockpiles will continue to be treated by the lime treatment system and discharged to the TSF.
- Water will be recycled and discharged via the tailings distribution system or sprayed (e.g. by sprinklers) when required to maintain the beaches in a wetted condition to significantly restrict oxygen diffusion.
- The TSF pond level will be monitored to confirm there is no encroachment on freeboard allowances and that the PAG/NAG3 waste rock remains saturated. If necessary PAG/NAG3 waste rock piles above the water level will be bulldozed into the pond.
- If necessary, surplus water from the tailings supernatant pond will be pumped into the open pit (after about year 4 when the pit is no longer free draining) to prevent encroachment on freeboard allowances.
- If a tailings dam lift was being constructed at the time of the shutdown, the need to continue constructing the lift during the expected shutdown will be evaluated and the lift completed if required.
- Natural degradation (e.g. photolysis) will reduce cyanide and metal concentrations in the TSF supernatant. If required, the supernatant could be recycled through the $SO_2$/air treatment system to lower concentrations further.
- If a prolonged temporary shutdown were deemed possible, the two water treatment plants (mill $SO_2$/air and stockpile lime addition) will be evaluated for their suitability for treatment and discharge of mine site water to prevent surplus water accumulation. A wetland treatment system could also be constructed below the TSF Dam D to polish any effluent from the treatment systems.
- Regular site and geotechnical inspections of the water management systems and TSF will continue.

## 4.2 PREMATURE CLOSURE

Premature closure is the permanent closure of the mine before completion of the mine plan as described in the Application/EIS. The closure plan described for the final facility will be modified as required for the waste facilities in place at that time. The following measures will be applied in addition to those discussed for temporary closure and where still relevant, the closure plan in the Application/EIS:

- The tailings dams are planned to be constructed at closure slopes, and will be evaluated to confirm the dams as constructed meet long-term closure stability requirements. Modifications will be made if required prior to final contouring and reclamation.
- A wedge of overburden will be placed (by truck or wide-track dozer) or slurried onto the tailings beaches to cover the PAG tailings and shape the final closure pond to the desired size and location. A minimum 30 cm cover on the PAG/NAG3 waste rock will be placed as described in the Application/EIS.
- The water level will be allowed to rise such that the capillary fringe maintains PAG tailings in a partially saturated state restricting air entry.
- The interim emergency overflow channel will be modified as necessary to establish a final closure spillway. A secondary spillway will also be constructed.
- Treatment wetlands will be constructed in the ECD and water reservoir basins to improve seepage quality as described in the Application/EIS.
- Any unprocessed stockpiled coarse ore or low-grade ore will be deposited into the TSF or the open pit and will be flooded.

## 5 – SUMMARY

The FMEA demonstrated that the majority of risks to the TSF are mitigated through measures in place in the current design and measures to be applied during permitting. The risk rating process did not identify any high or very high hazards. The two highest rated risks (medium) identified were as follows:

- Excess water causing encroachment on freeboard allowance of the TSF, and
- No recognition/response to site changes resulting in insufficient storage capacity of the TSF.

The opportunity to enhance safety and reduce project risk through improvement in water management practices was evaluated during the risk assessment process. Several opportunities for improved water management became apparent during this review. These opportunities include consideration of the physical location of water storage, active management of undisturbed runoff contributing to the water balance, emergency removal of water from the pond, and dam safety in extreme conditions.

The FMEA process identified several measures that reduce risk, with four additional measures providing the most benefit in risk reduction. These opportunities were grouped into two categories: mitigations and contingencies. The mitigations and contingencies work together to reduce overall project risk by managing likelihood and consequence of potential hazards.

The mitigations were:

- Installation of optional diversions upstream of TSF Site D (northern diversion) and upstream of the mine facilities south of the TSF (southern diversion) to convey any excess water around rather than into the tailings facility, and
- Transfer and storage of the majority of tailings pond supernatant in TSF Site C to minimize water in TSF Site D and maximize the beach width.

The contingencies were:

- Establishment of interim emergency overflow channels around the Site D Main Dam during operations to ensure that the incremental increase in runoff from the Probable Maximum Flood (PMF) during operations is safely transmitted around the dam in a controlled manner, and
- Emergency water storage in the open pit in the event that excessive water is encountered in the TSF that causes a violation of freeboard requirements and water levels need to be lowered Use of the emergency pit storage will lead to a suspension of operations.

These additional practices combined with the design measures and practices already in place in the project design comprise the best available practices for the project TSF. The FMEA created a catalogue of potential hazards to the proposed TSF and documents the best available practices to mitigate the risk of each hazard. The FMEA is considered to be a living document that will be updated periodically during subsequent stages of design, operations, and during closure of the TSF.

The additional mitigations and contingencies will be developed further during permitting, design and early construction to establish an implementation strategy, which provides further reduction of risk to the current low risk TSF design developed for the Blackwater Gold Project.

## 6 – REFERENCES

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## 7 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared:

Duke Reimer, EIT
Staff Engineer




Reviewed:

Daniel Fontaine, P.Eng.
Senior Engineer

This report was prepared by Knight Piésold Ltd. for the account of New Gold Inc. Report content reflects Knight Piésold's best judgement based on the information available at the time of preparation. Any use a third party makes of this report, or any reliance on or decisions made based on it is the responsibility of such third parties. Knight Piésold Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. Any reproductions of this report are uncontrolled and might not be the most recent revision.

Approval that this document adheres to Knight Piésold Quality Systems:

# APPENDIX A

## FAILURE MODES AND EFFECTS ASSESSMENT – TABLE 1

(Pages A-1 to A-6)

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# TABLE 1

## NEW GOLD INC.
## BLACKWATER GOLD PROJECT

## FAILURES MODES AND EFFECTS ASSESSMENT

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| RISK NO. | RISK CATERGORY | PHASE | RISK DESCRIPTION | KEY DEFENSIVE MEASURES IN PLACE | KEY DEFENSIVE MEASURES TO BE APPLIED IN PERMITTING | RISK RATING | | | CLASSIFICATION | ADDITIONAL MITIGATION MEASURES | ADDITIONAL CONTINGENCY MEASURES | RISK RATING | | | MITIGATED CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Likelihood L | Impact I | SCORE | | | | Likelihood L | Impact I | SCORE | |
| 1 | Site D Coffer Dam | C | Extreme precipitation or runoff event: Overtop of coffer dam resulting in loss of dam fill material and sediment loading to receiving streams | • coffer dam sized to store 1 in 10 year event under wetter than average conditions<br>• coffer dam spillway designed for 1 in 200 year event<br>• freshet pumpback system can dewater full pond in 10 days<br>• sediment control pond positioned downstream of coffer dam | | 2 | 2 | 4 | Low | • maintain low spot during construction of dam as preferential emergency swale | | 2 | 1 | 2 | Very Low |
| 2 | Site C Coffer Dam | C | Failure of pumping system for coffer dam: coffer dam overflows resulting in discharge of suspended solids and sediment loading to receiving streams | • sediment control pond positioned downstream of coffer dam<br>• three (3) month exposure period before Stage 1A of Site C Main Dam is constructed<br>• Site D coffer dam position downstream of coffer dam with pumpback system | • test pumping system prior to use<br>• regular monitoring and maintenance of pumping system | 2 | 1 | 2 | Very Low | • maintain low spot during construction of dam as preferential emergency swale | | 2 | 1 | 2 | Very Low |
| 3 | Site C and D Coffer Dams | C | Coffer dam failure due to any mechanism leading to loss of containment with loss of dam contents (water and sediment) and dam materials to receiving streams | • dam designed with 2H:1V upstream and downstream slopes and 10 m crest width<br>• sediment control pond positioned downstream of coffer dam | • monitor coffer dam contruction<br>• visual observations daily during operation<br>• establish EOR notification as part of OMS manual | 2 | 2 | 4 | Low | • maintain low spot during construction of dam as preferential emergency swale | | 1 | 2 | 2 | Very Low |
| 4 | Diversion/Collection Ditches | C/O | Erosion of construction diversion ditches: high suspended solids and sediment loading to receiving streams | • ditches are designed to manage sediment during conveyance with erosion control BMPs (eg: sediment basins and check dams) and are armoured to prevent erosion | • construct diversion ditches in winter or during dry period<br>• monitor effectiveness and integrity of diversion ditches during routine daily inspections | 3 | 1 | 3 | Very Low | | | 3 | 1 | 3 | Very Low |
| 5 | Sediment Control Ponds | C/O | Excessive erosion or high flows from construction areas including borrow sites during runoff events: high suspended solids and sediment loading from SCP's to receiving streams | • BMPs designed for erosion control at source<br>• establish sediment control structures prior to disturbance<br>• SCPs sized to accomodate live storage of 1 in 10 year event to settle out 0.01 mm particles with minimum 10 hour retention<br>• SCPs and outlet spillway designed to withstand a 1 in 200 year event<br>• flocculent addition available if required | • monitor sediment level in SCP and remove as required<br>• monitor effectiveness of BMPs during operations<br>• revise location and size of BMPs and SCPs as required<br>• add new BMP measures as required<br>• monitor TSS and turbidity in sediment pond discharges | 3 | 1 | 3 | Very Low | | | 3 | 1 | 3 | Very Low |
| 6 | TSF Site C Dam | C | Too rapid rate of initial construction and filling of TSF dam: high pore pressures, foundation movement causing instability and TSF dam failure | • substantial geotechnical investigation has been completed within dam footprint<br>• initial construction includes 3 stages with downstream step outs prior to dam raising<br>• 2H:1V slopes distribute loading<br>• foundation drains to prevent development of adverse pore pressure conditions<br>• instrumentation plan in the design report includes vibrating wire piezometers in foundation | • monitor pore pressures in dam foundation and fill and adjust construction and filling schedule as required<br>• visual observations daily during construction<br>• analyze stability for interim phases and short term loading conditions<br>• establish trigger or alarm levels for pore pressures<br>• establish EOR notification as part of OMS manual<br>• establish emergency response plan<br>• conduct confirmatory investigations prior to detailed engineering targeting glaciolacustrine materials in dam foundation to confirm design parameters | 1 | 4 | 4 | Low | | | 1 | 4 | 4 | Low |
| 7 | TSF Site C Dam | O/CL | TSF dam foundation failure: foundation movement resulting in collapse of Site C tailings dam | • substantial geotechnical investigations conducted<br>• 2H:1V slopes distribute loading<br>• only one operational dam raise, downstream construction method<br>• PAG/NAG3 buttress downstream of Site C Dam progressively increases throughout operations<br>• instrumentation plan maximum dam section including movement monuments and vibrating wire piezometers | • conduct additional investigations prior to and during early construction<br>• visual observations daily during construction<br>• commission independent review of design<br>• consider additional monitoring sections | 1 | 3 | 3 | Very Low | | | 1 | 3 | 3 | Very Low |

