13.0 ACCIDENTS AND MALFUNCTIONS

13.1 Identification of Accidents and Malfunctions

This chapter identifies potential accidents and malfunctions that could affect the environment and will be used to aid the preparation of the emergency response and contingency plans for the Côté Gold Project (the Project). Accidents and malfunctions can include structural and operation failures, and/or accidents caused by human error.

IAMGOLD is committed to operate the Project, should it be approved, to the highest standards for operation, security and health and safety.

Potential accidents and malfunctions for the Project were identified from internal risk assessment discussions, as well as direct experience with other similar mining projects and relevant literature. Inputs and comments received from stakeholders and Aboriginal groups were also taken into account. Additional risks may be identified through the review and consultation process associated with this EA. Any further potential risks would then be reviewed and additions may be made as required.

It should be noted that accidents and malfunctions are not addressed in the prediction of effects of the Project on the environment, as they are not expected to occur. Only those accidents and malfunctions deemed of importance, such as those that could have a material and measurable environmental effect or have a reasonable probability of occurring during the life of the Project, have been considered based on a worst case scenario. Spatial boundaries considered include the area covered by the Project footprint (including the transmission line alignment (TLA)) and areas, watercourses and water bodies within the Project footprint and adjacent areas, as well as access and public transport roads.

Medical emergencies, though important, have not been assessed as they are unlikely to have an environmental effect. These and other similar or related emergencies are addressed through IAMGOLD's health and safety policies and the Project-specific health and safety plan which will be developed as Project engineering and permitting is finalized.

Identified accidents and malfunctions are described in the following sections according to the Project's the preliminary site plan (see Figure 1-2). The potential environmental concerns and related risks are identified, and relevant design aspects, operation safeguards, mitigation measures and contingency and emergency response procedures are indicated. Each credible potential accident and malfunction identified was subjected to a risk assessment to determine its likelihood of occurrence and environmental consequence. A summary of the identified accidents and malfunctions and the risk assessment is presented in Table 13-3.

Management measures and procedures are detailed in Chapter 16. A conceptual emergency and spill response plan is presented in Appendix X, indicating conceptual procedures and actions which would be immediately implemented under the potential accidents and malfunctions identified in this chapter. A detailed emergency and spill response plan will be established as part of the environmental management system prior to the start of the construction phase, should the Project proceed.

13.2 On-Site Accidents and Malfunctions

13.2.1 Open Pit Slope Failure

Preliminary aspects of the design of the open pit are described in Chapter 5.

The open pit is developed through excavation and removal of the overburden and mine rock to extract ore-bearing rock. The geology of the Project site can be generally characterized by mafic metavolcanic, metasedimentary and pyroclastic bedrock overlain by a veneer of glacial till at higher elevations and peat and glaciolacustrine deposits at lower elevations. The area is considered to be geologically stable.

Overburden ranges from approximately 0 m (exposed bedrock) to approximately 22 m thick in the open pit area. Overburden slopes along the perimeter of the open pit will be designed for 3H:1V to 4H:1V, depending on overburden depth. Where feasible, rock fill blankets and buttresses may allow for steeper slopes, which will minimize the final open pit footprint. Benches will be suitably wide to ensure stability and account for sloughing.

13.2.1.1 Potential Environmental Concerns

The two primary concerns are the failure of overburden slopes along the open pit perimeter due to pre-shearing or uncontrolled erosion, and the failure of bedrock slopes as a result of improper mine design and/or construction and operational procedures.

Failure of overburden slopes along the open pit perimeter can be caused by pre-shearing activities during its development. Such failures could potentially expand the open pit footprint, as adjacent areas could collapse into the pit.

A worst case scenario is the severe collapse of areas immediately adjacent to the open pit, and ground surface slump of adjacent areas such that surrounding infrastructure could be affected. Depending on where along the open pit perimeter a slump occurred, haul roads and other on-site access roads to and from the open pit could be disrupted. However, as Project components and infrastructure are being designed at a sufficient distance from the open pit perimeter, it is not expected that they would be affected in the event of overburden slope failure

A similar result could be caused by uncontrolled erosion, particularly water-related erosion, from surface runoff and flows or from groundwater seepage into the open pit. Terrestrial habitat would also incur some damage in the event of slope failure, but it is anticipated that this would only affect a minimal area immediately adjacent to the open pit.

Open pits with design flaws and improper operation may pose an environmental hazard to the surrounding environment, if a slope failure were to occur. A major rock slope failure at the north and north-western edge of the open pit would increase the open pit diameter, and this could affect a section of a proposed on-site road. Other than this potential scenario, it is not expected that the surface will be affected by a bedrock slope failure.

13.2.1.2 Design and Operations Safeguards

Design of the open pit overburden and mine rock slopes take into account safe distances from other planned Project components and infrastructure, and a thorough understanding of the geotechnical conditions of the area.

Geotechnical stability inspections will be carried out by qualified professionals during construction activities, and surface monitors may be installed to monitor ground movement. If notable movement is detected, a review will be conducted by qualified engineers to determine if any design changes should be considered to ensure safe operation of the open pit.

In order to maintain stability and prevent water erosion of slopes, drainage and water management design features have been planned with these issues in mind, as indicated in the Project Description (see Chapter 5). Clam Lake and Unnamed Pond, to the west and south of the open pit, will be dammed to prevent flow and flooding of the open pit. Flood prevention berms may be installed along sections of the open pit perimeter to prevent any potential flooding. Groundwater levels and seepage also have to be considered to maintain slope stability within the open pit. Piezometers may be installed along the final proposed pit perimeter in order to assist groundwater and slope monitoring.

Should erosion be detected during regular inspections, additional measures could be employed, including recontouring slopes or reinforcing them with suitable mine rock or progressive revegetation.

13.2.1.3 Contingency and Emergency Response

In the unlikely event of an open pit slope failure, work will cease and workers will be evacuated from the open pit as per emergency response procedures. Once the area is secured, and depending on the scale of the failure, recontouring and other measures will be employed.

Overburden slope failures along the open pit perimeter are not expected to affect the pit activities given that there is little to no overburden in the proposed open pit area. Contingency measures may include the recontouring of the affected area in the event of an overburden slope failure. Additional measures such as reinforcing with suitable mine rock or progressive revegetation may be considered in order to ensure overburden slope stability. Localized repairs of surrounding infrastructure (e.g., haul roads, perimeter ditches) may also be required.

13.2.2 MRA / Low-Grade Ore Stockpile Slope Failure

Overburden and mine rock stockpiles will be stored in the mine rock area (MRA), while the low-grade ore stockpile will be constructed adjacent to the open pit and ore processing plant. Designs take into account safe distances from other planned Project components and infrastructure and a thorough understanding of the geotechnical conditions of the area.