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# TABLE 1

## NEW GOLD INC.
## BLACKWATER GOLD PROJECT

## FAILURES MODES AND EFFECTS ASSESSMENT

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Likelihood L | Impact I | SCORE | | | | Likelihood L | Impact I | SCORE | |
| 8 | TSF Site D Dam | C | Too rapid rate of initial construction and filling of TSF dam: high pore pressures, foundation movement causing instability and TSF dam failure | • initial construction includes 3 stages with downstream step outs prior to dam raising<br>• multi-year construction timeframe<br>• substantial geotechnical investigation has been completed within dam footprint | • monitor pore pressures in dam foundation and fill and adjust construction and filling schedule as required<br>• visual observations daily during construction<br>• analyze stability for interim phases and short term loading conditions<br>• establish trigger or alarm levels for pore pressures<br>• establish EOR notification as part of OMS manual<br>• establish emergency response plan<br>• conduct confirmatory investigations prior to detailed engineering targeting glaciolacustrine materials in dam foundation to confirm design parameters | 1 | 4 | 4 | Low | | | 1 | 4 | 4 | Low |
| 9 | TSF Site D Dam | O/CL | TSF dam foundation failure: foundation movement resulting in collapse of Site D tailings dam | • extensive geotechnical investigations conducted<br>• instrumentation installed along five sections including movement monuments and vibrating wire piezometers and slope inclinometers (three sections)<br>• NAG3/PAG waste rock upstream zone on Site D Main Dam adds strength<br>• dam raising scheduled such that downstream butresses are complete prior to associated dam raise | • visual observations daily during construction<br>• map cut-off trench excavation during construction of Site D Main Dam | 1 | 5 | 5 | Low | • relocate water storage to Site C throughout operations and only manage minimal water within Site D | | 1 | 3 | 3 | Very Low |
| 10 | TSF Site D Dam | O/CL | Ponding on tailings dam crest or downstream shell: erosion of dam fill leading to localized scour of slopes (flows to ECD) | • rockfill construction materials not highly susceptible to scour<br>• final reclamation plan includes for long-term stabilization of exposed erodible materials | • visual observations daily during operations<br>• create water bars to drain ponded water to tailings pond or collection ditches as required<br>• re-grade surface to prevent ponding | 3 | 1 | 3 | Very Low | | | 3 | 1 | 3 | Very Low |
| 11 | TSF Site D Dam | O/CL | Inclusion of ice or snow in tailings dam fill: settlement of dam resulting in deformation but not loss of containment | • special winter construction measures for fill surface preparation<br>• dam shell construction less susceptible to freezing conditions | • visual observations of daily fill placement<br>• construction quality control / quality assurance requirements<br>• completion of test fill placement during winter conditions to confirm specific lift thickness, and placement and compaction times and level of effort<br>• OMS requirements for daily monitoring in winter to include photographs of fill surface preparation | 3 | 1 | 3 | Very Low | | | 3 | 1 | 3 | Very Low |
| 12 | TSF Site D Dam | O/CL | Extreme precipitation or runoff event: overtop of Site D Main Dam resulting in failure of dam | • tailings facility designed to store the IDF assuming all diversions fail<br>• IDF during operations 2/3rds between 1/1000 yr flood and PMF; IDF during closure is the PMF<br>• design includes multiple spillways in place for closure<br>• closure spillway designed for PMF<br>• dam staging includes allowance for IDF storage above operational freeboard | • establish maximum filling level for each construction stage<br>• monitor filled capacity of the TSF and available storm storage regularly<br>• establish emergency response plan | 1 | 5 | 5 | Low | | • establish interim emergency overflow structures for TSF after each major construction lift | 1 | 3 | 3 | Very Low |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Likelihood L | Impact I | SCORE | | | | Likelihood L | Impact I | SCORE | |
| 13 | TSF Site D Dam | O/CL | Failure of TSF Site D Main Dam filter zone resulting in excessive internal erosion, leading to piping and collapse of dam | • dam designed with ten meter wide core zone, two meter wide filter and two meter wide transition zone (second filter)<br>• downstream drain zone and longitudinal drain pipe included in design to manage seepage flows<br>• instrumentation planning includes pore pressure monitoring to confirm drain behaviour | • contruction quality control / quality assurance requirements to confirm as-built dam meets design specifications<br>• establish OMS criteria for inspection of production and storage of engineered materials<br>• establish EOR notification as part of OMS manual<br>• establish emergency response plan<br>• commission independent review of design | 1 | 5 | 5 | Low | • relocate water storage to Site C throughout operations and manage minimal water volume within Site D | | 1 | 3 | 3 | Very Low |
| 14 | TSF Site D Dam | O/CL | Embankment deformation resulting in overtopping and discharge of supernatant pond | • TSF beaches developed to separate supernatant pond from embankment | • monitor and maintain extensive subaerial tailings beach during operations separating the supernatant pond from the tailings dam | 1 | 5 | 5 | Low | • relocate water storage to Site C throughout operations and only manage minimal water within Site D | | 1 | 2 | 2 | Very Low |
| 15 | TSF Site D Dam | O/CL | Embankment deformation resulting in slumping of tailings | • tailings slurry with 50% solids content will generate a coarse beach partially drained except during active discharge | | 1 | 3 | 3 | Very Low | • relocate water storage to Site C throughout operations and only manage minimal water within Site D<br>• monitor and maintain extensive subaerial tailings beach during operations separating the supernatant pond from the tailings dam | | 1 | 2 | 2 | Very Low |
| 16 | TSF Site D Dam | O/CL | PAG or NAG3 waste rock used in Site D tailings dam downstream shell: contamination of runoff and seepage to ECD | • water flows to ECD for recycle back to TSF pond (no discharge)<br>• extensive geochemical model has been developed and will be updated as mining progresses<br>• overburden and NAG5 material used in dam construction with very limited NAG4 | • daily dig plans incorporating geochemical information to be established to ensure proper identification and handling of waste rock<br>• database of waste rock geochemical properties, mining and deposition records to be maintained<br>• confirmatory testing of waste rock to be completed periodically at source and upon placement | 3 | 1 | 3 | Very Low | | | 3 | 1 | 3 | Very Low |
| 17 | TSF Site D Dam | O/CL | Unexpected metal or nitrogen leaching from NAG waste rock and/or overburden used in TSF Site D dam shell construction: contamination of surface runoff and seepage to ECD | • water flows to ECD for recycle back to TSF pond (no discharge)<br>• monitor quality and quantity of runoff from dam at the ECD<br>• recycle water from ECD to TSF until meets discharge requirements (closure) | | 3 | 1 | 3 | Very Low | | | 3 | 1 | 3 | Very Low |
| 18 | TSF Site D Dam | O/CL | Failure of TSF Site D cutoff trench resulting in increased seepage | • seepage flows predicted to surface and be captured at the ECD for recycle back to TSF pond (no discharge)<br>• interception trenches designed to capture residual seepage not surfacing<br>• substantial geotechnical investigations conducted to determine cutoff trench depth - to be confirmed during construction<br>• pump back system designed for flood conditions, increased seepage would not impact ability to manage flows | • monitor quality and quantity of runoff from dam at the ECD | 2 | 3 | 6 | Low | | | 2 | 3 | 6 | Low |
| 19 | TSF Site D | O/CL | Landslide or avalanche into TSF Site D resulting in supernatant pond wave and/or additional material in TSF | • low risk of landslides or avalanches given topography<br>• TSF beaches developed to separate supernatant pond from embankment | • monitor snow accumulations in catchment above TSF | 1 | 2 | 2 | Very Low | | | 1 | 2 | 2 | Very Low |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Likelihood L | Impact I | SCORE | | | | Likelihood L | Impact I | SCORE | |
| 20 | TSF Site C or D | O | Failure to follow staged construction plan to meet filling requirements or storage of excess water leading to design freeboard violation | • maximum filling level defined for each construction stage<br>• dam stages constructed to match storage requirement for preceding year<br>• availability of construction fill requirements for each stage based on mine waste production schedule<br>• dam staging includes allowance for IDF storage above operational freeboard<br>• tailings facility designed to store the IDF assuming all diversions fail | • monitor filled capacity of the TSF and available storm storage regularly during operations<br>• monitor construction material delivery continuously during operations<br>• establish quantitative performance objective during permitting to prevent freeboard violations | 3 | 3 | 9 | Medium | | • establish extension of reclaim water system to open pit for emergency drawdown of the TSF pond<br>• establish interim emergency overflow structures for TSF after each major construction lift | 1 | 1 | 1 | Very Low |
| 21 | TSF Site C or D | O | Inability to recognize and respond to changes at the site (e.g. increased disturbance area, low NAG waste rock/overburden production for dam construction, climate conditions consistently wetter than average, extended mine life): inadequate tailings pond capacity or excessive water resulting in need to discharge tailings pond supernatant to receiving streams | • water balance modelling includes consideration for range of climate possibilities including consistently wetter than average conditions<br>• waste rock and overburden materials used for construction of dams based on detailed mine waste model | • water balance modelling to be continually reevaluated during operations<br>• annual review by EOR will consider recent changes to the site and potential impacts to design | 3 | 3 | 9 | Medium | | • establish extension of reclaim water system to open pit for emergency drawdown of the TSF pond | 1 | 1 | 1 | Very Low |
| 22 | TSF Site C or D | O | Incorrect water balance modelling resulting in unexpected surplus or deficit of water | • water balance modelling includes consideration for range of climate possibilities including consistently wetter than average conditions | • monitor water balance including water levels in tailings pond regularly<br>• maintain water balance model including projection of future conditions and needs<br>• conduct annual tailings pond capacity investigations | 2 | 2 | 4 | Low | • install diversions systems in areas upslope of TSF Site D (northern diversion) and upslope of mine facilities (southern diversion) for optional diversion of these catchment areas | | 1 | 1 | 1 | Very Low |
| 23 | TSF Site C or D Dams | O/CL | Extreme seismic activity: large earthquake resulting in embankment deformation and/or tailings liquefaction | • tailings dams designed for MCE<br>• tailings dam designed to not be reliant on tailings strength for stability during earthquake (assumes tailings liquified)<br>• predicted settlement during MCE less than design freeboard<br>• tailings slurry with 50% solids content will generate a coarse beach partially drained except during active discharge | • inspect tailings dam immediately after any seismic event | 1 | 4 | 4 | Low | | | 1 | 4 | 4 | Low |
| 24 | ECD | O | High sediment loading to ECD reducing pond capacity | • monitor sediment loading to ECD<br>• sediment and erosion control BMPs in place<br>• reclamation concurrent with construction and in closure to minimize sediment transport | • remove additional sediment from ECD | 3 | 1 | 3 | Very Low | | | 3 | 1 | 3 | Very Low |
| 25 | ECD | O | Failure of recycle water pump or pipeline from ECD to tailings pond resulting in excessive water in ECD | • system comprised of three operating and one installed spare pump<br>• normal operating conditions only one pump required<br>• pump system is level actuated to maintain ECD pond in dewatered condition<br>• three operating pumps required to dewater pond after 1/100 year flood event | | 1 | 2 | 2 | Very Low | | | 1 | 2 | 2 | Very Low |
| 26 | ECD | O | Seepage or runoff exceeds pumping capacity of ECD resulting in discharge from ECD to receiving streams | • ECD designed to capture 1/100 yr. event (pumped out over 10 days)<br>• spillway designed to pass 1/200 yr. event | | 2 | 2 | 4 | Low | | | 2 | 2 | 4 | Low |
| 27 | TSF Site C or D | O | Unforeseen capital costs for TSF construction | • feasibility study cost estimate completed | | 2 | 2 | 4 | Low | | | 2 | 2 | 4 | Low |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Likelihood L | Impact I | SCORE | | | | Likelihood L | Impact I | SCORE | |
| 28 | ECD | O/CL | Unforeseen seepage or run-off resulting in overtopping of ECD | • system comprised of three operating and one installed spare pump<br>• normal operating conditions only one pump required<br>• pump system is level actuated to maintain ECD pond in dewatered condition<br>• three operating pumps required to dewater pond after 1/100 year flood event<br>• spillway installed in ECD | • monitor and clean spillway as required | 1 | 3 | 3 | Very Low | | | 1 | 3 | 3 | Very Low |
| 29 | ECD | O/CL | Failure of ECD due to piping | • ECD designed to be drawn down to minimum operating level<br>• designed with minimum 6 m-wide core zone, 2 m filter zone and 2 m transition zone<br>• downstream filter to prevent piping when pond full, upstream filter to prevent piping during rapid drawdown<br>• downstream drain zone and longitudinal drain pipe included in design to manage seepage flows, if any | • contruction quality control / quality assurance requirements to confirm as-built dam meets design specifications<br>• instrumentation installed to monitor porewater pressure<br>• establish trigger or alarm levels for pore pressures<br>• establish EOR notification as part of OMS manual<br>• establish emergency response plan | 1 | 3 | 3 | Very Low | | | 1 | 3 | 3 | Very Low |
| 30 | ECD | O/CL | Blockage of the spillway in ECD by debris | • ECD designed to capture 1/100 yr. event (pumped out over 10 days)<br>• system comprised of three operating and one installed spare pump<br>• normal operating conditions only one pump required<br>• pump system is level actuated to maintain ECD pond in dewatered condition | • monitor and clean spillway as required | 1 | 2 | 2 | Very Low | | | 1 | 2 | 2 | Very Low |
| 31 | ECD | O/CL | Unexpected metal or nitrogen leaching from NAG waste rock and/or overburden used in ECD dam construction: contamination of water reservoir and discharge to receiving streams | • overburden for reclamation of downstream dam face will not be blasted so no nitrogen present | • select waste rock that has been only lightly blasted or has been rinsed by precipitation and runoff<br>• test rock to be used in ECD dam for ML/ARD potential (use best NAG5 rock) | 2 | 3 | 6 | Low | | | 2 | 3 | 6 | Low |
| 32 | ECD | O/CL | Excessive metals or increase in unrecoverable seepage to receiving streams during operations and closure | • ECD and interception trenches positioned downstream to intercept seepage and reduce potential for unrecoverable seepage<br>• slow movement of groundwater allows early monitoring of plume | • monitor and evaluate downstream surface water quality during operations and closure and investigate and mitigate any exceedances<br>• groundwater monitoring locations between Site D Main Dam and ECD, as well as beyond the ECD to monitor seepage water quality during operations and closure | 2 | 2 | 4 | Low | | | 2 | 2 | 4 | Low |
| 33 | Tailings Distribution Pipeline | O | Failure of tailings distribution line on tailings dam resulting in discharge of tailings outside of impoundment footprint | • tailings distribution line designed to withstand expected pressures<br>• tailings distribution lines arranged such that any potential discharge would be contained in the impoundment area<br>• distribution system includes redundancies to switch distribution pipeline in the event of a failure<br>• periodic replacement of tailings pipelines included in sustaining capital costs | • regular inspections of tailings line<br>• quality assurance / quality control on pipe welding<br>• place tailings distribution line on inside edge of tailings dam (between edge of dam crest and road safety berm) | 3 | 1 | 3 | Very Low | | | 3 | 1 | 3 | Very Low |
| 34 | TSF | CL | Blockage of TSF spillways by debris | • multiple spillways in TSF dams | • inspect dam annually during closure to ensure spillway clean and remove obstructions as required | 3 | 1 | 3 | Very Low | | | 3 | 1 | 3 | Very Low |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Likelihood L | Impact I | SCORE | | | | Likelihood L | Impact I | SCORE | |
| 35 | TSF | CL | Inadequate capacity of spillways to convey flows | • multiple spillways in TSF dams<br>• TSF spillways designed for PMF at closure<br>• design includes additional depth of spillway as safety factor | | 1 | 2 | 2 | Very Low | | | 1 | 2 | 2 | Very Low |
| 36 | TSF Site D | CL | Excessive metals in tailings pond supernatant and seepage discharge to receiving streams during closure | • tailings deposition planned to submerge PAG prior to prevent ARD and minimze ML conditions developing<br>• seepage reporting to ECD<br>• TSF designed to maintain water cover over PAG and tailings with seasonal variability<br>• all PAG tailings and waste rock to be covered by 30 cm of overburden<br>• seepage flows predicted to surface and be captured at the ECD for recycle back to TSF pond (no discharge)<br>• significant attenuation capicity in subsurface materials | • recycle water from ECD to TSF until meets discharge requirements (closure)<br>• monitor and evaluate downstream water quality during closure and investigate and mitigate any exceedances<br>• monitor groundwater quality | 2 | 2 | 4 | Low | | | 2 | 2 | 4 | Low |
| 37 | CN Treatment Plant | CL | Excessive CN in tailings pond supernatant and seepage discharge to receiving streams during closure | • monitor performance of plant during operations including continuous pH sensor<br>• seepage flows predicted to surface and be captured at the ECD for recycle back to TSF pond (no discharge)<br>• recycle water from ECD to TSF until meets discharge requirements (closure)<br>• significant attenuation capicity in subsurface materials | • monitor and evaluate downstream water quality during closure and investigate and mitigate any exceedances<br>• monitor groundwater quality | 2 | 2 | 4 | Low | | | 2 | 2 | 4 | Low |
| 38 | TSF Site D | CL | Extreme drought: inadequate water cover resulting in acid generation from the tailings or PAG waste rock contaminating seepage and tailings pond supernatant discharge to receiving streams | • analysis shows very low probability of loss of water cover<br>• all PAG tailings and waste rock to be covered by 30 cm of overburden<br>• organic layer will naturally build up on top of overburden cover (scavenge oxygen) | | 1 | 2 | 2 | Very Low | | | 1 | 2 | 2 | Very Low |
| 39 | TSF Site D/ECD | CL | Settlement of tailings leading to formation of depression on the tailings surface and inability to meet closure objectives including location of closure water pond. | • tailings coarse and fine fraction will be separated through deposition (settlement likely to be most significant in center of TSF) | • annual review by EOR will consider potential impacts of settlement on closure plan | 2 | 1 | 2 | Very Low | | | 2 | 1 | 2 | Very Low |

M:\1\01\00457\15\A\Report\2 - FMEA Report\Rev 0\Appendices\Appendix A - FMEA Table\[Appendix A - Table 1 - RevC.XLSX]Blackwater FMEA

**NOTES:**

1. LIKELIHOOD, CONSEQUENCE AND RISK RATINGS BASED ON TABLES SUMMARIZED IN "PI SCALE AND DIAGRAM' TAB.
2. C - CONSTRUCTION; O - OPERATIONS; CL - CLOSURE.

| REV | DATE | DESCRIPTION | PREP'D | RVW'D |
|---|---|---|---|---|
| 0 | 08DEC'15 | ISSUED WITH REPORT VA101-457/15-2 | MAP | DDF |

# APPENDIX B

# NORTHERN DIVERSION

(Pages B-1 to B-6)

Knight Piésold
CONSULTING

**APPENDIX B**

**NEW GOLD INC.**
**BLACKWATER GOLD PROJECT**

**TAILINGS STORAGE FACILITY FAILURE MODES AND EFFECTS ASSESSMENT REPORT OPPORTUNITIES – NORTHERN DIVERSION**

## B.1 INTRODUCTION

A monthly operational and closure water balance was developed for the Blackwater Project and presented in the Mine Waste and Water Management Design Report (KP, 2014a). The water balance model results indicated that the tailings storage facility (TSF) will be in a balance under average precipitation conditions throughout the first ten years of operations. A surplus condition was predicted to begin in Year 11 and was expected to increase steadily over time until the end of mining. The report recommended that runoff from a portion of the upstream contributing catchment could be diverted around the facility to Davidson Creek to reduce the volume of water reporting to the TSF later in mine life. However, the surplus in the later mine years was considered to be a desirable feature as it resulted in a larger pond that could be pumped to the Open Pit upon closure to accelerate pit filling and mitigate the onset of acid rock drainage from the pit walls.

This letter presents the proposed design concept of the northern diversion structure and water conveyance pipeline to provide operational flexibility to capture or divert flows depending on annual water balance conditions and closure plans.

## B.2 DESIGN BASIS

Table 1 presents the design basis for the proposed diversion structure and water conveyance pipeline.

**Table 1 Design Basis Summary**

| ITEM | DESIGN CRITERIA |
|---|---|
| **1.0 GENERAL** | |
| Codes and Standards | Dike Design and Construction Guide, Best Management Practices for British Columbia, July 2003<br>Canadian Dam Association Dam Safety Guidelines, 2007 Revised 2013 |
| Design Operating Life | 17 years |
| Site Elevation | Intake ~ EL.1350m<br>Discharge ~ EL.1165m |
| **2.0 DIVERSION STRUCTURE** | |
| Function | Head pond for water conveyance pipeline |
| Type | Reinforced Concrete and Earthfill |
| Inflow Design Flood (IDF) | Maximum mean monthly flow for catchment with zero discharge to the TSF Site D. |
| Spillway Design Flow (SDF) | 1 in 200 yr peak instantaneous flow; assuming collection ditches are capable of conveying full runoff to the diversion structure and water conveyance pipeline is inoperable. Freeboard – 0.5 m |
| **3.0 WATER CONVEYANCE PIPELINE** | |
| Function | Convey collected runoff to the Freshwater Reservoir |
| Type | HDPE |
| Inflow Design Flood (IDF) | Maximum mean monthly flow for catchment with zero discharge to the TSF Site D. |
| **4.0 COLLECTION DITCHES** | |
| Function | Collect upstream catchment for diversion |
| Type | Earth excavation; lined to avoid erosion and contamination of receiving waters. |
| Inflow Design Flood (IDF) | 1 in 10 year peak instantaneous flow |

## B.3 DESIGN METHODOLOGY

The proposed northern diversion system has been sized to convey runoff for the area northwest of the TSF Site D, as shown on Figure B.1. Water is expected to pass over the intake structure spillway during extreme runoff events, for short durations, however the volume of water reporting to the TSF Site D is anticipated to be minimal when compared to the supernatant pond volume and will have little impact on the water balance. Overflow to the TSF during extreme runoff events can be offset by subsequent diversion during average conditions to maintain water within the preferred operating limits. The design peak flows for each of the northern diversion system components have been calibrated for their respective catchment area using project site long term unit runoff and regional peak flow estimates (KP, 2013a).

**Table 2 Design Peak Flows**

| Item | Design Event | Catchment Area (Square Kilometer) | Design Flow (Cubic Meter/Second) |
|---|---|---|---|
| Water Conveyance Pipeline | Max. Mean Monthly | 9.7 | 0.2 |
| Gated Sluice Pipe (Bypass) | Max. Mean Monthly | 9.7 | 0.2 |
| Overflow Spillway | 200 Year | 9.7 | 6.5 |
| Northern Collection Ditch | 10 Year | 1.0 | 0.5 |
| Southern Collection Ditch | 10 Year | 1.4 | 0.6 |

## B.4 RESULTS

The northern diversion structure consists of a 3.5 m high concrete structure to provide submergence to the water conveyance pipeline. The 16-inch diameter HDPE water conveyance pipeline is sized to convey the estimated maximum mean monthly flow of 0.2 $m^3/s$. The northern diversion structure will include a gated sluice pipe to clean out sediment accumulation. Flow from the water conveyance pipe will enter the Freshwater Reservoir, via an energy dissipation structure, prior to release to Davidson Creek. Fish passage has been excluded.

The northern diversion structure spillway design conveys the full 200 year design peak flow of 6.5 $m^3/s$; assuming the water conveyance pipeline and gated sluice pipe are inoperable. The spillway will consist of a 5 m wide broad crested weir capable of passing the design storm while maintaining 0.5 m of freeboard between the maximum water level and the crest of the structure.

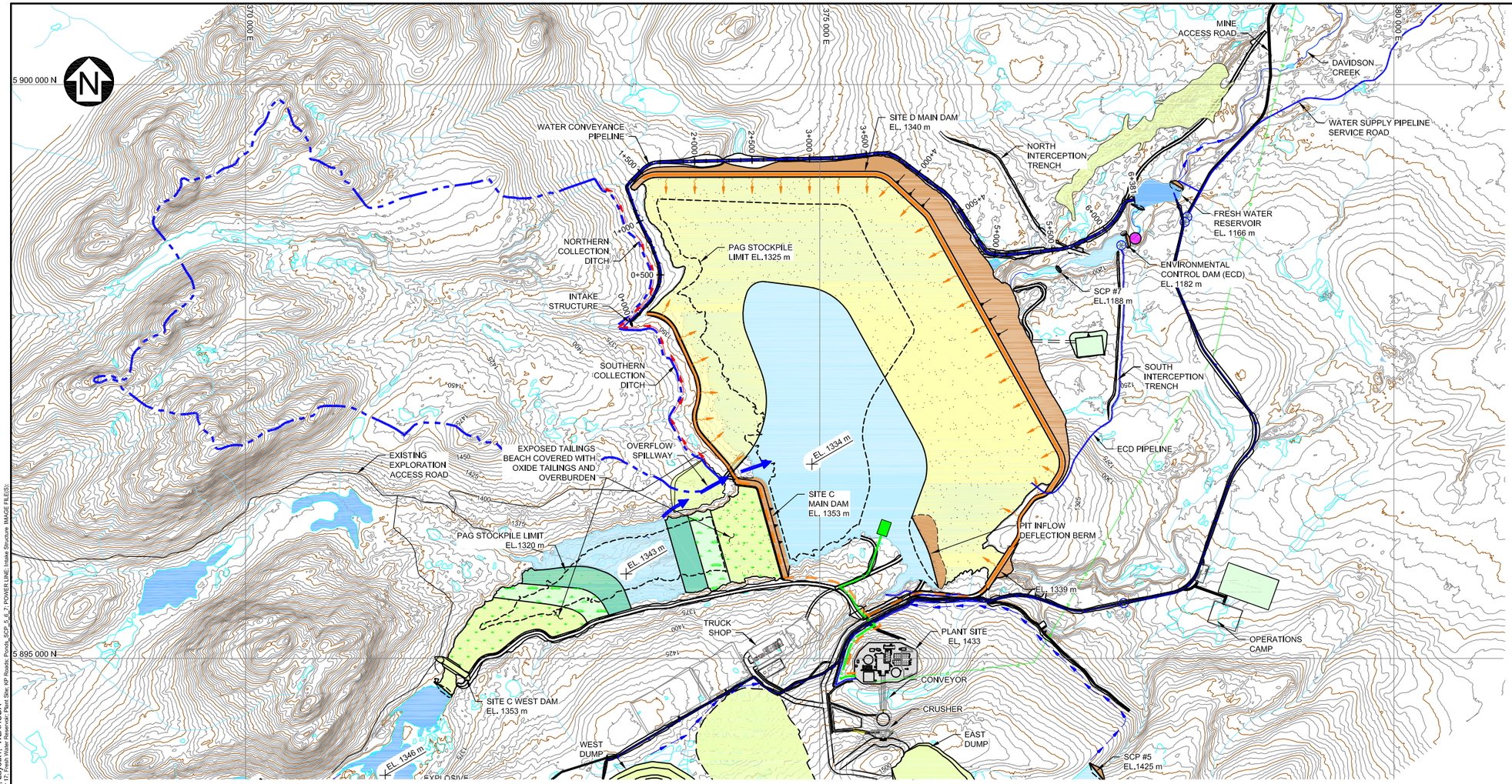
The northern and southern collection ditches have been designed with sufficient capacity to convey the runoff and withstand erosive forces from the 10 year design peak flow of 0.5 and 0.6 $m^3/s$, respectively. A typical ditch cross-section is presented on Figure B.3. Erosion resistant material will be placed over a non-woven geotextile, which will help prevent erosion of fine underlying soils.

Although not needed until year 10 for average conditions it is recommended that the diversion structure be constructed during the early years of project development to control the volume of water reporting to the TSF prior to operations and to provide water management features to control the accumulation of the supernatant pond in the TSF during wetter than average years.

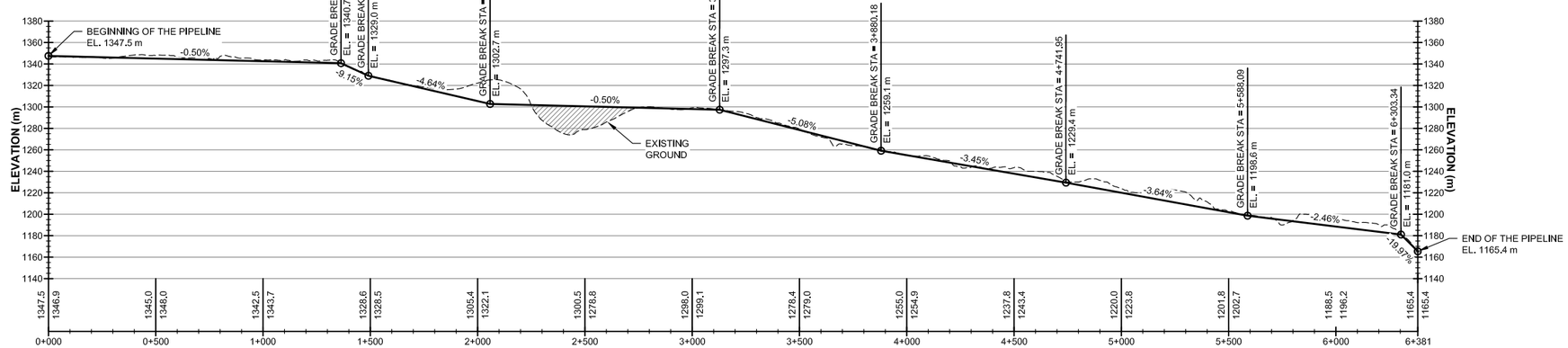
## B.5 REFERENCES

Knight Piésold Ltd. (KP, 2013a). New Gold Inc., Blackwater Gold Project 2013 Hydrometeorology Report (Ref. No. VA101-457/6-12 Rev. 0) November 4, 2013.

Knight Piésold Ltd. (KP, 2014a). New Gold Inc., Blackwater Gold Project Mine Waste and Water Management Design Report (Ref. No. VA101-457/6-11 Rev. 2) September 12, 2014




## PLAN
### GENERAL ARRANGEMENT
SCALE A




## PROFILE
### WATER CONVEYANCE PIPELINE
HORIZONTAL SCALE A
VERTICAL SCALE B

**NOTES:**

1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. SCP STANDS FOR SEDIMENT CONTROL POND.

SCALE C: 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE B: 2.5 1.25 0 2.5 5 7.5 10 12.5 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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| 0 | 18NOV'15 | ISSUED WITH REPORT | BSH | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**NORTHERN DIVERSION GENERAL ARRANGEMENT AND WATER CONVEYANCE PIPELINE PROFILE**

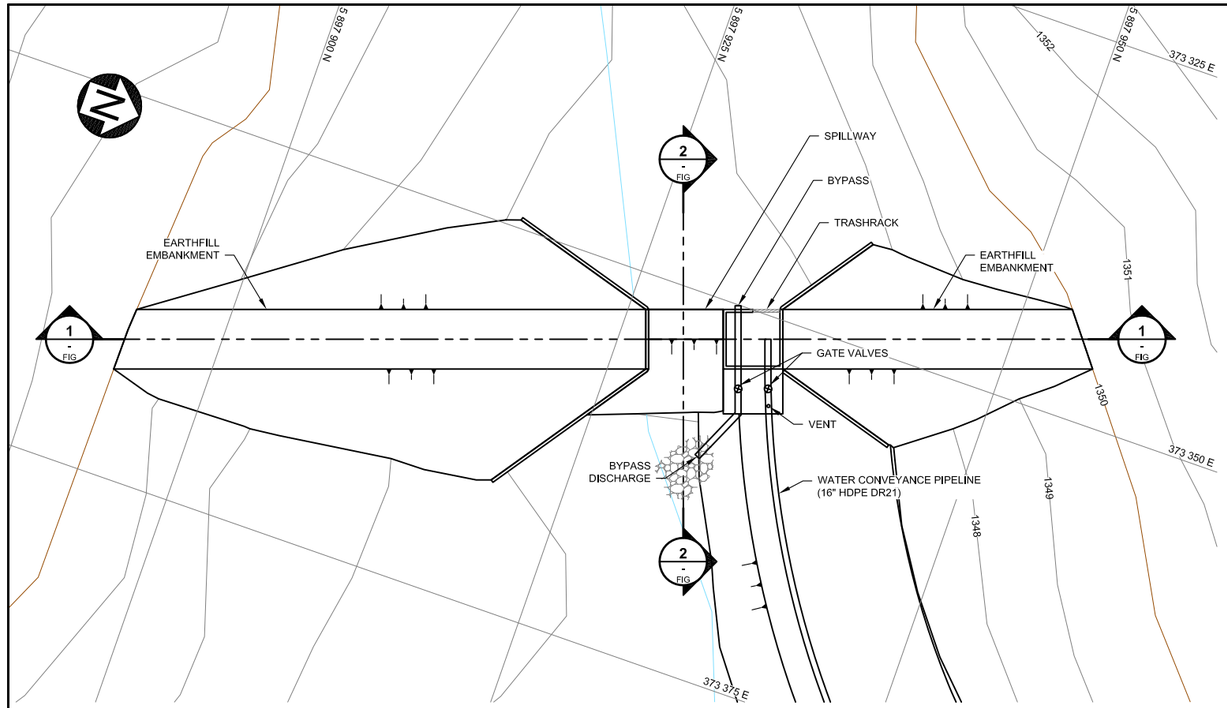
Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 2

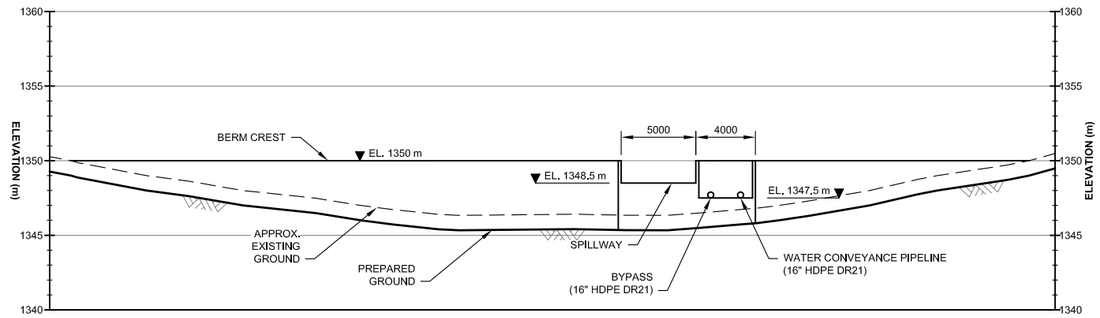
**FIGURE B.1** | REV 0



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XREF FILES): Hydro: Topo 5m Contours; Tailings Ponds; Topo&Bornite Stockpiles; Cell C Stages; Cell D Stages; Open Pit - End of Year 17; Ponds; Dumps - End of year 17; Fresh Water Reservoir; Plant Site; KP Roads; Ponds_SCP_4_6_7; POWER LINE; Intake Structure; IMAGE FILE(S):

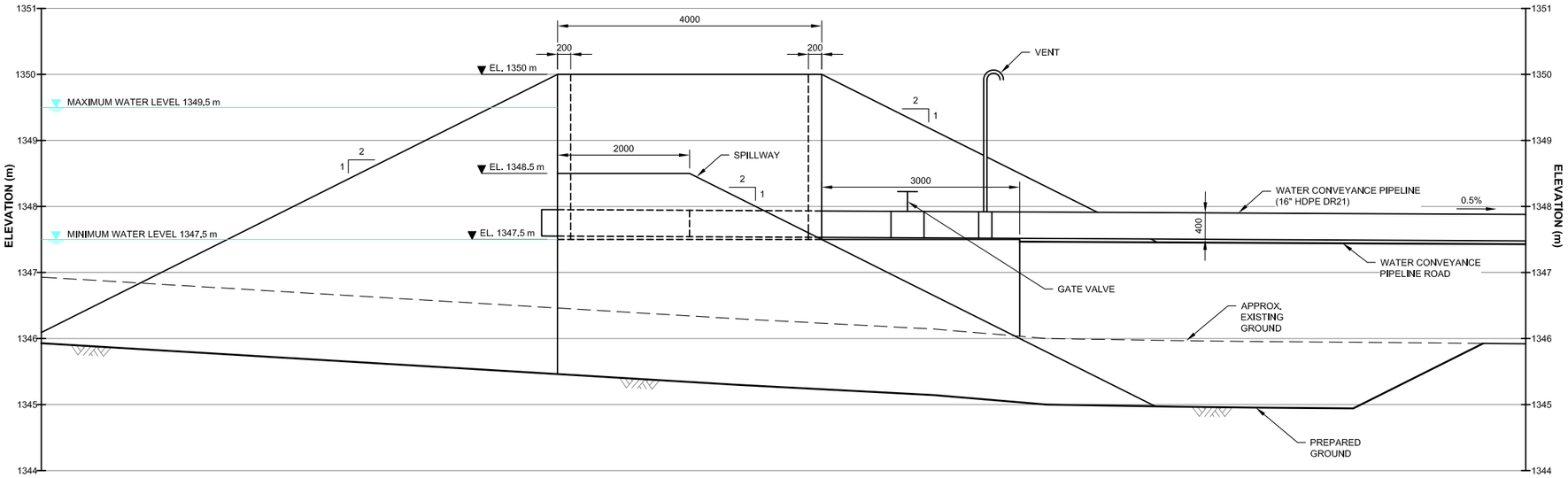



**PLAN**
**INTAKE STRUCTURE**
SCALE A




1
-
FIG

**SECTION**
**INTAKE STRUCTURE**
SCALE A




2
-
FIG

**SECTION**
**INTAKE STRUCTURE**
SCALE B

**NOTES:**

1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE B 0,8 0,4 0 1 2 3 4 m
SCALE A 4 2 0 4 8 12 16 20 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 18NOV'15 | ISSUED WITH REPORT | BSH | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**NORTHERN DIVERSION**
**INTAKE STRUCTURE GENERAL ARRANGEMENT**
**PLAN AND SECTIONS**

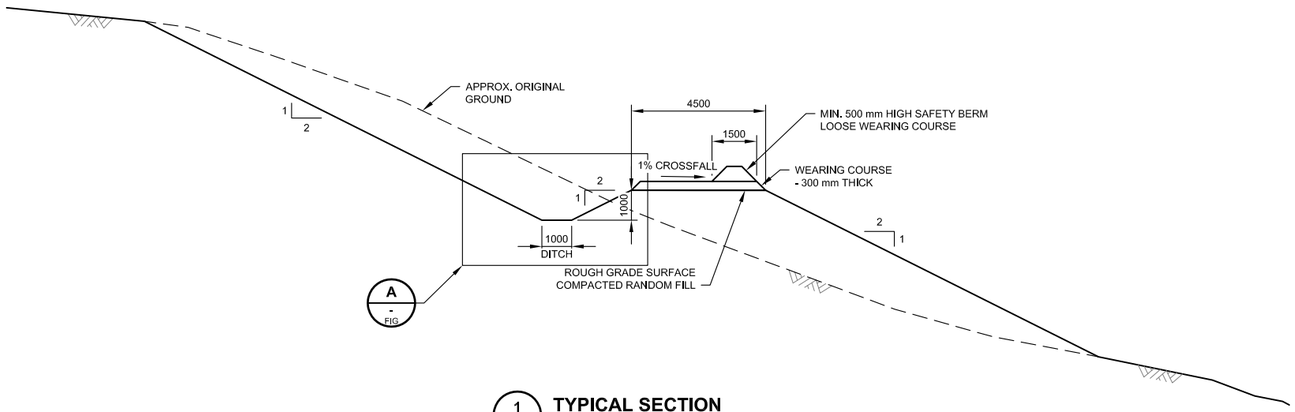
Knight Piésold CONSULTING

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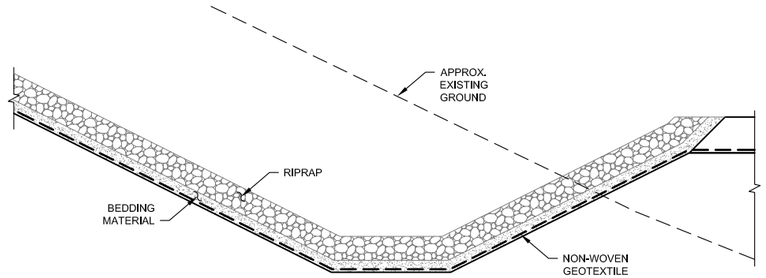
**FIGURE B.2** | REV 0