The MRA will store the majority of the mine rock from the open pit not used for construction at the Project site and will cover an area of approximately 400 ha (4 km^2). Overburden stripped from the open pit area will be stored in the northern portion of the MRA, to be later used for closure activities towards the end of the Project life. As some areas in the proposed open pit area have very little to no overburden, a portion of overburden will be excavated and stockpiled together with the excavated mine rock.

Low-grade ore will be stockpiled in the low-grade ore stockpile for future processing, and its design will be similar to that of the mine rock stockpile in the MRA.

13.2.2.1 Potential Environmental Concerns

Failure of a mine rock slope could result in the release of rock and overburden, posing a safety hazard to workers and facilities in the immediate vicinity of the affected stockpile.

If the failure of the slope does not breach water and drainage management installations of the stockpile, such as runoff collection ditches and seepage collection ponds, no environmental concern is anticipated, in which case the stockpile may only need to be recontoured. This is a likely outcome for potential small scale failures as the stored mine rock is typically in smaller sized blocks due to transportation requirements, minimizing the potential for rolling or sliding.

Mine rock slope failure will have a higher, albeit unlikely, probability of occurrence during a pre-shearing event, as part of the stockpile may potentially collapse. No environmental effects are anticipated for this kind of event, and local remediation/recontouring and monitoring of the failure will be applied. In the event of such a failure, the distance that the stockpile may spread should be minimal. The maximum potential distance of a run out failure is estimated to cover a distance of less than the height of the first bench.

The low-grade ore stockpile may suffer similar slope failures. Any potential slope failure is anticipated to affect a minimal area based on the design of the stockpile (expected to extend less than the height of the first stockpile bench), and since the low grade ore is anticipated to be non-potentially acid generating (NPAG) rock, environmental effects are not expected and only recontouring may be required.

Slope failure could also affect perimeter ditching or seepage collection ponds. See Section 13.2.3 for more details.

13.2.2.2 Design and Operations Safeguards

The MRA stockpiles will be developed with suitable safety factors for short-term and long-term stability. Designs will take into account safe distances from nearby infrastructure and water features. Retention dams along nearby water bodies (Three Duck Lakes, Chester Lake) will be constructed to prevent flow and flooding of the MRA. Piezometers will be installed at certain points along the MRA perimeter to monitor groundwater, and regular inspections for stability and erosion damage will be conducted by qualified professionals.

The low-grade ore stockpile is planned only as a temporary stockpile. A similar factor of safety will be used for the temporary stockpiles as for the MRA to protect the Project's facilities.

The following safeguards could minimize the hazard of a stockpile slope failure:

- the overburden stockpile in the MRA will be built with relatively shallow slopes (3H:1V), and the mine rock portion will also be built with shallow, but somewhat steeper, overall slopes (likely 2.6H:1V);
- internal access and haul roads will be designed to provide internal drainage and help dissipate construction induced pore pressure within stockpiles;
- if appropriate during final design, instrumentation may be installed to record pore pressures and deformation of the underlying ground and mineral waste in order to provide an early warning of potential failure;
- external slopes will be constructed with relatively dry clays or clays mixed with rock for stability; and
- runoff will be collected in ditches to protect against infiltration and erosion.

13.2.2.3 Contingency and Emergency Response

If a stockpile failure were to occur, the first response will be to cease all work in the area and ensure worker safety. Once the area is secured, and depending on the scale of the failure, the stockpile slope will be recontoured in place, when it is safe to do so.

Other measures will include excavating any material which may have reached perimeter ditches and seepage collection ponds, returning it to the MRA. Damaged water management infrastructure may need to be repaired. If the slope failure caused seepage in the perimeter ditching/seepage collection ponds to spill, silt fencing or temporary earth/snow dams could be deployed downstream of the spill to prevent sediment-laden waters from entering a watercourse.

13.2.3 Seepage Collection System Failure

Seepage collection systems, as part of the site-wide water management system, will be designed to capture runoff and seepage from various Project components, most notably the MRA and the low-grade ore stockpile. Seepage collection ponds are planned around the MRA and low-grade ore stockpile, designed with enough capacity to receive surface runoff and seepage, and to allow for a minimal residence time and pumping the water to the environment (if it meets applicable criteria) or to the mine water pond.

13.2.3.1 Potential Environmental Concerns

If the slope failure of any of the stockpiles affects their related perimeter ditching or seepage collection ponds, suspended solids, ammonia and other materials, potentially at levels higher than permissible standards, may be released to the environment and nearby water bodies. Parameters such as suspended solids and heavy metals can interfere with aquatic life and affect spawning periods. Sediments can damage fish gills, interfere with feeding or smother eggs preventing oxygen exchange. Ammonia at elevated concentrations may be toxic to aquatic life.

The sensitive receptors adjacent to the MRA include the Three Duck Lakes to the east and Chester Lake to the west. Sensitive receptors adjacent to the low-grade ore stockpile include Three Duck Lakes (Upper) and Bagsverd Pond. These lakes and pond are beyond the proposed perimeter ditch of the MRA or low-grade ore stockpile and should not be affected by any slope failure, unless the perimeter ditches are breached and/or effluent is released.

13.2.3.2 Design and Operations Safeguards

Designs for perimeter ditching and seepage collection ponds around the Project components will take into account safe distances from nearby infrastructure and water features. As mentioned in the previous section, the low-grade ore stockpile is planned only as a temporary stockpile, and a similar factor of safety will be used as for the MRA.

Perimeter ditching will allow for runoff management from Project components and stockpiles by directing runoff and allowing it to settle in corresponding seepage collection ponds prior to pumping to the mine water pond.

13.2.3.3 Contingency and Emergency Response

If any material migrates as far as the perimeter ditches, due to stockpile failure or other component failures, it will likely be excavated and returned to the MRA and, if required, the drainage ditches would be repaired. If the slope failure caused effluent in the perimeter ditching to spill, silt fencing and/or excavation around the seepage area could be deployed downstream of the spill to prevent sediment-laden waters from entering a watercourse. Excavated areas could be filled with well-compacted or low-permeability material to limit the extent of discharge to the environment and to divert flow back to unaffected seepage collection ponds, if possible. Spill reporting and monitoring could be required under this scenario, along with follow-up monitoring and potential clean-up/remedial action of affected soils.

13.2.4 Ore Processing Plant Reagent Release

The primary chemicals to be used and stored at the Project site are typical of those used in other gold mines in Ontario. All chemicals such as liquid, gas and solid reagents required at the Project for processing and other purposes will be adequately stored and handled (see Section 13.2.20 for storage and dispensing areas).