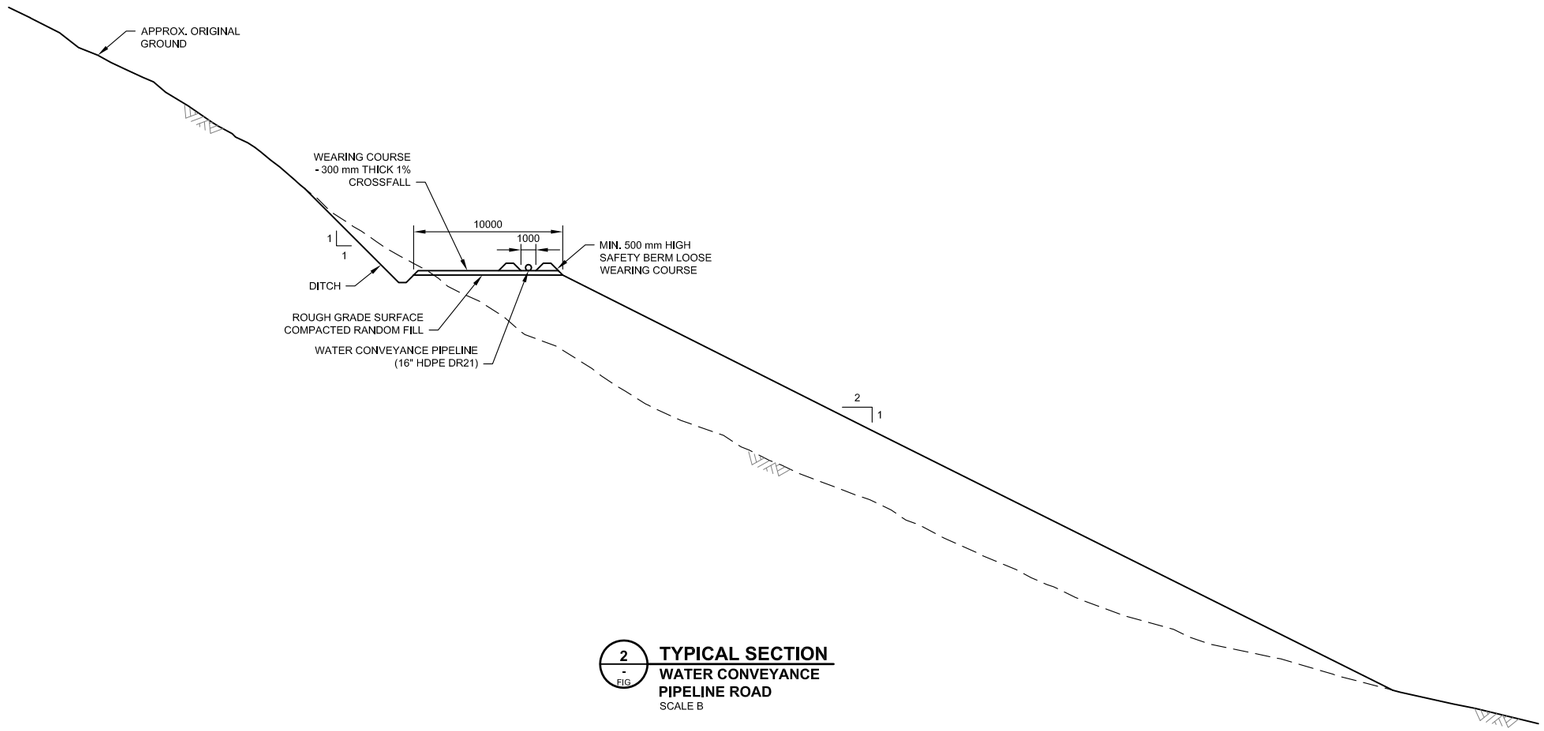
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XREF FILES): Intake Structure; Topo 1m Contours Hydro IMAGE FILES):




**1 - FIG — TYPICAL SECTION**
**COLLECTION DITCH**
SCALE A




**A - FIG — DETAIL**
**SUB-TITLE**
SCALE C




**2 - FIG — TYPICAL SECTION**
**WATER CONVEYANCE PIPELINE ROAD**
SCALE B

**NOTES:**

1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE C: 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE B: 4 2 0 4 8 12 16 20 m
SCALE A: 2 1 0 2 4 6 8 10 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**NORTHERN DIVERSION ROAD AND DITCH TYPICAL SECTIONS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 2

**FIGURE B.3** | REV 0



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# APPENDIX C

# SOUTHERN DIVERSION

(Pages C-1 to C-6)

Knight Piésold
CONSULTING

**APPENDIX C**

**NEW GOLD INC.**
**BLACKWATER GOLD PROJECT**

**TAILINGS STORAGE FACILITY FAILURE MODES AND EFFECTS ASSESSMENT REPORT OPPORTUNITIES – SOUTHERN DIVERSION**

## C.1 INTRODUCTION

A monthly operational and closure water balance was developed for the Blackwater Project and presented in the Mine Waste and Water Management Design Report (KP, 2014a). The water balance model results indicated that the tailings storage facility (TSF) will be in a balance under average precipitation conditions throughout the first ten years of operations. A surplus condition was predicted to begin in Year 11 and was expected to increase steadily over time until the end of mining. The report recommended that runoff from a portion of the upstream contributing catchment could be diverted around the facility to Davidson Creek to reduce the volume of water reporting to the TSF later in mine life. However, the surplus in the later mine years was considered to be a desirable feature as it resulted in a larger pond that could be pumped to the Open Pit upon closure to accelerate pit filling and mitigate the onset of acid rock drainage from the pit walls.

This letter presents the proposed design concept of the southern diversion structure and water conveyance pipeline to provide operational flexibility to capture or divert flows depending on annual water balance conditions and closure plans.

## C.2 DESIGN BASIS

Table 1 presents the design basis for the proposed diversion structure and water conveyance pipeline.

**Table 1 Design Basis Summary**

| ITEM | DESIGN CRITERIA |
|---|---|
| **1.0 GENERAL** | |
| Codes and Standards | Dike Design and Construction Guide, Best Management Practices for British Columbia, July 2003<br>Canadian Dam Association Dam Safety Guidelines, 2007 Revised 2013 |
| Design Operating Life | 17 years |
| Site Elevation | Intake ~ EL.1,450 m<br>Discharge ~ EL.1,165 m |
| **2.0 DIVERSION STRUCTURE** | |
| Function | Head pond for water conveyance pipeline |
| Type | Reinforced Concrete and Earthfill |
| Inflow Design Flood (IDF) | Maximum mean monthly flow for catchment with zero discharge to the TSF Site D. |
| Spillway Design Flow (SDF) | 1 in 200 yr peak instantaneous flow; assuming collection ditches are capable of conveying full runoff to the diversion structure and water conveyance pipeline is inoperable. Freeboard – 0.5 m |
| **3.0 WATER CONVEYANCE PIPELINE** | |
| Function | Convey collected runoff to the Freshwater Reservoir |
| Type | HDPE |
| Inflow Design Flood (IDF) | Maximum mean monthly flow for catchment with zero discharge to the TSF Site D. |
| **4.0 COLLECTION DITCHES** | |
| Function | Collect upstream catchment for diversion |
| Type | Earth excavation; lined to avoid erosion and contamination of receiving waters. |
| Inflow Design Flood (IDF) | 1 in 10 year peak instantaneous flow |

## C.3 DESIGN METHODOLOGY

The proposed southern diversion system has been sized to convey runoff for the area southwest of the open pit and west dump, as shown on Figure C.1. Water is expected to pass over the intake structure spillway during extreme runoff events, for short durations, however the volume of water reporting to the TSF Site D is anticipated to be minimal when compared to the supernatant pond volume and will have little impact on the water balance. Overflow to the TSF during extreme runoff events can be offset by subsequent diversion during average conditions to maintain water within the preferred operating limits. The design peak flows for each of the southern diversion system components have been calibrated for their respective catchment area using project site long term unit runoff and regional peak flow estimates (KP, 2013a).

**Table 2 Design Peak Flows**

| Item | Design Event | Catchment Area (Square Kilometer) | Design Flow (Cubic Meter/Second) |
|---|---|---|---|
| Water Conveyance Pipeline | Max. Mean Monthly | 5.4 | 0.1 |
| Gated Sluice Pipe (Bypass) | Max. Mean Monthly | 5.4 | 0.1 |
| Overflow Spillway | 200 Year | 5.4 | 4.1 |
| Collection Ditch | 10 Year | 3.9 | 1.3 |

## C.4 RESULTS

The southern diversion structure consists of a 3.5 m high concrete structure to provide submergence to the water conveyance pipeline. The 10-inch diameter HDPE water conveyance pipeline is sized to convey the estimated maximum mean monthly flow of 0.1 $m^3/s$. The southern diversion structure will include a gated sluice pipe to clean out sediment accumulation. Flow from the water conveyance pipe will enter the Freshwater Reservoir, via an energy dissipation structure, prior to release to Davidson Creek. Fish passage has been excluded.

The southern diversion structure spillway design conveys the full 200 year design peak flow of 4.1 $m^3/s$; assuming the water conveyance pipeline and gated sluice pipe are inoperable. The spillway will consist of a 3 m wide broad crested weir capable of passing the design storm while maintaining 0.5 m of freeboard between the maximum water level and the crest of the structure.

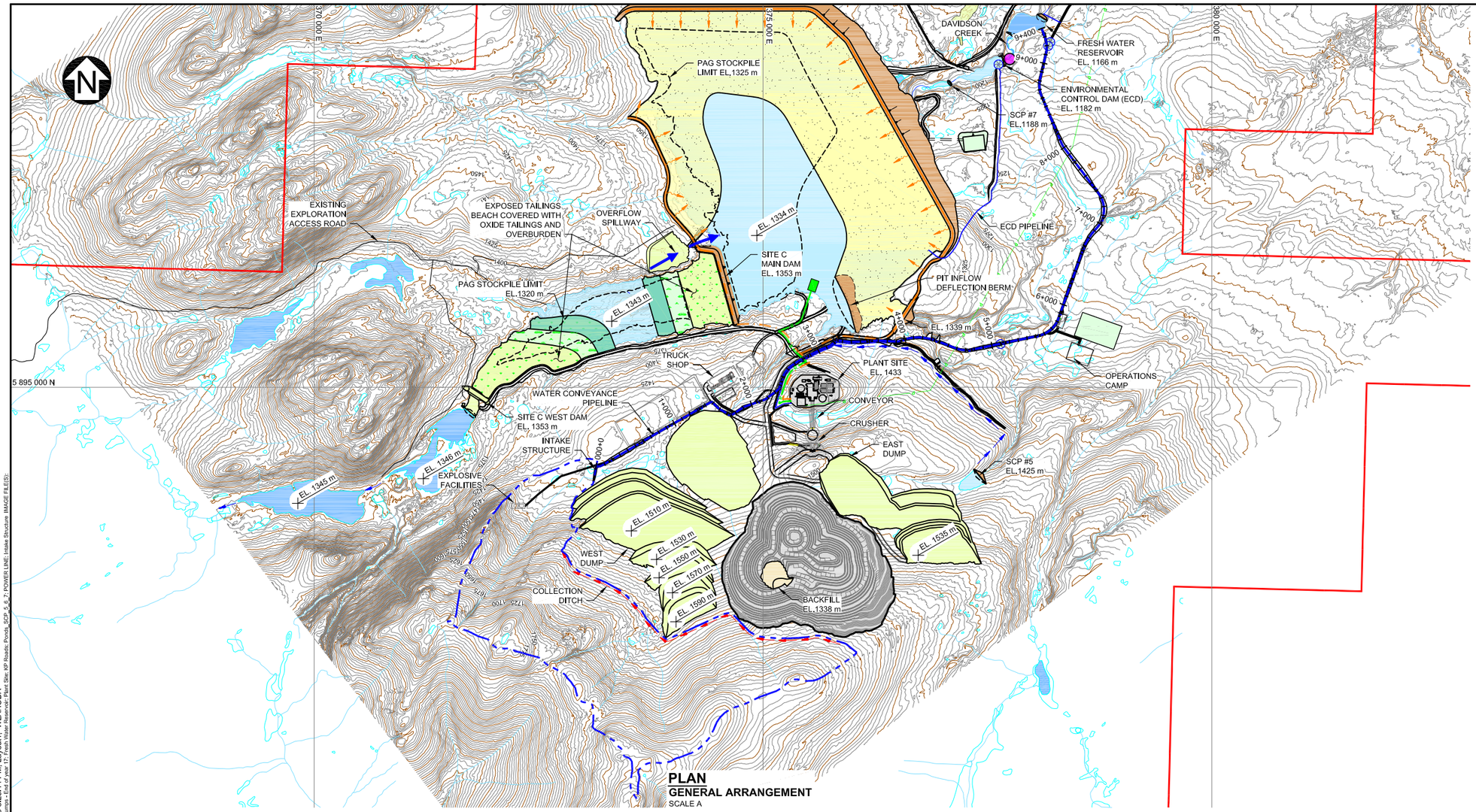
The collection ditch has been designed with sufficient capacity to convey the runoff and withstand erosive forces from the 10 year design peak flow of 1.3 $m^3/s$. A typical ditch cross-section is presented on Figure C.3. Erosion resistant material will be placed over a non-woven geotextile, which will help prevent erosion of fine underlying soils.

Although not needed until year 10 for average conditions it is recommended that the diversion structure be constructed during the early years of project development to control the volume of water reporting to the TSF prior to operations and to provide water management features to control the accumulation of the supernatant pond in the TSF during wetter than average years.

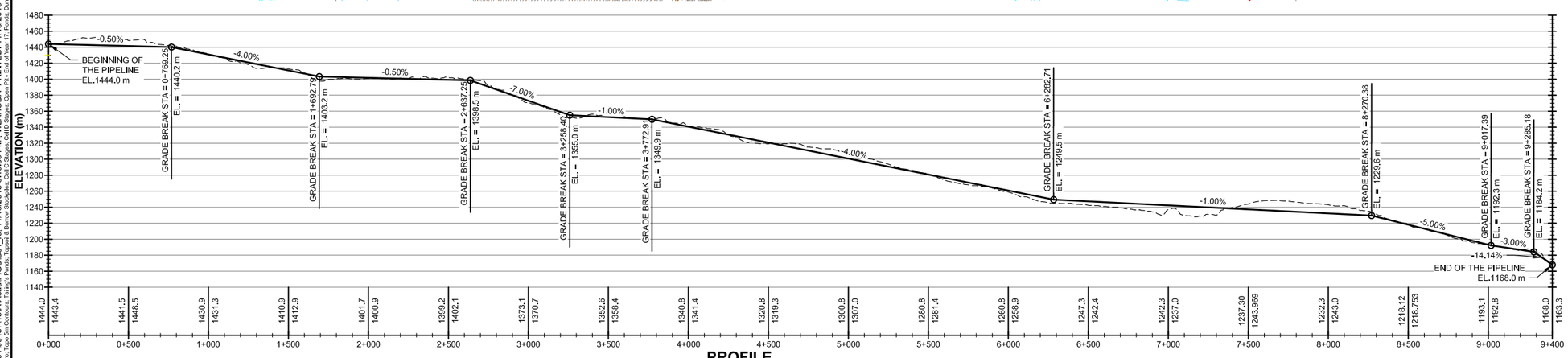
## C.5 REFERENCES

Knight Piésold Ltd. (KP, 2013a). New Gold Inc., Blackwater Gold Project 2013 Hydrometeorology Report (Ref. No. VA101-457/6-12 Rev. 0) November 4, 2013.

Knight Piésold Ltd. (KP, 2014a). New Gold Inc., Blackwater Gold Project Mine Waste and Water Management Design Report (Ref. No. VA101-457/6-11 Rev. 2) September 12, 2014.




**PLAN**
**GENERAL ARRANGEMENT**
SCALE A




**PROFILE**
**WATER CONVEYANCE PIPELINE**
HORIZONTAL SCALE A
VERTICAL SCALE B

**NOTES:**

1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. SCP STANDS FOR SEDIMENT CONTROL POND.

SCALE C 60 30 0 100 200 300 m
SCALE B 300 150 0 500 1000 1500 m
SCALE A 500 250 0 500 1000 1500 2000 2500 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**SOUTHERN DIVERSION GENERAL ARRANGEMENT AND WATER CONVEYANCE PIPELINE PROFILE**

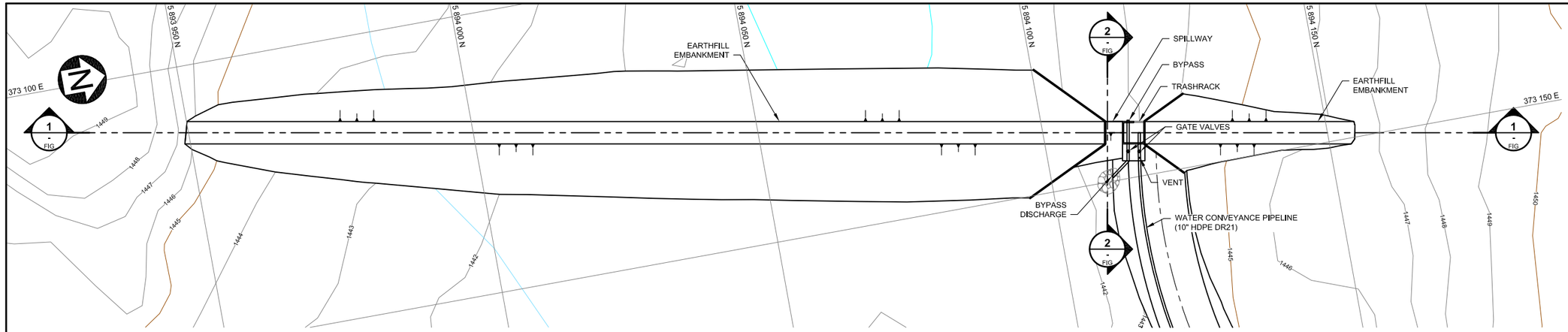
Knight Piésold CONSULTING

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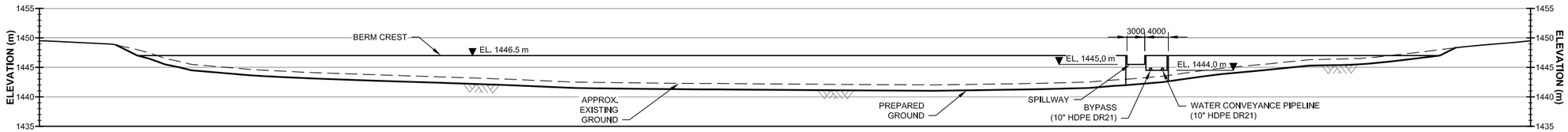
**FIGURE C.1** | REV 0



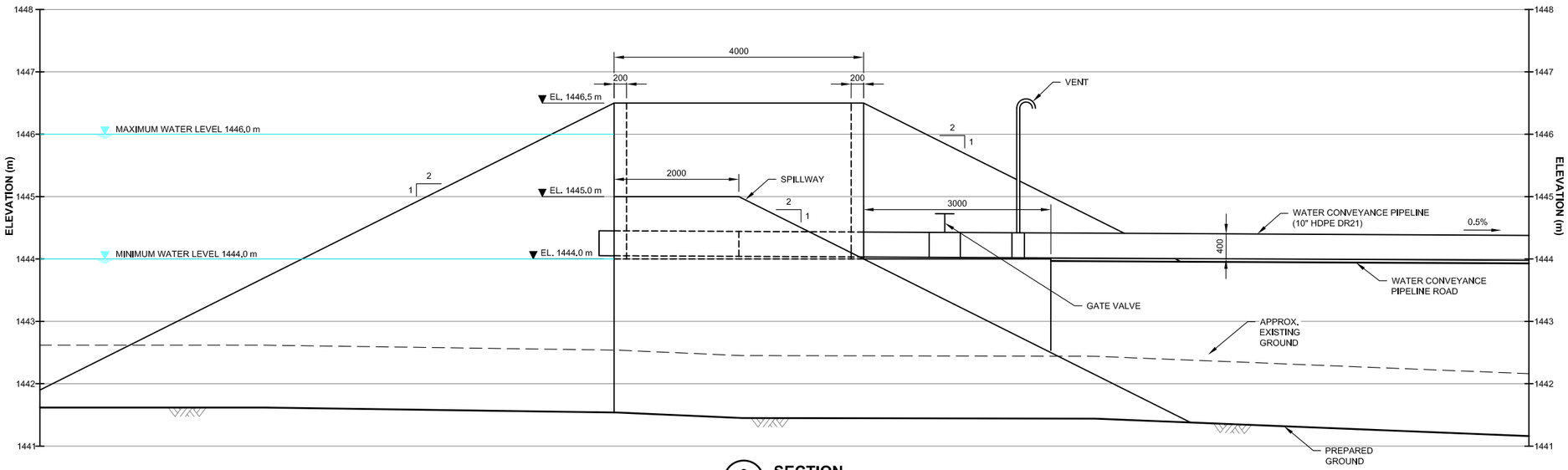
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XREF FILES: Hydro_Topo Jan Contours, Barry's Ponds, Topsoil & Borrow Stockpiles Cell Staging, Open Pit + End of Year 17, Ponds, Dumps - End of year 17, Fresh Water Reservoir Plant Site, WP Roads, Ponds




**PLAN**
**INTAKE STRUCTURE**
SCALE A




1 - FIG **SECTION**
**INTAKE STRUCTURE**
SCALE A




2 - FIG **SECTION**
**INTAKE STRUCTURE**
SCALE B

**NOTES:**

1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE B 0,8 0,4 0 1 2 3 4 m
SCALE A 8 4 0 10 20 30 40 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 18NOV'15 | ISSUED WITH REPORT | BSH | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**SOUTHERN DIVERSION INTAKE STRUCTURE**
**GENERAL ARRANGEMENT**
**PLAN AND SECTIONS**

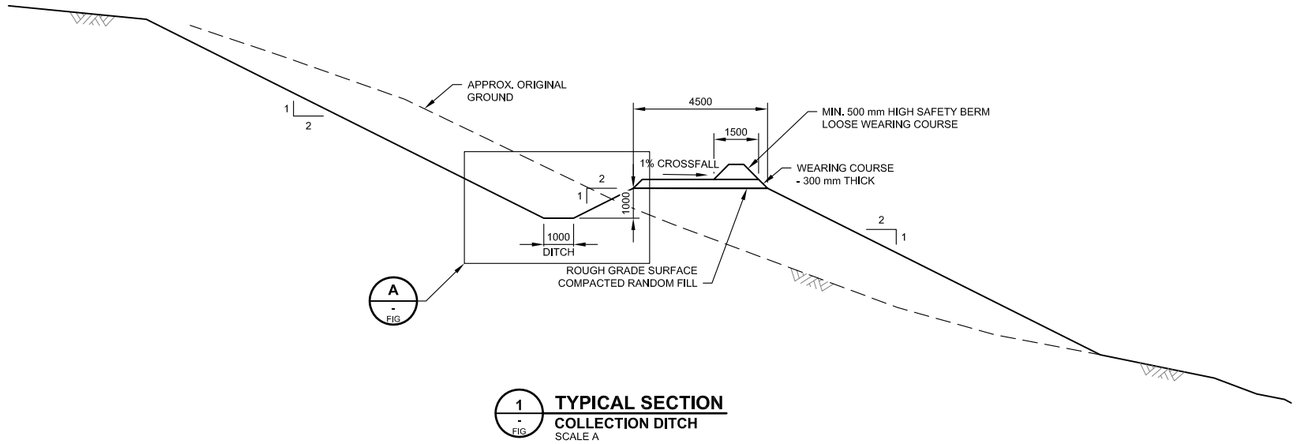
Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 2 | REV 0

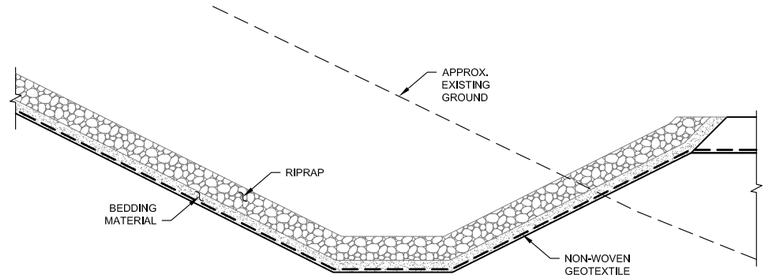
**FIGURE C.2**



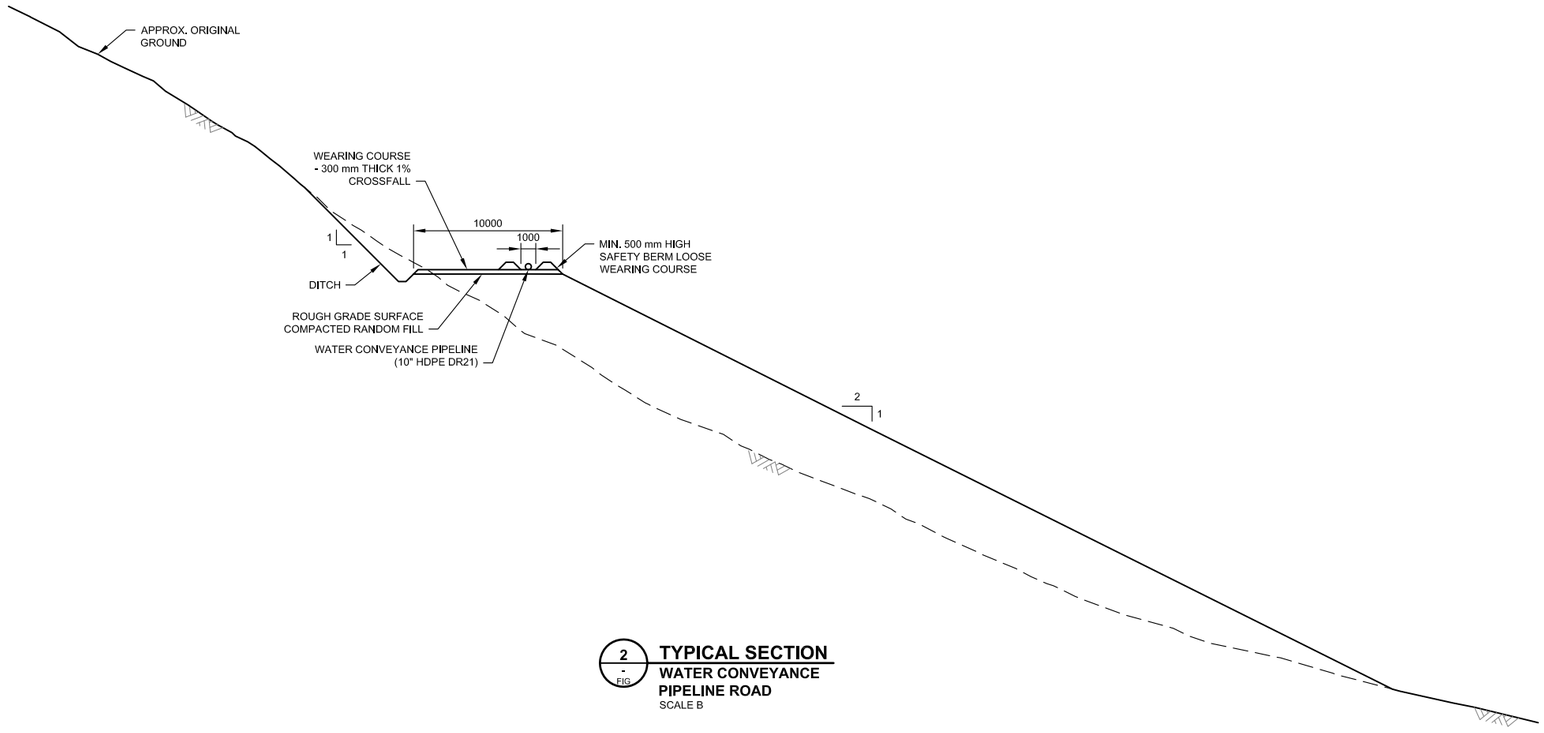
SAVED: M:\1\101\00457\15\A\Acad\FIGS\B32_r0, 11/18/2015 3:10:58 PM , WLAHODA PRINTED: 11/18/2015 3:27:02 PM, Layout1, WLAHODA
XREF FILES: Intake Structure Topo Int Contours Hydro Plant Site IMAGE FILES:




**1 - FIG TYPICAL SECTION**
**COLLECTION DITCH**
SCALE A




**A - FIG DETAIL**
**SUB-TITLE**
SCALE C




**2 - FIG TYPICAL SECTION**
**WATER CONVEYANCE PIPELINE ROAD**
SCALE B

**NOTES:**

1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

0,5 0,25 0 0,5 1,0 1,5 2,0 2,5 m
SCALE C
4 2 0 4 8 12 16 20 m
SCALE B
2 1 0 2 4 6 8 10 m
SCALE A

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 18NOV'15 | ISSUED WITH REPORT | BSH | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**SOUTHERN DIVERSION ROAD AND DITCH TYPICAL SECTIONS**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 2

**FIGURE C.3** | REV 0



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XREF FILES: IMAGE FILES:

# APPENDIX D

## SITE C WATER STORAGE

(Pages D-1 to D-8)

Knight Piésold
CONSULTING

**APPENDIX D**

**NEW GOLD INC.**
**BLACKWATER GOLD PROJECT**

**TAILINGS STORAGE FACILITY FAILURE MODES AND EFFECTS ASSESSMENT REPORT OPPORTUNITIES – RELOCATION OF WATER STORAGE TO TSF SITE C**

## D.1 INTRODUCTION

The Failure Modes and Effects Assessment (FMEA) demonstrated the majority of risks to the Blackwater Gold Project (the Project), are mitigated through the key defensive measures in place in the current design and key defensive measures to be applied during permitting. The design summary of the TSF concept was presented in the Mine Waste and Water Management Design Report (KP, 2014a). The highest rated risks can be reduced further with additional design elements, operational practices, and contingencies.

A strategy for relocation of the majority of water storage from Site D to Site C throughout operations was identified as one of the additional mitigation measures that would further reduce the overall risk of TSF design.

The relocation of water storage to Site C from Site D reduces overall risk of the TSF by several means. Water storage relocated from the impoundment undergoing active construction to the inactive impoundment reduces one variable of impoundment filling. It simplifies mine waste disposal planning within the active impoundment and increases flexibility to actively manage the location where the tailings beach meets the co-disposed potentially acid generating (PAG) waste rock platform thereby improving the ability to meet closure plan objectives. The reduction in the supernatant pond will increase subaerial beach length, which is an indicator of improved dam safety. The storage of water outside of the active impoundment decreases the likelihood and consequences of containment loss in the event of embankment deformation.

## D.2 WATER MANAGEMENT OBJECTIVES

The key water management objective for the Project is to provide sufficient mill water reclaim requirements and maintain the PAG and NAG3 waste rock disposal area (referred to as the PAG disposal area) in the TSF in a subaqueous state, while mitigating environmental impacts to downstream receiving waters.

Water within the project area will be recycled and used to the maximum practical extent by collecting and managing site runoff from both undisturbed and disturbed areas. Site runoff water will be collected and stored within the TSF and used to inundate the PAG waste rock and tailings solids to prevent ARD and minimize ML.

## D.3 CURRENT RECLAIM WATER SYSTEM STRATEGY

The reclaim water system, as described in the Mine Waste and Water Management Design Report (KP, 2014a), will initially utilize a barge-mounted pump station sized to deliver 3,200 $m^3$/hr of process water from TSF Site C to the reclaim water tank at the Mill. The reclaim barge will be located in TSF Site C during Years 1 and 2 of operations, and then moved to TSF Site D late in Year 2 for the remainder of mine operations and closure.

A reclaim structure, consisting of a concrete intake with stoplogs and trash racks, will be constructed in TSF Site C in Year 2 to reclaim water during the relocation of the barge. The reclaim structure may be used during the remaining years of operations to regulate the water level within TSF Site C and/or to

support the barge-mounted pump station with reclaim to the mill. The reclaim structure pump system will incorporate the same pumps and motors as the barge-mounted system for consistency of spare parts and ease of maintenance.

The site water management plans, before and after barge relocation, are shown on Figures D.1 and D.2, respectively.

## D.4 PROPOSED CHANGE TO WATER MANAGEMENT STRATEGY

It is proposed to relocate the majority of water storage currently proposed at Site D to Site C throughout operations. The water management strategy for Years 1 and 2 would utilize a barge-mounted pump station in TSF Site C, as described above in Section 3. However, the barge-mounted pump station would remain in TSF Site C throughout the life of mine and reclaim water would be transferred from TSF Site D to TSF Site C, utilizing the Freshet Pump Station. The volume of water maintained with the TSF Site D facility would be only the amount required to maintain potentially acid generating (PAG) materials in a saturated state with an allowance for annual operational fluctuation. The proposed site water management plans for the same years as presented above are shown on Figures D.3 and D.4, respectively.

## D.5 CHANGES TO THE WATER BALANCE

The effects to the water balance due to the changes proposed in Section 4 are shown on Figure D.5. The majority of the supernatant pond volume will be stored in TSF Site C. The TSF Site C pond is located upstream of the TSF Site C Main Dam, and is connected to TSF Site D by a closure spillway for passive management of the maximum Site C operating pond level.

The pump rates from TSF Site D to TSF Site C required to achieve the pond volumes presented on Figure 5 are:

- 1,000 $m^3$/hr (mine years 1 and 2)
- 1,900 $m^3$/hr (mine years 3 through 17) during the winter season (October through March), and
- 2,050 $m^3$/hr (mine years 3 through 17) during the summer season (April through September).

The TSF Site C pond volume will fluctuate approximately between 9 $Mm^3$ and 10 $Mm^3$ of water for the majority of the mine life, with an increase to 13 $Mm^3$ at the end of mine Year 14. TSF Site C can store up to 14 $Mm^3$ of water based on a spillway invert elevation of 1346 m. The TSF Site D pond volume will fluctuate approximately between 3 $Mm^3$ and 5 $Mm^3$ of water for the majority of the mine life.

The amount of surplus increases after Year 11 over time due to increasing runoff from the expanding disturbed areas of the mine facilities, and also from decreases in waste rock production and corresponding decreases of water storage in waste rock voids for the mine rock stored within TSF Site D. This was identified as a desirable condition during the Feasibility Study (KP, 2014a) with this surplus water used to accelerate open pit filling and limit the onset of acid rock drainage conditions in the pit walls. It was also identified as a surplus condition that was manageable with additional fresh water diversions. Two optional diversions of undisturbed areas were identified during the FMEA and are now included in the project design (KP, 2015a and 2015b). These diverted areas are not considered here, but will be combined with the revised water management strategy in subsequent water balance modelling to support permitting.