Process reagents that pose a potential risk to the environment will be used within contained areas at the ore processing plant, with sealed floors, containment dykes/berms and sumps or drains which will collect and report spilled material to appropriate receptors for subsequent disposal at approved off-site facilities. Only trained personnel will handle chemicals and reagents, and a program for regular inspections of tanks and operational procedures will be put in place. As a result, there is no reasonable potential for reagents or chemicals to be released to the environment at the ore processing plant during normal operations.

13.2.4.1 Potential Environmental Concerns

Reagents and chemicals may have toxic and corrosive properties, or also pose fire hazards if spilled or unintentionally released due to structural failures or operational accidents.

Some gases or liquids that may be required, such as oxygen and sulphur dioxide (SO_2), will likely be stored in pressurized vessels or tanks, which could suffer structural failures due to corrosion, over pressurization (relief system failure) or external damage (such as through vehicular impact).

The environmental concerns associated with potential malfunctions or accidents from spills or pressurized vessel failure are:

- worker health and bodily harm (if in close proximity to a failing pressurized vessel);
- damage to ore processing plant equipment and infrastructure; and
- air quality concerns.

Potential effects would be limited to the immediate area environment as a result of the fast dissipation of the material as it expands out from the vessel itself and the volume of gas contained. Liquids leaked from pressurized vessels would be treated as spills, and contained by spill containment berms and other safety measures which will form part of the ore processing plant design.

13.2.4.2 Design and Operations Safeguards

Designs and operational practices will be prepared to limit worker exposure to reagents and chemicals.

All chemicals used at the Project site will have Material Safety Data Sheets (MSDS), in order to comply with best practices in the industry for health and safety, and to provide relevant regulatory standards for the safe use of these materials. Pressurized vessels will be designed and constructed to industry standards, and will be operated in accordance with industry best practices. Pressurized vessels will be equipped with safety and relief valves (automated and mechanical), with related piping located outside the ore processing plant.

Regular inspections of holding tanks and operational procedures will be carried out. This program will have continual reviews and updates to remain current. These will also be used in the training programs conducted by the health and safety department personnel.

13.2.4.3 Contingency and Emergency Response

In the unlikely event of unintended reagent release or pressurized vessel failure at the ore processing plant, the first response will be to cease work in the area and ensure worker safety, including notification to workers at locations downstream/downwind of the incident. Once the area is secured, temporary earth/snow dams may be constructed to limit the extent of spill migration should berming and containing measures at the ore processing plant be breached. A spill emergency response plan will be developed prior to operations at the Project. Follow-up monitoring and potential remedial action could be employed if required.

Any gas plume would quickly dissipate once entering the natural environment and no further response / environmental effects would be expected related to the unintended release of gas from pressurized vessels. Unintended HCN gas release is discussed in the following section.

13.2.5 Ore Processing Plant HCN Gas Release

The Project will extract gold form gold-bearing ore by using cyanide leaching. Cyanide leaching is a technically-proven and cost-effective reagent for the recovery of gold. Cyanide will occur as both liquid phase (free cyanide and complexed with heavy metals) and gaseous phase (hydrogen cyanide (HCN) gas).

The ore processing plant will be designed according to best practice engineering standards for safe operation, with appropriate ventilation systems. As ore processing plant design involving cyanide is common industry practice, including detailed cyanide management plans, there is no reasonable potential for HCN gas to be unintentionally released from the ore processing plant.

13.2.5.1 Potential Environmental Concerns

HCN gas can be harmful to humans, wildlife and equipment upon exposure to elevated concentrations, as it is toxic at elevated concentrations and also poses a fire hazard.

13.2.5.2 Design and Operations Safeguards

Designs and operational practices will be prepared to limit worker exposure to cyanide and cyanide compounds in compliance with exposure limits established in Canada, and/or as recommended by the International Cyanide Management Institute.

As per other reagents and chemicals that will be used at the ore processing plant, cyanide, cyanide compounds and related chemicals will each have a MSDS in order to comply with the best practices in the industry for health and safety, and to provide relevant regulatory standards for the safe use of these materials. Regular inspections of holding tanks and operational procedures will be carried out. This program will have continual reviews and updates to remain current. These will also be used in the training programs conducted by the health and safety department personnel.

13.2.5.3 Contingency and Emergency Response

Body and eye wash stations will also be established at the ore processing plant as a first response measure. Personnel and the ore processing plant area will also be equipped with HCN gas sensors with an alarm system, should gas reach unacceptable ambient levels. Work will immediately cease in the area in the event of HCN gas release and workers will evacuate the area as per the established emergency response plan that will be developed for the Project. Notification to workers downwind of the incident and ore processing plant shutdown may be required in order to secure the area.

In the event of fire, the fire will be permitted to burn out unless the leak can be safely and immediately stopped. HCN gas fires are very resilient, and may not necessarily be put out with regular fire-fighting foam or water spraying.

The HCN gas plume will quickly dissipate once entering the natural environment and no further response / environmental effects will be expected. HCN gas degrades quickly and naturally in the environment due to sunlight and oxidation, and will not have any long-term effects on the environment.

13.2.6 Cyanide Destruction Process Failure

As part of Project operations, the resulting tailings from ore processing containing cyanide will be submitted to in-plant SO_2/Air treatment for cyanide destruction, to reduce cyanide and heavy metal concentrations in the final effluent.

This process is a technically-proven and well-established technology that is unlikely to fail during normal operations. Pressurized vessels are necessary to store certain gases and liquids, including sulphur dioxide (SO_2), as indicated in Section 13.2.4.

13.2.6.1 Potential Environmental Concerns

In the event of cyanide destruction process failure, the potential environmental concerns include the release of effluent with high concentrations of cyanide and heavy metals to the TMF, and HCN gas and SO_2 gas release in the ore processing plant.

As the tailings from the cyanide destruction process are released to the TMF, there is no immediate or direct potential for effects to the environment. However, effluent concentrations under this scenario would rise, and this could in turn cause potential effects on the environment should it be coupled with TMF dam failure. The potential release of HCN or SO_2 gas in the ore processing plant could endanger worker safety and cause damage to equipment and infrastructure.

13.2.6.2 Design and Operations Safeguards

The SO_2/Air process is an industry standard process designed based on industry best practices to meet all conditions for responsible management and use of cyanide. Personnel will be appropriately trained and systems will be regularly maintained and inspected as per standard operating procedures. Design and operations safeguards for HCN and SO_2 gas release will follow that indicated in Sections 13.2.4 and 13.2.5. Given the designs and best practices that will be employed at the Project, there is no reasonable potential for the cyanide destruction process to fail or for there to be any consequential environmental effects.

13.2.6.3 Contingency and Emergency Response

Should the SO_2/Air destruction process fail, the ore processing plant will be shutdown and all pumping inputs and outputs from the plant will cease. All work in the area will cease to ensure worker safety and notification will be given to workers downwind of the incident. Workers will be evacuated as per the established emergency response procedures. Any gas plume will quickly dissipate once entering the natural environment and no further response / environmental effects related to the release of gas would be expected.

13.2.7 TMF Dam Failure

The tailings management facility (TMF) is expected to cover 840 ha in its final configuration, storing up to 261 Mt of tailings. As described in Chapter 5, the dam will be designed in stages around the TMF, built with mine rock and overburden extracted from the pit. Overall dam slopes will be 2H:1V, and subject to final design considerations, the height is expected to be 40 m to 45 m above grade, to a maximum elevation of approximately 421 metres above sea level (masl).

13.2.7.1 Potential Environmental Concerns

Under extreme or unlikely circumstances, a breach of the TMF dam, even if only partial, could result in the release of tailings solids and effluent to the surrounding environment. Based on the TMF's location, the water bodies at risk would be Bagsverd Lake, Bagsverd Creek, Unnamed

Lake #1 and #2, and the planned Bagsverd Creek watercourse realignment proposed to the west of the TMF. Mesomikenda Lake is considered to be at a sufficient distance from the TMF to evade any potential effects in the event of a breach of the TMF dam.

A dam breach that includes the release of effluent is unlikely, as ponded water and effluent is maintained in the central-eastern end of the TMF in the reclaim pond. TMF solids may affect the surrounding terrestrial and aquatic habitat in the event of a dam breach and tailings solids runout. Water quality would deteriorate due to the resulting slurry as tailings solids are expected to retain some toxicity due to residual cyanide, heavy metals, and ammonia and cyanate left over from the ore processing and SO_2/Air cyanide destruction process, among other parameters.

A TMF dam breach in winter, under frozen ground conditions, may have a lesser effect as the tailings solids are likely to remain solid. Tailings and affected ice/snow and frozen ground can be removed prior to snowmelt and deposited back in the restored TMF. Any effluent or tailings solids releases that may happen in ditches will likely freeze before reaching water bodies, negating potential aquatic and terrestrial habitat effects.

Another potential effect associated with the TMF dam breach is seepage infiltrating the ground, affecting groundwater quality. TMF seepage is discussed in Section 13.2.8.

13.2.7.2 Design and Operations Safeguards

The TMF dam will meet strict regulatory requirements including the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines (2007) and the Provincial *Lakes and Rivers Improvement Act.* The tailings containment dams will be designed with sufficient storage to contain the Environmental Design Flood (EDF), which is defined as a 24-hr rainfall event with a return period of 100 years. The TMF will have an emergency spillway designed to safely route the 1,000-year Inflow Design Flood (IDF) to Lake Mesomikenda. In addition, the tailings containment dams have been designed for the 1,000 year Earthquake Design Ground Motion and the 1,000 year IDF (Golder, 2014).

Table 13-1 presents some of the potential dam failure mechanisms and associated safeguards.

Table 13-1: Potential Tailings Dam Failure Mechanisms and Safeguards

Tailings Dam Failure Mechanism	Safeguards
Dam overtopping resulting in loss of containment	• Provision of sufficient freeboard to contain the Environmental Design Flood (EDF; • Provision of an emergency spillway to passively prevent excessive pond water levels; • Design of the emergency spillway to safely route the 1,000 year Inflow Design Flood (IDF) in accordance with Canadian Dam Association and Ministry of Natural Resources and Forestry (MNRF) guidelines; and • Tailings deposition from the perimeter containment dams to create a wide tailings beach adjacent to the perimeter dam crests and push the TMF pond against natural topography.
Earthquake event resulting in loss of containment	• Tailings containment dam slopes that can resist the 1,000-year Earthquake Design Ground Motion; • Granular foundation materials with high shear strength that will be assessed for liquefaction potential during detailed design; and • Dam shells constructed of rockfill that are free-draining and not susceptible to post-earthquake liquefaction.
Piping through the dam fill and/or foundation materials potentially resulting in dam instability and loss of containment	• Provision of granular and/or geotextile filters to prevent the migration of tailings through the dam; • Appropriate zoning of construction materials; and • Provision of toe and blanket drains, where appropriate.
Progressive erosion of dam slopes resulting in loss of containment	• Dam slopes constructed of materials (e.g., rockfill, geomembrane, etc.) that are resistant to erosion from precipitation and/or wave action, as appropriate.

(Golder. 2014)

In addition to the above dam design mitigation measures, IAMGOLD has committed to implementing the following measures during tailings dam construction and TMF operation:

- Implementation of Quality Assurance and Quality Control (QA/QC) measures during tailings dam construction to ensure they are constructed in accordance with the design and specifications;
- Preparation and implementation of an Operation, Maintenance and Surveillance (OMS) Manual in accordance with Mining Association of Canada (MAC) guidelines;

- Installation and routine monitoring of geotechnical instrumentation (e.g., piezometers, slope inclinometers, etc.) to provide early warning of potential dam instability;
- Installation and monitoring of survey monuments to identify dam crest settlement and/or slope movement;
- Daily inspections of TMF dams and pond water levels to confirm that the facility is operating within the normal range of conditions; and
- Periodic TMF dam inspections by a geotechnical engineer to verify stability and determine if maintenance is required.

The combination of passive dam safety features incorporated into the tailings containment dam design, dam construction QA/QC and TMF operational safeguards described above will ensure a very low likelihood of tailings dam failure and a corresponding very low risk of tailings containment failure (Golder, 2014).

13.2.7.3 Contingency and Emergency Response

The initial response in the event of a TMF dam failure will be to ensure worker safety and shutdown pumping of tailings to the TMF. The emergency response plan would also be initiated. The emergency response plan could include emergency repairs, if safe to do so. The TMF reclaim pond could be pumped to the mine water or polishing pond, if possible, to reduce the amount of released effluent during the emergency repair. The spill will be contained to the extent possible using temporary earthen or snow dams, silt fences and/or through other available equipment or means.

IAMGOLD will work closely with local residents and authorities to ensure the needs of downstream residents are met should any such event occur.

A remedial action plan will be developed in consultation with appropriate government agencies in the event of dam failure. Spilled tailings will need to be effectively contained to limit potential effects. This likely means that spilled tailings and soil beneath would need to be excavated and hauled back to the repaired TMF. Alternatively, a cover could be engineered over the deposited material. All areas where tailings are removed would be restored and revegetated to the extent practical. A surface water and groundwater monitoring program will be designed to monitor the movement of parameters that may infiltrate from spilled tailings and the success of rehabilitation measures.