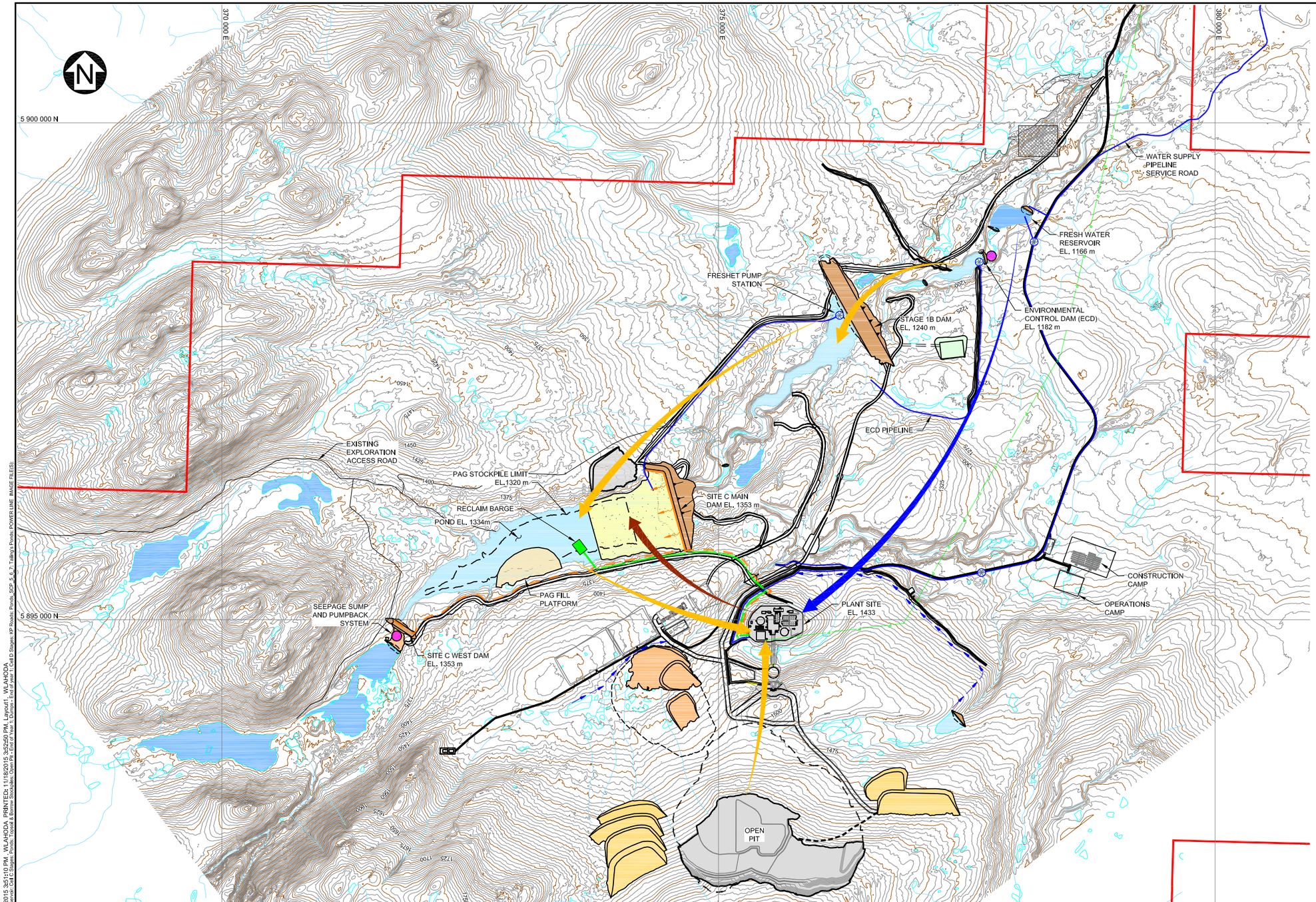
## D.6 REFERENCES

Knight Piésold Ltd. (KP, 2014a). New Gold Inc., Blackwater Gold Project Mine Waste and Water Management Design Report (Ref. No. VA101-457/6-11 Rev. 2) September 12, 2014.

Knight Piésold Ltd. (KP, 2015a). Blackwater Project – Opportunities – Northern Diversion (VA101-457/15-A.01, Continuity No. VA15-03071). September 18, 2015.

Knight Piésold Ltd. (KP, 2015b). Blackwater Project – Opportunities – Southern Diversion (VA101-457/15-A.01, Continuity No. VA15-03072). September 18, 2015.

Incoming Correspondence, Blackwater Project Final FS Cost Estimates, P173304 Sustaining Timberline Report, November, 2014.




**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT
- PAG WASTE ROCK
- NAG WASTE ROCK / OVERBURDEN
- LOW-GRADE ORE
- TOPSOIL
- BORROW AREA (ZONES S, C, AND ROCKFILL)
- RECLAIM SYSTEM
- PUMPSTATION
- SEEPAGE SUMP AND PUMPBACK SYSTEM
- MINE ACCESS ROAD
- PIPELINE SERVICE ROAD
- EXISTING ACCESS TRAILS
- DIVERSION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TAILINGS PIPELINE
- TAILINGS DEPOSIT
- FRESH WATER
- TAILINGS SLURRY
- SITE WATER

**NOTES:**

1. CONTOUR INTERVAL IS 5 METRES.
2. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. SCP STAND FOR SEDIMENT CONTROL POND.

SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 18NOV'15 | ISSUED WITH REPORT | BSH | NSD | DDF |

NEW GOLD INC

BLACKWATER GOLD PROJECT

**CURRENT WATER MANAGEMENT PLAN END OF YEAR 1**

Knight Piésold CONSULTING

P/A NO. VA101-457/15 | REF NO. 2

**FIGURE D.1** | REV 0



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370 000 E

375 000 E

380 000 E

5 900 000 N

5 895 000 N

WATER SUPPLY PIPELINE SERVICE ROAD

SITE D MAIN DAM EL. 1340 m

FRESH WATER RESERVOIR EL. 1166 m

ENVIRONMENTAL CONTROL DAM (ECD) EL. 1182 m

PAG STOCKPILE LIMIT EL.1325 m

EXISTING EXPLORATION ACCESS ROAD

EXPOSED TAILINGS BEACH COVERED WITH OXIDE TAILINGS AND OVERBURDEN

OVERFLOW SPILLWAY

SITE C MAIN DAM EL. 1353 m

PAG STOCKPILE LIMIT EL.1320 m

RECLAIM STRUCTURE

EL. 1339 m

OPERATIONS CAMP

PLANT SITE EL. 1433

SITE C WEST DAM EL. 1353 m

RECLAIMED LOW-GRADE STOCKPILE

EXPLOSIVE FACILITIES

WEST DUMP

EAST DUMP

OPEN PIT

**LEGEND:**

- UPLAND BEACH
- BOG / WETLAND AREA
- EMERGENT VEGETATION WETLAND
- UPLAND SLOPE
- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- PAG WASTE ROCK
- TOPSOIL
- RECLAIM SYSTEM
- PUMPSTATION
- SEEPAGE SUMP AND PUMPBACK SYSTEM
- MINE ACCESS ROAD
- PIPELINE SERVICE ROAD
- DIVERSION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TRANSMISSION LINE
- SPILLWAY
- TAILINGS PIPELINE
- TAILINGS DEPOSITION
- FRESH WATER
- TAILINGS SLURRY
- SITE WATER

**NOTES:**

1. CONTOUR INTERVAL IS 5 METRES.
2. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. SCP STANDS FOR SEDIMENT CONTROL POND.

SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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NEW GOLD INC

BLACKWATER GOLD PROJECT

**CURRENT WATER MANAGEMENT PLAN END OF YEAR 17**

Knight Piésold CONSULTING

P/A NO. VA101-457/15

REF NO. 2

REV 0

**FIGURE D.2**



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370 000 E
375 000 E
380 000 E
5 900 000 N
5 895 000 N

EXISTING EXPLORATION ACCESS ROAD
PAG STOCKPILE LIMIT EL.1320 m
RECLAIM BARGE
POND EL. 1334m
SEEPAGE SUMP AND PUMPBACK SYSTEM
SITE C WEST DAM EL. 1353 m
PAG FILL PLATFORM
SITE C MAIN DAM EL. 1353 m
FRESHET PUMP STATION
STAGE 1B DAM EL. 1240 m
ECD PIPELINE
ENVIRONMENTAL CONTROL DAM (ECD) EL. 1182 m
WATER SUPPLY PIPELINE SERVICE ROAD
FRESH WATER RESERVOIR EL. 1166 m
PLANT SITE EL. 1433
CONSTRUCTION CAMP
OPERATIONS CAMP
OPEN PIT

**LEGEND:**

- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT
- PAG WASTE ROCK
- NAG WASTE ROCK / OVERBURDEN
- LOW-GRADE ORE
- TOPSOIL
- BORROW AREA (ZONES S, C, AND ROCKFILL)
- RECLAIM SYSTEM
- PUMPSTATION
- SEEPAGE SUMP AND PUMPBACK SYSTEM
- MINE ACCESS ROAD
- PIPELINE SERVICE ROAD
- EXISTING ACCESS TRAILS
- DIVERSION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TAILINGS PIPELINE
- TAILINGS DEPOSIT
- FRESH WATER
- TAILINGS SLURRY
- SITE WATER

**NOTES:**

1. CONTOUR INTERVAL IS 5 METRES.
2. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. SCP STAND FOR SEDIMENT CONTROL POND.

SCALE A 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
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NEW GOLD INC

BLACKWATER GOLD PROJECT

**PROPOSED WATER MANAGEMENT PLAN END OF YEAR 1**

Knight Piésold CONSULTING

P/A NO. VA101-457/15

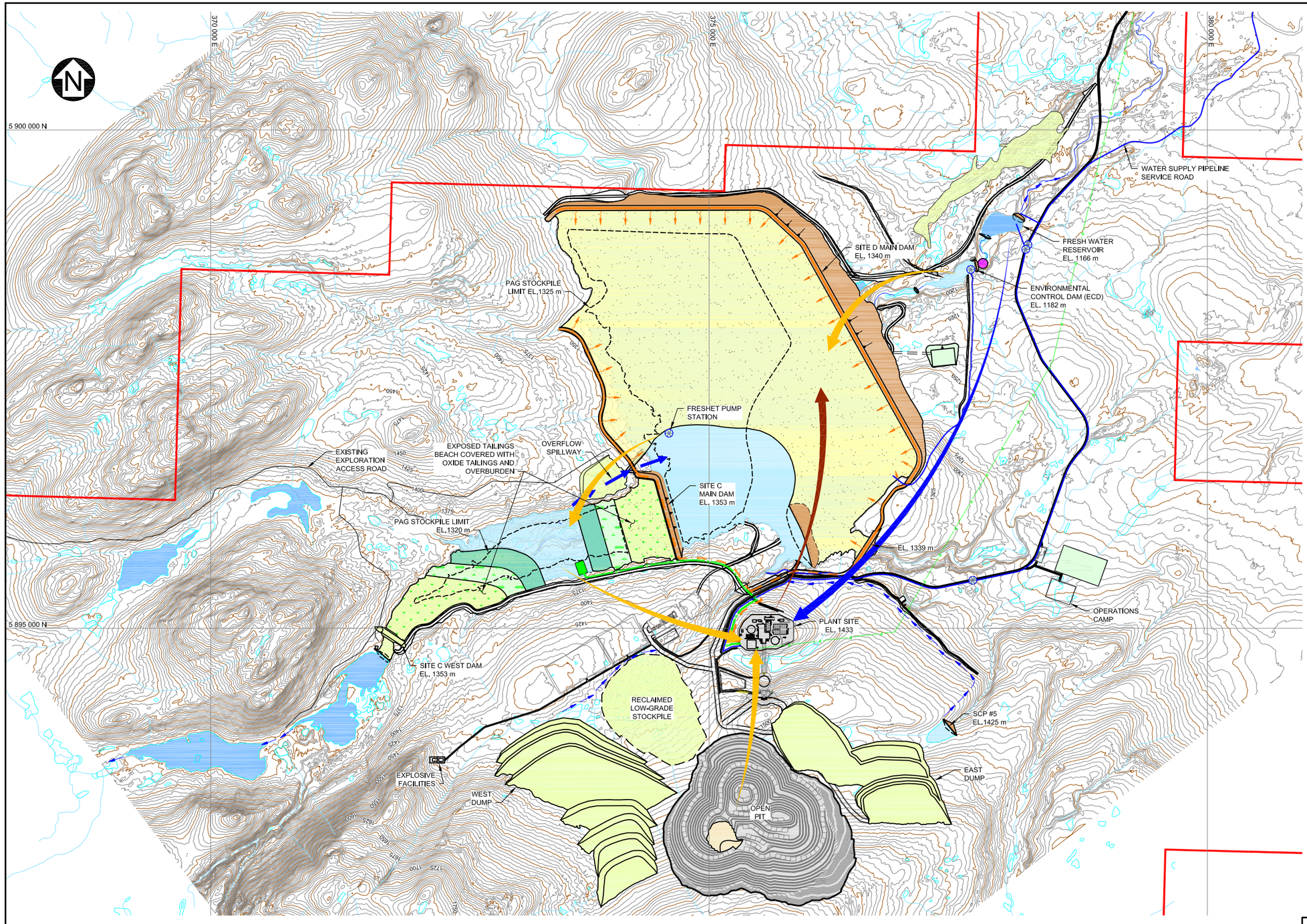
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**FIGURE D.3**

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SETTINGS: Hydro Tools Set Contours Plans Site: Fresh Water Reservoir 1241 C Saigas, Ponds - Tailings & Borrow Stockpiles Open Pit + End of Year 1 Dumps + End of Year 1, Cad D Slopes XP Roads, Ponds, SCP, 5 & 7, Tailings Ponds POWERLINE IMAGE FILES)




**LEGEND:**

- UPLAND BEACH
- BOG / WETLAND AREA
- EMERGENT VEGETATION WETLAND
- UPLAND SLOPE
- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT FILL
- PAG WASTE ROCK
- TOPSOIL
- RECLAIM SYSTEM
- PUMPSTATION
- SEEPAGE SUMP AND PUMPBACK SYSTEM
- MINE ACCESS ROAD
- PIPELINE SERVICE ROAD
- DIVERSION CHANNEL
- WATER RECLAIM PIPELINE
- NEW GOLD PROPERTY BOUNDARY
- TRANSMISSION LINE
- SPILLWAY
- TAILINGS PIPELINE
- TAILINGS DEPOSITION
- FRESH WATER
- TAILINGS SLURRY
- SITE WATER

**NOTES:**

1. CONTOUR INTERVAL IS 5 METRES.
2. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. SCP STANDS FOR SEDIMENT CONTROL POND.

SCALE A: 400 200 0 400 800 1200 1600 2000 m

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NEW GOLD INC

BLACKWATER GOLD PROJECT

**PROPOSED WATER MANAGEMENT PLAN END OF YEAR 17**

Knight Piésold CONSULTING

P/A NO. VA101-457/15

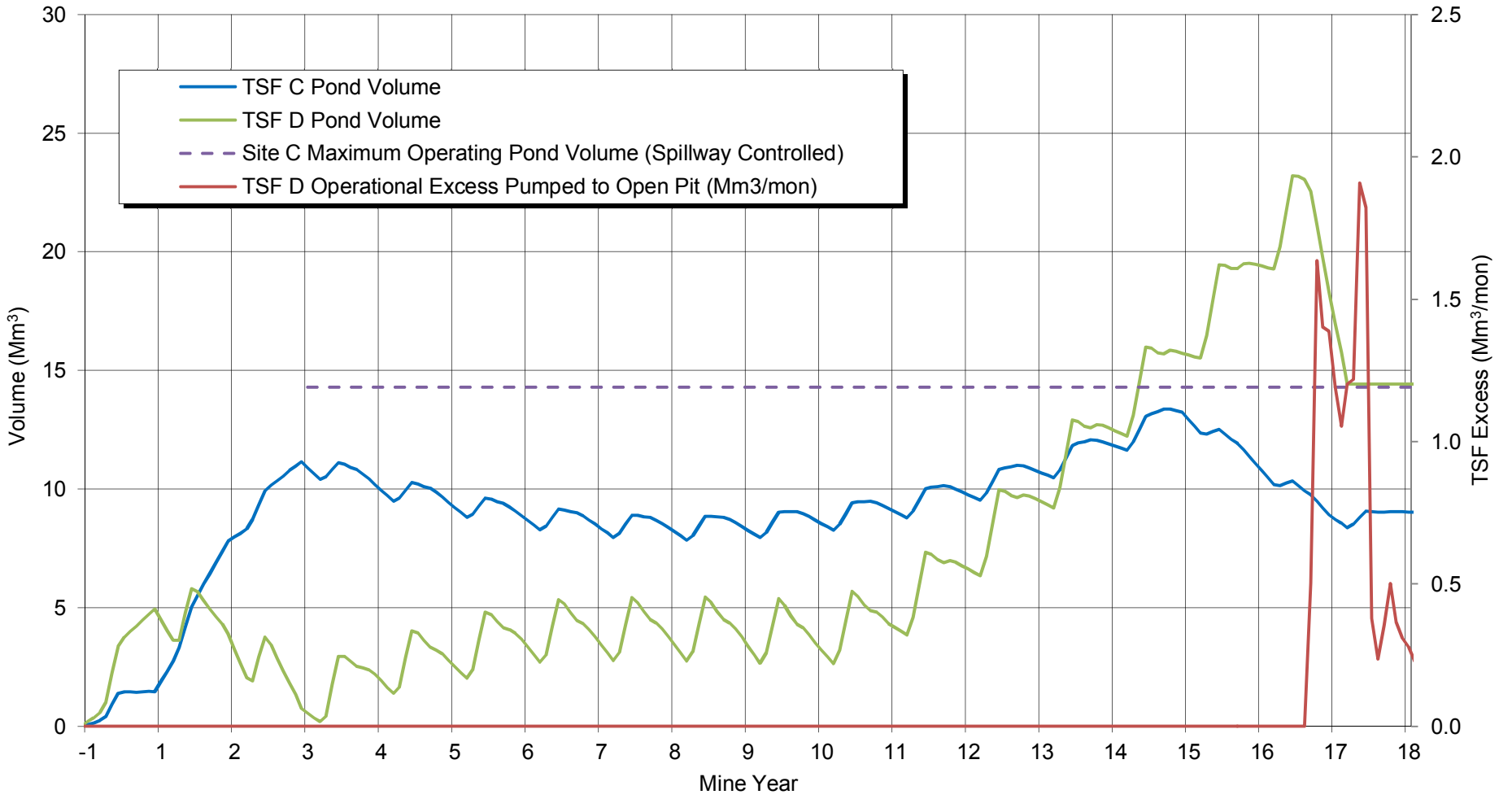
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**FIGURE D.4**

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**NOTES:**
1. SPILLWAY IS CONSTRUCTED IN YEAR 3.