13.2.8 TMF Seepage

Seepage collection systems, as part of the site-wide water management system, will be designed to capture runoff and seepage from various Project components, as indicated in Section 13.2.3. Seepage collection ponds are planned around the TMF, designed with enough capacity to receive surface runoff and seepage, allow for a minimal residence time and pumping the water to the environment (if it meets applicable criteria). Seepage at the TMF may contain residues of reagents from the ore processing plant.

13.2.8.1 Potential Environmental Concerns

If the TMF dam fails and affects related perimeter ditching or seepage collection ponds, suspended solids, ammonia, residual cyanide and other materials, potentially at levels higher than permissible standards, could be released to the environment and nearby water bodies. Parameters such as suspended solids and heavy metals can interfere with aquatic life and affect spawning periods. Sediments can damage fish gills, interfere with feeding or smother eggs preventing oxygen exchange. Ammonia is toxic to aquatic life if exposed to elevated concentrations.

Nearby water bodies are considered to be beyond the proposed perimeter ditch of the TMF and should not be affected by any seepage, unless the perimeter ditches are breached and/or effluent is released. Seepage from the TMF is more likely to affect nearby soil and infiltration to the groundwater, if unintentionally released.

13.2.8.2 Design and Operations Safeguards

Designs for perimeter ditching and seepage collection ponds around the TMF will take into account safe distances from nearby infrastructure and water features.

Perimeter ditching will allow for runoff management from the TMF by directing runoff and allowing it to settle in corresponding seepage collection ponds prior to discharge to the environment, only when, and if seepage quality meets applicable criteria.

13.2.8.3 Contingency and Emergency Response

Any material which could migrate as far as the perimeter ditches as a result of a potential TMF dam failure would likely be excavated and returned to the TMF and, if required, the drainage ditches would also be repaired. Similar measures listed for seepage concerns for the MRA or low-grade ore stockpile, if the dam failure caused effluent in the perimeter ditching to spill, silt fencing and/or excavation around the seepage area could be deployed downstream of the spill to prevent sediment-laden waters from entering a watercourse. Excavated areas could be filled with well-compacted or low-permeability material to limit the extent of discharge to the environment and to divert flow back to unaffected seepage collection ponds, if possible. Alternatively, flow could be directed to the TMF reclaim pond. Spill reporting and monitoring could be required under this scenario, along with follow-up monitoring and potential clean-up/remedial action of affected soils.

13.2.9 TMF Overflow

As described in Section 13.2.7, the TMF dam will meet strict regulatory requirements including the requirements of the Provincial *Lakes and Rivers Improvement Act*. The TMF dam will be designed to hold the environmental design flood over the maximum operating water level of the

TMF dam. An emergency spillway will pass any flows in excess of the environmental design flood from the reclaim pond to Mesomikenda Lake. As a result, there is no reasonable potential for the TMF to overflow under any circumstances.

13.2.10 Tailings Pipeline Failure

The treated tailings will be pumped as 50% solids by mass through the approximately 4.5 km long tailings slurry pipeline from the ore processing plant to the TMF for permanent storage. This pipeline will cross one or more creeks feeding the Bagsverd Lake.

Though the tailings will be treated in the ore processing plant for cyanide destruction and heavy metal precipitation, it is expected that the tailings effluent will contain residual cyanide, ammonia and cyanate and dissolved heavy metals in the treated slurry.

The piping system will be designed for immediate automatic shutdown to protect against leaks and significant pipeline breaks. Detection in flow rate variation between the beginning and end of the pipeline will activate an interlock protection system which will stop the pumping system. Additional alarm systems may also be employed, as engineering designs are finalized. In addition, several spill collections ponds will be established in low areas along the tailings pipeline.

A worst case scenario considers the complete breach of the tailings pipeline during operation, between the ore processing plant and the TMF, resulting in the spill of tailings until pumping ceases and the loss of any remaining pipeline content. As pumping will cease within a few seconds of the breach, the coarser solids will settle out within the remaining pipeline while the liquid fraction of the slurry will continue to be released.

13.2.10.1 Potential Environmental Concerns

The environmental effects of any potential spill will depend on where the spill occurs along the length of the pipeline and the severity or magnitude of the spill/pipeline breach, which will determine the volume of slurry spilled.

The contents will spread over the immediate area of any breach, covering vegetation. The majority of the solids in the slurry will be retained within the pipeline and/or in close proximity to the breach location. Liquid will flow down gradient to the nearest water body, generally towards Bagsverd Lake.

During the winter months and frozen ground conditions, the environmental effects of a spill will be reduced as infiltration will be limited and the spilled material (settled solids) will freeze and be readily cleaned up.

13.2.10.2 Design and Operations Safeguards

The main safeguards include the pressure sensors on the automatic shutdown system along the pipeline and the flow transmitters at the ore processing plant and the TMF tailings receiving point.

The tailings pipeline will also be visually inspected at least once or twice per working shift, to detect any cracks or smaller leaks that may not be picked up by the sensors. Leaks can be prevented or minimized through early detection. Incidental observations during operations will immediately notify any observed damage if detected.

13.2.10.3 Contingency and Emergency Response

In the event that a leak or breach is detected in the tailings pipeline, flow to the faulty pipeline will be immediately stopped. The combination of excavating equipment to build temporary earth/snow dams and spill containment materials will be used as needed in order to contain or limit the discharge of tailings and effluent in an uncontrolled manner to the environment. Spilled tailings will be excavated and transported to the TMF.

Depending on the amount of tailings spilled and whether tailings enter Bagsverd Lake or other water bodies in the vicinity, a remedial action plan may be developed.

13.2.11 Effluent Discharge Pipeline Failure

Treated effluent from the TMF will be pumped to the polishing pond, and from the polishing pond north to the discharge location at Bagsverd Creek via an effluent discharge pipeline, similar in design to other water pipelines planned for the Project. It is expected that this pipeline will have a length of approximately 4 km.

13.2.11.1 Potential Environmental Concerns

Effluent discharged to the environment will meet applicable regulations and guidelines. A breach of the effluent discharge pipeline could however result in flooding of the immediate area, leading to possible erosion damage and sediment that could reach the Bagsverd Creek or Neville Lake, which could affect aquatic life.

13.2.11.2 Design and Operations Safeguards

Active pipelines will be inspected during every work shift during the operations phase and through incidental observations, to note any potential leaks or damage to the respective pipeline.

13.2.11.3 Contingency and Emergency Response

Should a leak or damage be detected, pumping of effluent along the pipeline will cease until it is repaired. Should the leak be of a larger volume, erosion and sediment control measures would be employed, including the use of temporary earth/snow dams or silt fencing.

13.2.12 Mine Water Pond Failure

The Project will have a large network of ponds for on-site water management, but the mine water pond is central and key to the overall water management system. The mine water pond will have the capacity to store up to 0.59 Mm^3 of recycled and fresh water.