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**PROPOSED WATER MANAGEMENT CHANGES**
**TSF POND VOLUMES AND EXCESS VOLUMES**

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P/A NO. VA101-457/15

REF. NO. 2

**FIGURE D.5**

REV 0

# APPENDIX E

## INTERIM EMERGENCY OVERFLOW CHANNELS

(Pages E-1 to E-6)

Knight Piésold
CONSULTING

**APPENDIX E**

**NEW GOLD INC.**
**BLACKWATER GOLD PROJECT**

**TAILINGS STORAGE FACILITY FAILURE MODES AND EFFECTS ASSESSMENT REPORT OPPORTUNITIES – TSF INTERIM EMERGENCY OVERFLOW CHANNEL**

## E.1 INTRODUCTION

The Failure Modes and Effects Assessment (FMEA) demonstrated the majority of risks to the Blackwater Gold Project (the Project), are mitigated through the key defensive measures in place in the current design and key defensive measures to be applied during permitting. The design summary of the TSF concept was presented in the Mine Waste and Water Management Design Report (KP, 2014). The highest rated risks can be reduced further with additional design elements, operational practices, and contingencies.

The conceptual design for an Interim Emergency Overflow Channel for the TSF Site D Main Dam is developed in the following sections, as a contingency for extreme conditions coupled with the malfunction of management plans for the project. The overflow channel will not be used during normal operation of the facility, and was added to the design to prevent the possibility of overtopping for dam safety purposes.

## E.2 HAZARD CLASSIFICATION

A hazard classification was completed to determine the design storm event for the embankments of the Tailings Storage Facility (TSF) as part of the Mine Waste and Water Management Design Report (KP, 2014). Classification of the tailings dams was carried out by considering the potential incremental consequences of a failure which are in addition to the impacts that would occur from the earthquake or flood event alone. The consequences of failure include the potential for loss of life, economic, social and environmental considerations. The dam safety classification for the project tailings dams was determined to be VERY HIGH.

The following suggested inflow design floods (IDF) were adopted for the Project:

- Construction and operational phases– 2/3 between 1/1000 year and Probable Maximum Flood (PMF) - based on the criteria provided by the Canadian Dam Association (CDA) “Dam Safety Guidelines” (CDA, 2007).
- Closure phase – PMF – in accordance with the technical bulletin released by the Canadian Dam Association in 2014 (CDA, 2014).

## E.3 DESIGN BASIS

The Interim Emergency Overflow Channel for the TSF Site D was designed to pass the peak flow from the PMF flood event without consideration of attenuation provided by tailings facilities ponds or storage that will be maintained below the invert of the channel. It was assumed that the diversion ditches were damaged and not functioning at the time of the flood as this represented the worst case condition. The PMF flood event volume of approximately 11.7 $Mm^3$ was calculated based on the following:

- Probable maximum precipitation (PMP) of 195 mm
- Snowmelt equivalent of 171 mm, calculated based on:
  - The average maximum temperature and wind speed recorded in the months of April and May, and
  - Assuming the catchment area of 4150 ha is at least 50 percent covered by trees.

Table 1 summarizes the design basis for the proposed Interim Emergency Overflow Channel.

**Table 1 Interim Emergency Overflow Channel Design Criteria Summary**

| Item | Design Criteria |
|---|---|
| Tailings Storage Facility Capacity | Water level is at the Interim Emergency Overflow Channel invert at the time of the storm. |
| Design Flood | Probable Maximum Flood (PMF); probable maximum precipitation (PMP) and snowmelt |
| Flood Management - Catchment Areas | Area upstream of TSF Site D, assuming all diversion systems are non-functional during the Design Flood. |
| Design Freeboard | Minimum 1 m above maximum water level for wave run-up. |

## E.4 INTERIM EMERGENCY SPILLWAY DESIGN

The design flow for the Interim Emergency Overflow Channel was calculated by routing the PMF hydrograph through TSF Site D Stage 3 (End of Year 4) and Stage 15 (End of Year 17) arrangements to determine the range of design flows. The routing evaluation, using HydroCAD, determined the peak inflow to be approximately 355 $m^3/s$. Modelling indicated that a 2 meter (m) wide and 4 m deep channel, with 0.5 horizontal to 1 vertical side slopes, would result in a peak outflow of approximately 21 and 6 $m^3/s$ for the Stage 3 and Stage 15, respectively. The peak water elevations, above the Interim Emergency Overflow Channel invert, were estimated to be approximately 2.8 and 1.4 m for the Stage 3 and Stage 15, respectively; maintaining the minimum freeboard of 1.0 m for wave run-up. The stage discharge curve for the Interim Emergency Overflow Channel is shown on Figure E.1.

The Interim Emergency Overflow Channel will be located on the right (south) abutment of each stage of the TSF Site D embankment. The channel will be excavated in bedrock to provide erosion protection. The Interim Emergency Overflow Channel will convey the design flood past the right abutment and downstream of the TSF Site D embankment to a plunge pool for energy dissipation prior to release to Davidson Creek via the South Interception Trench and Environmental Control Dam. The plunge pool design will be completed during detailed design based on precise channel alignments, slopes, and flow characteristics.

Conceptual layouts of the Stage 3 and Stage 15 Interim Emergency Overflow Channel are shown on Figures E.2 and E.3, respectively, and include a plan, a profile, and a typical section for each. Phases between these two stages will advance up the abutment, in a similar arrangement, coincident with embankment construction.

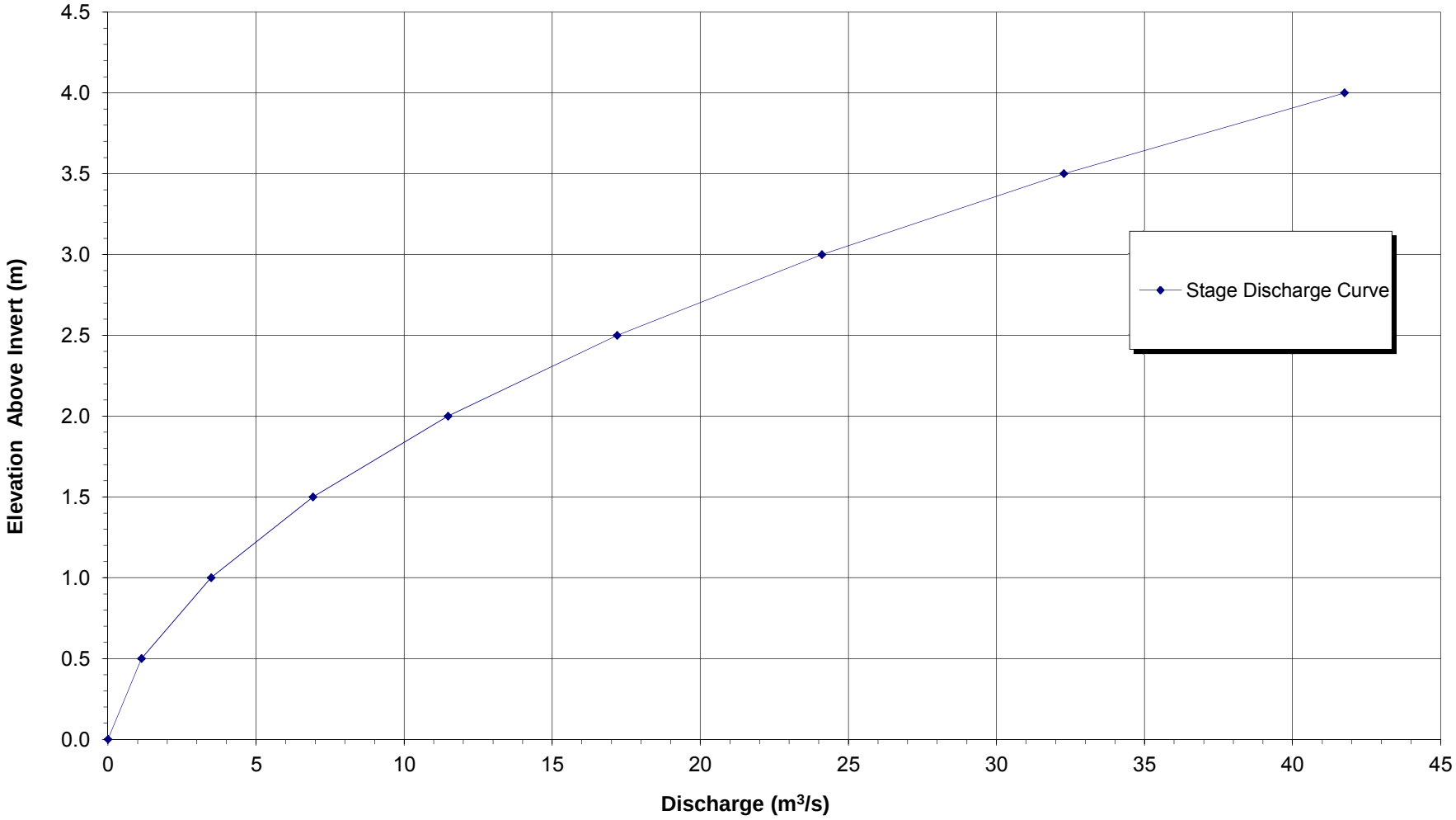
## E.5 REFERENCES

CDA, 2007. Canadian Dam Association “Dam Safety Guidelines”. 2007, Revised 2013.

CDA, 2014. Canadian Dam Association – Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams, 2014.

Knight Piésold Ltd. (KP, 2013). Blackwater Gold Project, 2013 Hydrometeorology Report (Ref. No. VA101-457/6-12 Rev. 0) November 4, 2013.

Knight Piésold Ltd. (KP, 2014). Blackwater Gold Project, Mine Waste and Water Management Design Report (Ref. No. VA101-457/6-11 Rev. 2) September 12, 2014.




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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**TAILINGS STORAGE FACILITY**
**INTERIM EMERGENCY OVERFLOW CHANNEL**
**STAGE DISCHARGE CURVE**

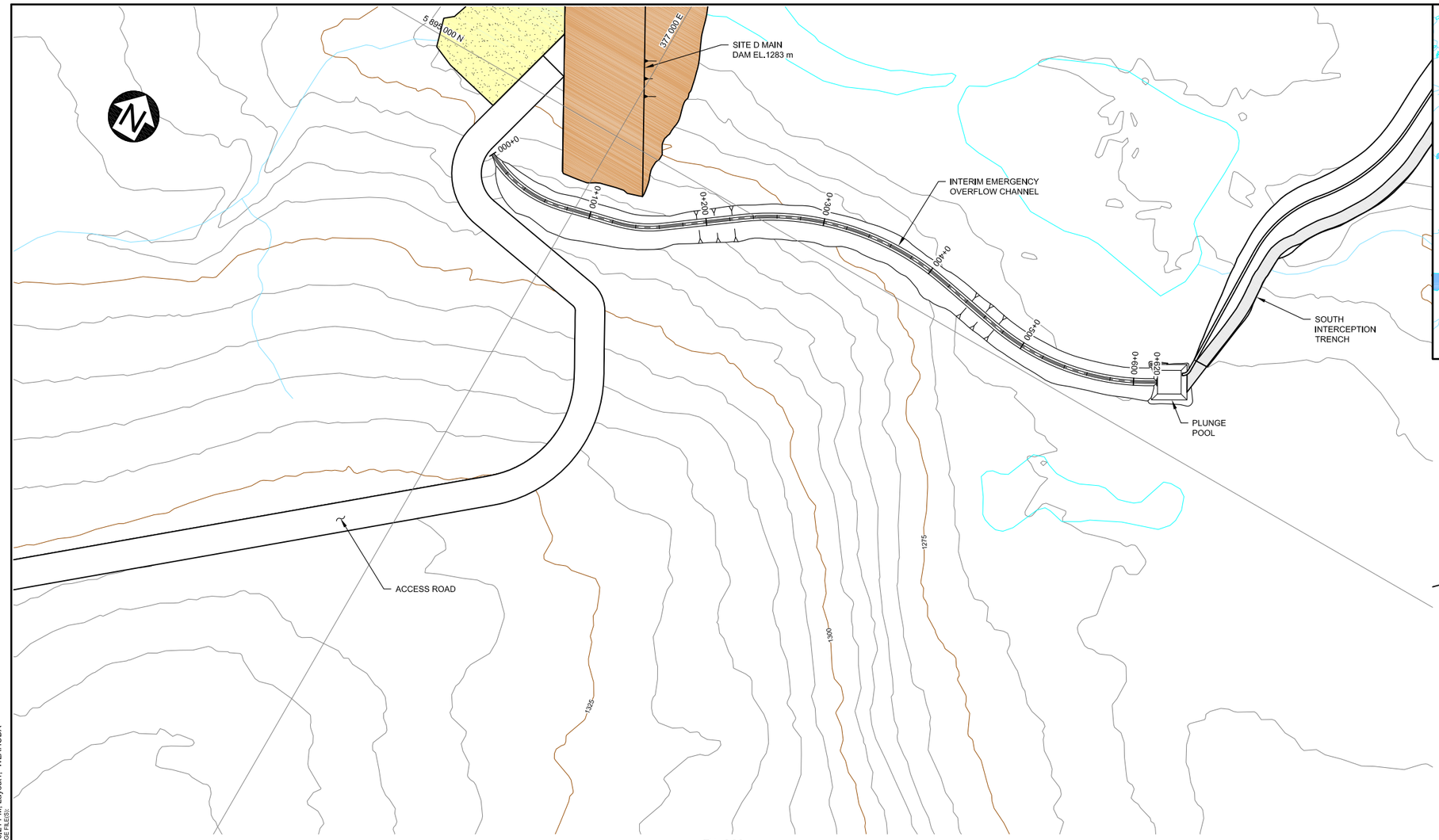
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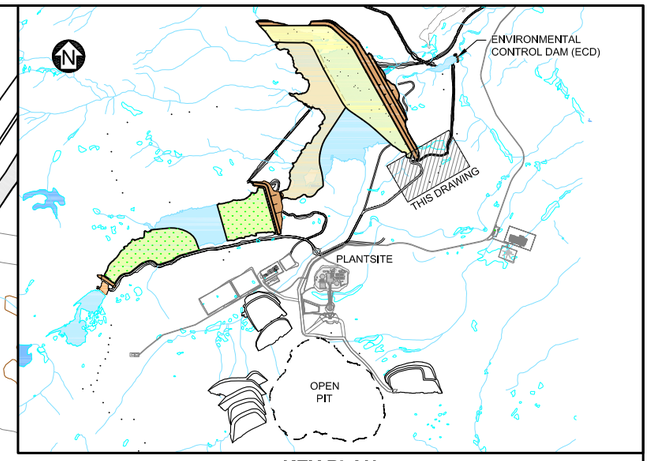
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**FIGURE E.1**

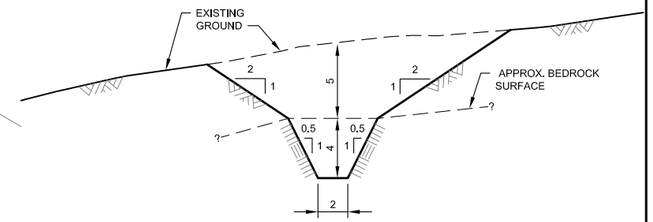
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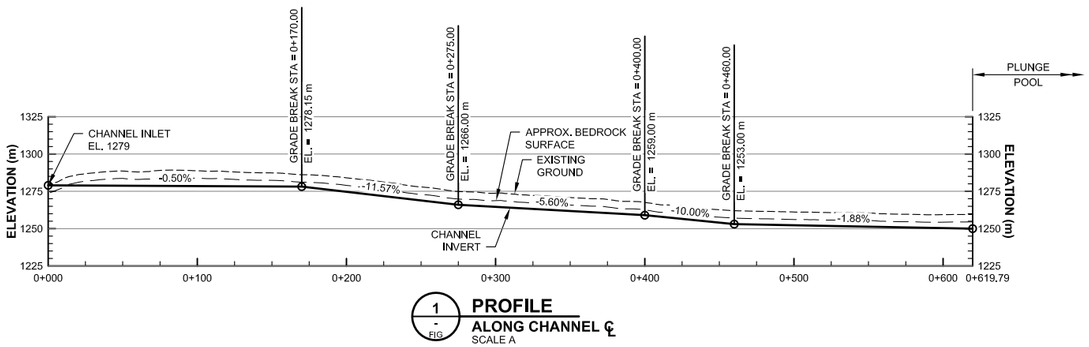

**PLAN**
SCALE A




**KEY PLAN**
NTS




2 - FIG **SECTION**
**TYPICAL SECTION**
SCALE B




1 - FIG **PROFILE**
**ALONG CHANNEL ℄**
SCALE A

**LEGEND:**

- UPLAND BEACH
- TAILINGS BEACH
- MINE WATER
- EMBANKMENT

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE B: 4 2 0 4 8 12 16 20 m
SCALE A: 40 20 0 40 80 120 160 200 m

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NEW GOLD INC.