13.2.12.1 Potential Environmental Concerns

The environmental concerns related to any potential pond dam breach will depend on the quality of the stored water in question, the quantity and the dam height (potential energy of the stored water). The open pit will be protected from flooding by the haul road. Depending on the quantity of water being released and its discharge velocity, the down gradient environment of the pond failure could be damaged by erosion.

The mine water pond may contain slightly acidic water, suspended solids and ammonia. Any breach of the pond will release these parameters to the surrounding environment, with Bagsverd Lake or Clam Lake most likely to be affected, due to the location of the mine water pond. Ammonia and acidic water are toxic to aquatic life. Suspended solids affect aquatic life by interfering with the gills of fish, impeding feeding, and affecting egg incubation by covering them and preventing oxygen exchange.

A worst case scenario will be the complete failure of the mine water pond, spilling partially treated recycled water.

13.2.12.2 Design and Operations Safeguards

The maximum operating water level of the mine water pond will be based on the largest pond in 15-year annual wet conditions, while storage capacity takes into consideration an environmental design flood event above the maximum water level.

Ponds dams will also be visually inspected on a daily basis. They will be inspected by a qualified engineer at pre-determined intervals to comply with regulatory requirements.

13.2.12.3 Contingency and Emergency Response

In the event of a failure of the mine water pond, an emergency repair will occur once it is safe to do so. Workers may be evacuated from the immediate area. Pumping to the mine water pond will immediately cease, and released water may be pumped to the TMF via the reclaim pipeline. Appropriate spill control equipment will be kept at the Project site at all times as per the emergency and spill response plan that will be developed for the Project. Silt fences, temporary earth/snow dams and other erosion and sediment control measures will be deployed to prevent the entry of sediments into a downstream water body. No long term environmental effects are expected.

13.2.13 Water Pipeline Failure

Water pipelines on the Project site can be characterized according to the quality of the water being transferred:

- Mesomikenda Lake to mine water pond and/or ore processing plant for process plant start-up and contingency supply thereafter (fresh water);
- TMF reclaim pond to the ore processing plant to transport treated effluent for reuse in the process plant (treated recycled water);
- mine water pond to the polishing pond (partially treated water);
- mine water pond to the ore processing plant (partially treated water);
- polishing pond to the mine water pond and/or ore processing plant (partially treated water); and
- open pit sumps and the seepage collection ponds (from the MRA and low-grade ore stockpile) to the mine water pond (untreated runoff).

13.2.13.1 Potential Environmental Concerns

A leak or pipeline rupture from any of the water pipes throughout the Project site has the potential to cause erosion down slope from the breach point, the scale of which will depend on the force and the volume of water released. If sediment is consequently released to a nearby water body or watercourse, it could affect aquatic life.

A break or leak from a fresh water or treated water pipeline will not have any other discernable environmental effects.

Discharge of untreated water to the environment could have a more significant effect, particularly on water quality.

13.2.13.2 Design and Operations Safeguards

Like the tailings slurry pipeline, water bearing pipelines will be visually checked once or twice during work shifts. These visual inspections will be supplemented by incidental observations made throughout the day by Project personnel. If flow lessens or is stopped, an inspection will be conducted immediately.

It should be noted that untreated water pipelines will be of the shortest length practicable and any uncontrolled discharge will be captured by site ditches, and hence will be unlikely to have an environmental effect.

13.2.13.3 Contingency and Emergency Response

Upon discovery of a leak or breach, pumps will be shut down and the pipeline repaired. If possible, erosion and sediment control measures such as silt fencing, temporary earth/snow dams or other containment could be employed to prevent overland runoff impeding sediments from directly entering a watercourse.

13.2.14 Watercourse Realignment Failure

Several watercourse realignments are planned around the Project site to accommodate Project components and ensure safe operations while maintaining water flow regimes in the area.

Realignments will be constructed by developing connecting channels between the relevant water bodies or courses. These include the realignment from Chester Lake to Clam Lake, from Little Clam Lake to Bagsverd Lake, Bagsverd Creek to Weeduck Lake, Weeduck Lake to Three Ducks Lake (Upper) and the realignment of Bagsverd Creek from Bagsverd Lake to Unnamed Lake #2. A Natural Channel Design approach will be used to plan the channel such that the new watercourses will convey a range of flows in a manner consistent with the needs to support productive aquatic habitats while prevent erosions and flooding of critical areas.

13.2.14.1 Potential Environmental Concerns

It is typical of all watercourses to erode overtime and the channel to migrate laterally and downstream. It is highly unlikely for realignment channels to completely fail. The worst case scenario for realignment failure includes the complete loss of channel form due to excessive erosion forces that can occur during a spring freshet and/or a major storm event. Erosion of channel banks can damage fish habitat and large scale movements of sediment which may be mobilized can interfere with aquatic life through direct deposition or changes in habitat suitability. Sediment may also be deposited within the valley corridor or remain entrenched within the watercourse.

13.2.14.2 Design and Operations Safeguards

All realignments will be sized to convey a range of flow conditions based on hydrological investigations. Watercourse realignment design will account for the predicted hydrological conditions and will incorporate design criteria to support the fish and fish habitat.

13.2.14.3 Contingency and Emergency Response

Monitoring of the channel realignments on a proactive schedule along with internal review and adaptive management mechanisms will support the long-term stabilization of the watercourses. In the event of a realignment failure, an emergency response plan will be employed and any necessary emergency repairs will occur once it is secure. If the breach occurs during a major storm event, it may not be possible to immediately repair the realignment. IAMGOLD will work closely with local authorities to ensure the needs of downstream residents are met should any such event occur.

Erosion and sediment control measures will be incorporated into the construction plans to ensure stability during the first few years of operation. Erosion and sediment measures could include silt fences, temporary earth/snow dams and other appropriate control measures.

13.2.15 Retention Dam Failure

Several retention dams are planned at the Project site to contain waters in order to accommodate proposed Project components.

13.2.15.1 Potential Environmental Concerns

Considering dam design standards that will be implemented, the likelihood of a complete retention dam failure is unlikely. Erosional damage to retention dams or a dam breach could lead to uncontrolled flooding of several Project components and surrounding areas, including the open pit, MRA, low-grade ore stockpile and associated infrastructure.

If retention dams along Clam Lake fail, and water levels are at a maximum, the open pit could flood.

13.2.15.2 Design and Operations Safeguards

Design planning for these dams are ongoing, but will follow best engineering practices and designs. Dams will be setback at a safe distance from Project components and designed based on: expected water level increases which will result from planned watercourse realignments, 15-year annual wet conditions, and capacity for an environmental design flood event above the maximum water level. Dams will be visually inspected regularly by a qualified engineer at pre-determined intervals to comply with applicable regulatory requirements.

Additionally, the proposed transport road along the perimeter of the open pit will also act as a protective berm should a leak from any of the retention dams surrounding the open pit occur.

13.2.15.3 Contingency and Emergency Response

In the event of a retention dam breach, work in the area will immediately cease and the emergency response plan will be deployed. Alarm systems may be installed along the open pit perimeter to warn of waters that may flow into the open pit, and workers may be evacuated as per the emergency response plan. Small leaks can be temporarily contained with earth/snow dams while repairs are performed.

Should waters reach components such as the MRA or low-grade ore stockpile, sediment and erosion control measure will be implemented. Water will then be pumped towards the TMF for treatment, as waters coming in contact with Project components could disperse suspended solids, reagents and ammonia residuals that could affect water quality if they were to reach unaffected water bodies downstream of the incident.

13.2.16 Emulsion Plant and Explosives Accidents

Explosives needed for Project development will be prepared in a dedicated explosives (emulsion) plant located to the east of the main Project components and the ore processing plant as per applicable regulations. Explosives will be stored on site near the emulsion plant at a safe distance. If local commercial operations can reliably transport explosives to the site, this alternative may replace on-site storage. Explosives used at the Project are expected to be ammonium nitrate/fuel oil (ANFO) and emulsion-blend explosives types.

13.2.16.1 Potential Environmental Concerns

The worst possible scenario will result from operator error of improperly handling explosives causing bodily harm. The explosive components cannot be accidentally detonated as they are not individually explosive and will be separately stored. Explosion will only result if the explosives are mixed in the appropriate proportions in a corresponding setting and detonated with an external device. Pre-packaged explosives only detonate with an external detonation device.

Concerns associated with explosives during storage include the health of workers, damage to the Project facilitates and infrastructure, and excessive disturbance to nearby receptors (landowners, wildlife) due to noise.

13.2.16.2 Design and Operations Safeguards

The location of the explosive storage and plant will be selected according to the Quantity Distance Principles User's Manual, published by the Explosives Regulatory Division of Natural Resources Canada (NRCan, 1995), with respect to the nearest inhabited building, transmission lines, roads and blast sites, to ensure safety.

Transportation of explosives is controlled by the Explosives Regulatory Division of NRCan and the Transportation of Dangerous Goods Directorate (Transport Canada). All companies that transport explosive materials for the Project will be required to comply with the requirements established by these agencies. Likewise, the handling and storage of explosives is regulated by the Federal *Explosives Act* and related regulations, enforced by NRCan.

IAMGOLD will develop a blasting plan describing the proposed blasting operations at the Project site, including personnel responsibilities, type of equipment and materials used, signage, dust control, spillage control and clean-up and safety requirements (pre- and post-blast). All personnel who handle explosives will have appropriate training; all other individuals will be restricted from access. Procedures for misfires and/or destruction of unusable explosives will be based on the applicable regulations and performed by trained and experienced personnel.

13.2.16.3 Contingency and Emergency Response

Damage to facilities and infrastructure may be possible in the event of an unintended explosion, but will generally only occur in association with the explosives storage, or where used at the open pit and other blasting locations at the Project site (such as construction of watercourse realignments, aggregate pit blasting). There is the potential that some additional minor blasting may be required during Project construction for excavations in bedrock areas. Any damage envisioned is recoverable, except for issues associated with worker health and welfare.

Explosives will not be stored or used in close proximity to the ore processing plant or any other structure, and as a result, excessive damage and injuries to workers not involved in explosives preparation and use are not expected.

13.2.17 Landfill Leachate or Methane Gas Release

A landfill in close proximity to the Project site, the MNRF Neville Township Landfill, will be used during operations for disposal of non-hazardous waste. IAMGOLD will operate the landfill during Project operations.

13.2.17.1 Potential Environmental Concerns

Leachate produced in the landfill as a result of runoff infiltration into wastes and decomposition, and the production of methane gas, can cause environmental effects if unintentionally released to the environment.

Leachate can infiltrate into the groundwater or can migrate to reach nearby surface water bodies, potentially affecting water quality with dissolved and suspended solids, dissolved organic matter and other parameters.

Methane gas can build up within landfills if improperly vented, and this can pose an explosive/fire hazard to the immediate area.

13.2.17.2 Design and Operations Safeguards

The landfill is an existing landfill that may be expanded by the MNRF to meet the waste disposal needs of the Project. The landfill expansion will be in accordance with best practice engineering design and applicable regulations and guidelines.

The landfill may be lined either with low-permeability material and/or a geomembrane to prevent the infiltration of leachate into the ground, along with appropriate leachate management systems.

Landfills, depending on their size, are also designed with appropriate venting systems to gradually release methane to the atmosphere. As the MNRF Neville Township landfill, even if expanded, will have a volume of less than 1.5 Mm^3; under Ontario Regulation (O. Reg.) 347 and O. Reg. 232/98 it will not be required to include a landfill gas management strategy as gas volumes generated are expected to be low. As such, there is no reasonable likelihood of an explosive incident.

Regular inspections and monitoring will allow for early detection of any leachate leaks or methane gas build-up.

13.2.17.3 Contingency and Emergency Response

In the unlikely event of leachate escaping to the environment, the emergency and spill response plan will be deployed. The area around the leachate release could be excavated and filled with well-compacted or low-permeability material to divert flow of the leachate back into the landfill. Follow-up monitoring and potential remedial action of affected soils may be required.

13.2.18 Vehicular Accident

In addition to fuel, various chemicals and materials, including non-hazardous and hazardous substances, will be transported by road to and from the Project site. Access to the Canada-wide transport network is available via Highway 144 to the east of Mesomikenda Lake.

All materials of consequence will be shipped in sealed containers with secondary containment as appropriate, but as a minimum, in compliance with regulatory requirements, including the Transportation of Dangerous Goods Act and associated regulations.

Fuel will be transported to the Project site along the regional road network by tanker trucks. The tanker trucks will consist of single units that typically have a capacity of 30,000 L. Tanker trucks are generally compartmentalized, such that if there were to be an accident, only a portion of the load will be lost except in a catastrophic incident. The principal type of fuel used at the site will be diesel for generator power supplementation during the construction phase and heavy equipment fleet operation during construction, operation and closure. Fuel is transported safely throughout the local region and across Canada on a routine basis, by licensed and trained drivers, and the risk of incident involving a serious collision where fuel is released into the environment is small.

Smaller quantities of gasoline will be trucked to the Project site by tanker truck or container on truck, also using licensed and trained drivers.

The quantities and packaging details for the reagents are described in Chapter 5. During the construction phase, cement and paints will also be brought to the site.