BLACKWATER GOLD PROJECT

**TAILINGS STORAGE FACILITY**
**STAGE 3 INTERIM EMERGENCY OVERFLOW CHANNEL**

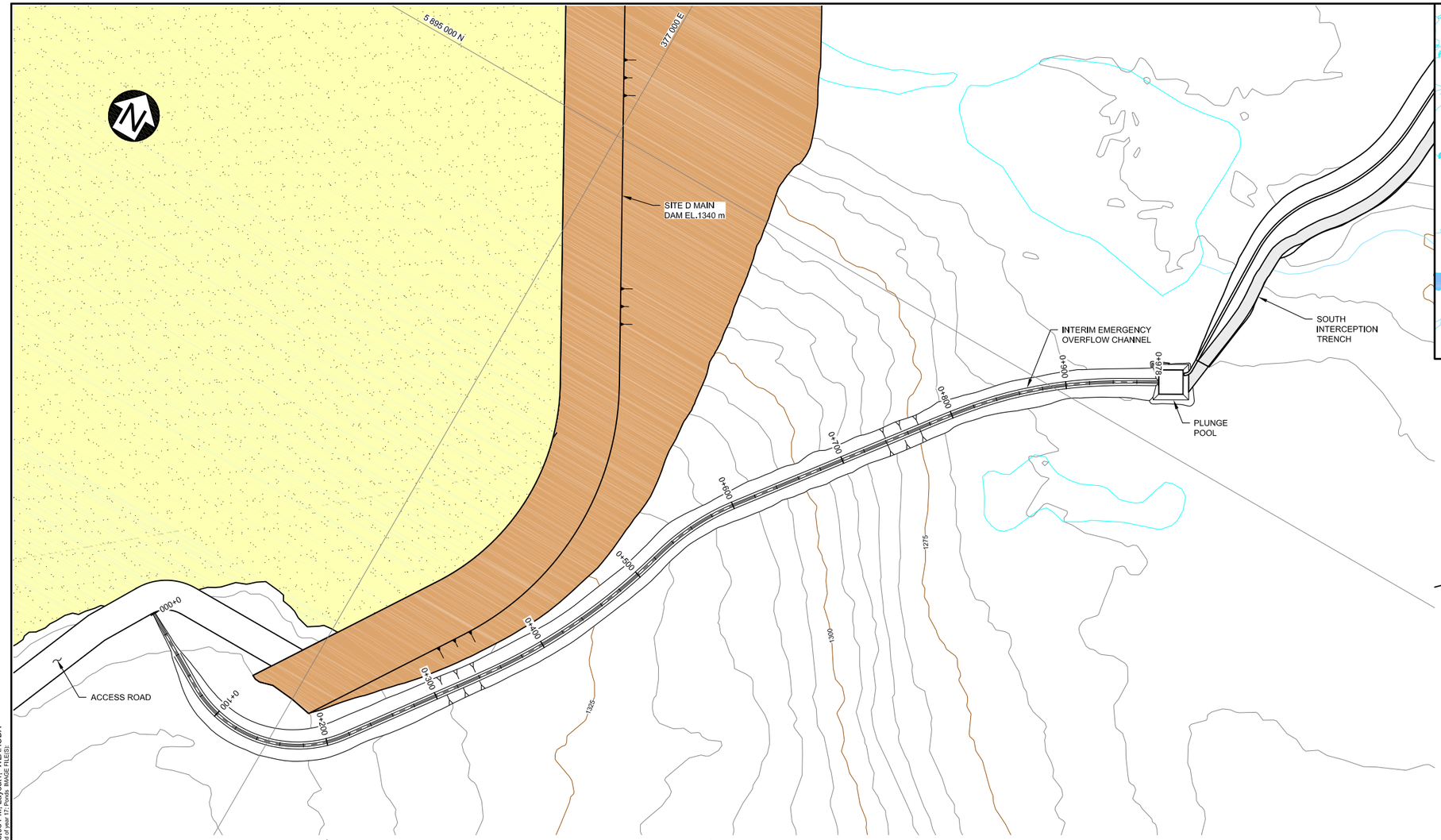
Knight Piésold CONSULTING

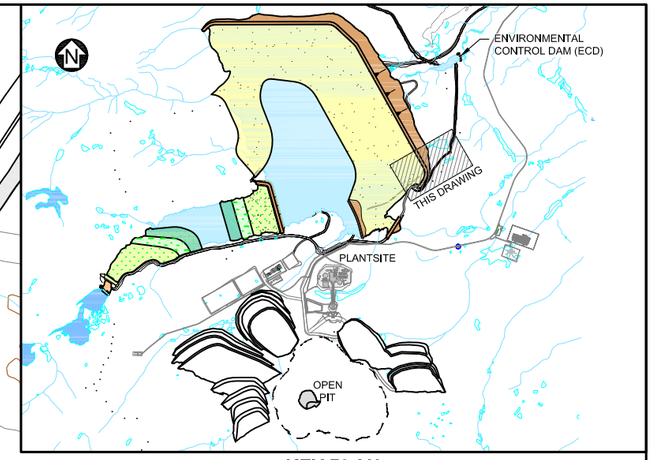
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**FIGURE E.2**

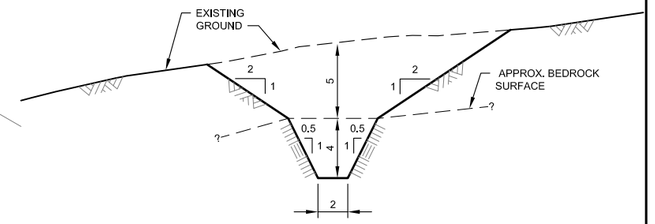


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XREF FILES(): Hydro - Topo Svn Contours; Tailing's Ponds; Cad D Stages; KP Roads; SPILLWAY 1 Dumps - End of year 3; Cad C Stages; Plant Site; Ponds; IMAGE FILES():



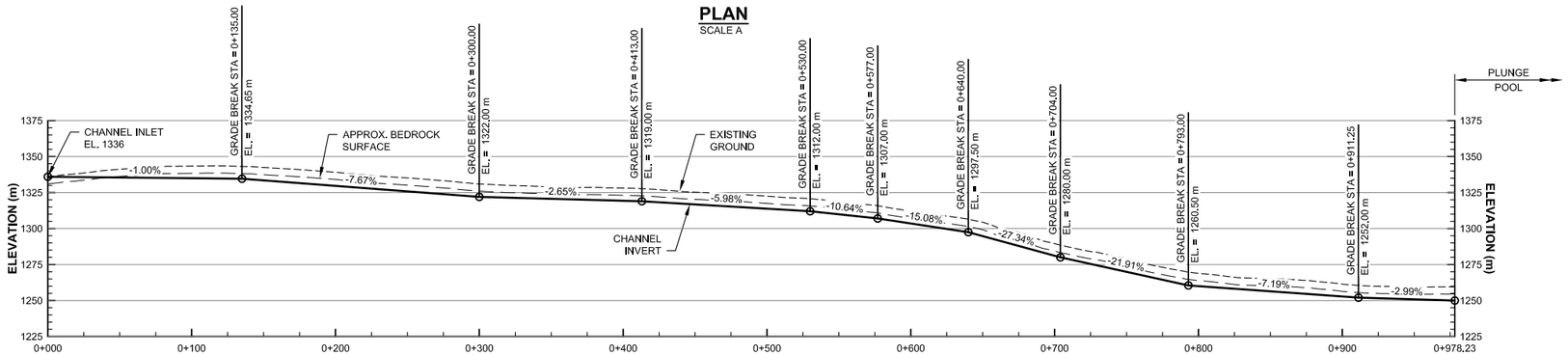




**KEY PLAN**
NTS




2 - FIG **SECTION**
**TYPICAL SECTION**
SCALE B

**PLAN**
SCALE A




1 - FIG **PROFILE**
**ALONG CHANNEL ℄**
SCALE A

**LEGEND:**

- UPLAND BEACH
- TAILINGS BEACH
- MINE WATER
- EMBANKMENT

**NOTES:**

1. COORDINATE GRID IS UTM NAD83 ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE B: 4 2 0 4 8 12 16 20 m
SCALE A: 40 20 0 40 80 120 160 200 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 18NOV'15 | ISSUED WITH REPORT | BSH | ABN | DDF |

NEW GOLD INC.

BLACKWATER GOLD PROJECT

**TAILINGS STORAGE FACILITY**
**STAGE 15 INTERIM EMERGENCY OVERFLOW CHANNEL**

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**FIGURE E.3** | REV 0



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XREF FILES): Hydro, Topo-5m Contours, Tailing's Ponds, Cell E Stages, KP Roads, Dumps - End of year 0, Cell C Stages, Plant Site, SPILLWAY 2, Dumps - End of year 17, Ponds, IMAGE FILE(S)

# APPENDIX F

## EMERGENCY WATER STORAGE IN OPEN PIT

(Pages F-1 to F-3)

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**APPENDIX F**

**NEW GOLD INC.**
**BLACKWATER GOLD PROJECT**

**TAILINGS STORAGE FACILITY FAILURE MODES AND EFFECTS ASSESSMENT REPORT OPPORTUNITIES – EMERGENCY WATER STORAGE IN OPEN PIT**

## F.1 INTRODUCTION

A Failure Modes and Effects Assessment (FMEA) was conducted on the Blackwater Gold Project (KP, 2015). The FMEA was completed to identify and characterize risks from accidents, failures of an engineered system or malfunctions. The FMEA evaluated risks specific to the selected TSF concept presented in the Mine Waste and Water Management Design Report (KP, 2014) and identified areas where additional mitigations and contingencies could be implemented to minimize the identified risks.

The TSF is planned as a zero operational surface water discharge (or closed circuit) facility. However, the ability to relocate water from the tailings facility to the open pit was considered a design improvement as a freeboard allowance violation will increase the risk of the facility and potentially adversely affect the safety of the embankment. It should be noted that the early pit development consists of a side cut that will be free draining and therefore provide no storage capacity until Year 4 of operations.

## F.2 TSF DEWATERING

### 1 – TSF DEWATERING

The transfer of water from the TSF to the Open Pit for storage could be accomplished by one of the following alternatives:

1. **Early Installation of the TSF Closure Dewatering Pipeline** - The closure plan for the Blackwater Project includes pumping the tailings supernatant pond to the Open Pit to expedite pit filling and submergence of the majority of PAG rock in the exposed pit walls. The planned pumping system would utilize the reclaim barge and/or structure and reclaim pipeline(s); with a 2000 m extension of the reclaim pipeline from the Mill to the Open Pit. The arrangement is shown on Figure F.1. This system will have a pumping capacity of 3,200 $m^3$/hr.
2. **Utilizing the Pit Dewatering System** – The current Open Pit dewatering system consists of a series of wells and skid-mounted diesel drive pumps conveying flows through a 16” pipeline, from the Open Pit to the Mill. In an emergency situation, where the water level in the TSF exceeded the maximum capacity, all operations; including processing and pit dewatering would be suspended. It was therefore reasonable to assume the pit dewatering pipeline could be used in combination with the reclaim system to convey water from the TSF to the Open Pit. This alternative would have a capacity of approximately 700 $m^3$/hr.

Table 1 summarizes the estimated rate of drawdown for each of the facilities, for each alterative, based on approximate pond areas of 100 and 500 hectares for TSF Site C and TSF Site D, respectively.

**Table 1 Drawdown Rate**

| Pumping System | Pumping Capacity ($m^3$/hr) | TSF Site C (mm/day) | TSF Site D (mm/day) |
|---|---|---|---|
| Alternative 1 | 3,200 | 77 | 15 |
| Alternative 2 | 700 | 17 | 3 |

**NOTES:**
1. ASSUMED PUMPING OCCURRED INDEPENDENTLY.

## F.3 CONCLUSION AND RECOMMENDATIONS

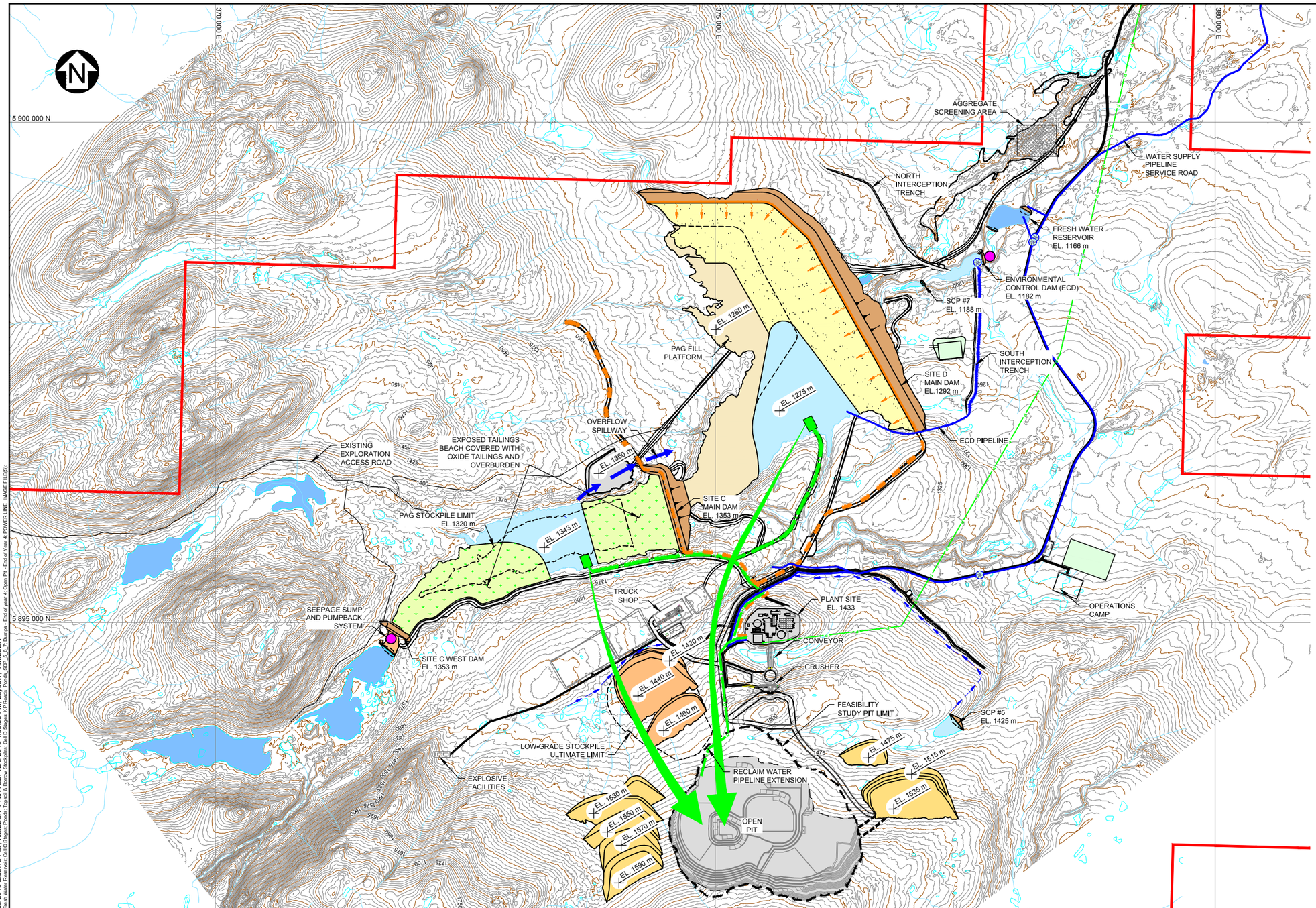
Early installation of the TSF closure dewatering pipeline (Alternative 1) is the recommended alternative because it would provide the maximum capacity to convey water from the TSF to the Open Pit in an emergency situation.

The conveyance of water from the TSF to the Open Pit for storage is not expect to be a viable alternative for emergency water management during the first three years of operations.

## F.5 REFERENCES

Knight Piésold Ltd. (KP, 2014). New Gold Inc., Blackwater Gold Project Mine Waste and Water Management Design Report (Ref. No. VA101-457/6-11 Rev. 2), September 12, 2014.

Knight Piésold Ltd. (KP, 2015). Blackwater Gold Project, Tailings Storage Facility Failure Modes and Effects Assessment (Ref. No. VA101-457/15-2 Rev. 0), December 2015.




**LEGEND:**

- UPLAND BEACH
- TAILINGS BEACH
- MINE WATER
- FRESH WATER
- EMBANKMENT
- PAG WASTE ROCK
- NAG WASTE ROCK / OVERBURDEN
- LOW-GRADE ORE
- TOPSOIL
- BORROW AREA (ZONES S, C, AND ROCKFILL)
- RECLAIM SYSTEM
- PUMPSTATION
- SEEPAGE SUMP AND PUMPBACK SYSTEM
- MINE ACCESS ROAD
- PIPELINE SERVICE ROAD
- EXISTING ACCESS TRAILS
- DIVERSION CHANNEL
- WATER RECLAIM PIPELINE
- TRANSMISSION LINE
- NEW GOLD PROPERTY BOUNDARY
- SPILLWAY
- TAILINGS PIPELINE
- TAILINGS DEPOSIT
- SITE WATER (EMERGENCY TRANSFER)

**NOTES:**

1. CONTOUR INTERVAL IS 5 METRES.
2. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. SCP STANDS FOR SEDIMENT CONTROL POND.

SCALE A: 400 200 0 400 800 1200 1600 2000 m

| REV | DATE | DESCRIPTION | DESIGNED | DRAWN | REVIEWED |
|---|---|---|---|---|---|
| 0 | 09DEC'15 | ISSUED WITH REPORT | DBR | KJM | BSH |

NEW GOLD INC

BLACKWATER GOLD PROJECT

**OPEN PIT EMERGENCY WATER STORAGE YEAR**

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P/A NO. VA101-457/15 | REF NO. 2

**FIGURE F1** | REV 0



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XREF FIELDS: Hydro, Topo1mContours, Plant Site, Tailing's Ponds, Fresh Water Reservoir, Cell C Stages, Ponds, Topsoil & Borrow Stockpiles, Cell D Stages, KT Roads, Ponds, SCP_5_6_7, Dumps, End of year 4, Open Pit - End of Year 4, POWER LINE - IMAGE FILE(S)