13.2.18.1 Potential Environmental Concerns

Reasonable safeguards have been taken into account for the design of the Project, but a small potential for spills along all transport routes from tanker trucks still exists due to possible accidents related to poor weather conditions, collisions and other factors. A spill from a tanker truck could potentially contaminate the soil it covers, or snow, or enter a nearby water body if such an incident occurred near one or at a watercourse crossing. The consequences of any spill will depend on the type and quantity of the material spilled, as well as the location and time of the spill. Materials that do not enter any water body are likely to have low or no environmental effects beyond the immediate footprint of the spill. The spilt material and contaminated soil and/or snow can be collected and hauled away for appropriate disposal.

A worst case scenario would be the spilling of the entire contents of a material being transported to the site through a collision, where it all spills into a water body. The effect of such a scenario will depend on the material spilled.

Diesel fuel and gasoline are toxic to aquatic life and a spill in a water body or course that supports aquatic life would have the greatest affect on the environment. A spill on land over frozen ground presents the lowest environmental effect as it could be readily contained and cleaned up.

A vehicular accident on site could happen at any time of the year. On-site accidents are most likely to involve personnel vehicles or haul trucks transporting coarse materials (ore, mine rock or overburden). Off-site accidents could include construction materials and other non-hazardous materials needed for the Project. Accidents strictly involving personnel and the public will have a detrimental effect on the families, communities and on the Project itself.

Any spill of non-hazardous material will not be expected to cause a significant environmental effect, with the exception of the immediate footprint of the accident. Heavy materials such a mine rock could crush vegetation and compact soil. Any effects will be temporary in nature and readily remediated as needed.

13.2.18.2 Design and Operations Safeguards

All shipments will be in compliance with regulatory requirements, including the *Transportation of Dangerous Goods Act* and associated regulations. The need for compliance with the *Transportation of Dangerous Goods Act* and associated regulations will be reinforced in all applicable contracts and vendor agreements.

The potential for environmental effects associated with accidents and malfunctions on the trucking route will be minimized by the following operational procedures which will be incorporated into the environmental management system, as possible, and into trucking/supply contracts, as reasonable:

- regular maintenance of fuel trucks;
- speed limits are to be strictly adhered to, including on site;
- strict adherence to national trucking hour limits and other applicable requirements;
- drivers will be required to meet all applicable regulatory training requirements, be trained in spill response procedures for the materials they transport, and carry the appropriate MSDS;

- all vehicles transporting materials to site will be required to maintain a supply of basic emergency response equipment, including communication equipment, first aid materials and a fire extinguisher; and
- penalties for infractions.

The emergency response plan that will form part of the environmental management system will address the primary hazardous materials on site, including procedures for spill response on the trucking route to the Project site. Materials to be maintained in vehicles will be identified in the emergency response plan, but are likely to include absorbent materials and equipment to contain spilled material.

At the Project site, the following additional controls will be put in place to reduce the potential for, or the severity of accidents involving hazardous materials:

- drivers will be required to meet all applicable regulatory training requirements;
- speed limits are to be strictly adhered to, to be posted and enforced by IAMGOLD security personnel;
- right-of-way procedures will be defined and haul trucks and loaded vehicles will be given preference;
- traffic will be required to yield to wildlife as observed;
- where possible, heavy traffic will be limited to site haul roads and other traffic limited to site access roads;
- oversized loads will only travel during daylight, to the extent practicable, to reduce the potential for collision;
- transportation of material during times of limited visibility will be avoided where possible;
- all vehicles transporting materials to site will be required to maintain a supply of basic emergency response equipment, including communication equipment, first aid materials and a fire extinguisher;
- waste management and littering;
- regular maintenance of fuel trucks; and
- penalties for infractions.

The potential for environmental effects associated with accidents and malfunctions on the trucking route will be minimized by the following operational procedures that will be incorporated into truck contracts as possible and the environmental management system:

- all materials of consequence will be shipped in sealed containers so that, in the event of an accident, an uncontrolled spill will not occur unless the containers break open. Types of shipment containers will include tanker trucks, containers, shipment cubes (1,000 L), sealed bulk bags, 205 L sealed drums and smaller containers on pallets; and

- procedures for primary hazardous materials on site, regarding spill response along the transport route, will be addressed in the Project's emergency and spill response plan. This will include details of emergency response materials to be kept in the vehicles, and will likely include absorbent materials.

13.2.18.3 Contingency and Emergency Response

Emergency and spill response procedures will be established as part of the environmental management system and include the following: medical response, notification, containment of spill, removal of spill, treatment of affected environment, monitoring of environment and learning from the accident.

The primary goal in any collision resulting in a fuel spill, will be to ensure public and worker health and safety. Potential ignition sources will be removed in the event of a spill of flammable or combustible materials, if possible, and the spill will be stopped or slowed using available equipment. Appropriate corporate and external personnel will be notified, and an assessment will be conducted to determine the best means to prevent immediate environmental effects. Spill countermeasures may include the use of absorbent materials, establishment of a collection trench and setting containment booms on water. When fuel is contained by booms, berms, or other means, it may be pumped, skimmed or mopped with absorbent matting, and disposed of in an approved facility designed to manage such wastes. If a spill were to directly enter a fast moving watercourse, it may not be possible to completely contain and remediate the spill.

The affected environment will be rehabilitated if and as needed. Clean-up and remediation will ensure long term environmental effects are reduced to the extent practical. After any major spill or accident, a review will be conducted to ensure that the required design changes and procedures and appropriate monitoring measures are in place to ensure that the incident will not be repeated.

13.2.19 Cyanide Spill during Transportation

Cyanide for ore processing purposes at the Project will be delivered by truck. It is expected that cyanide will be delivered to the Project site as sodium cyanide pellets or solid briquettes. Should solid cyanide not be available, cyanide in liquid form may be transported to site. Should this be the case, a risk assessment would be completed and the emergency and spill response plans would be updated and revised, as appropriate. Transportation of cyanide will be in compliance with all applicable regulatory requirements for transportation of dangerous goods. IAMGOLD may also consider cyanide transportation recommendations by the International Cyanide Management Institute.

Due to the safety and operational measures that will be put in place, there is no reasonable likelihood that a cyanide spill should occur during transportation to the Project.

13.2.19.1 Potential Environmental Concerns

The primary risk during transportation is the release of cyanide due to a vehicular accident, especially while crossing rivers/bridges or when in close proximity to water bodies. Cyanide can be harmful to humans, wildlife and aquatic life as it is acutely toxic and it can also cause damage to equipment as it is flammable and can cause corrosion.

13.2.19.2 Design and Operations Safeguards

Administrative and operational controls will follow similar procedures as those listed for the transport of other fuels, chemicals and reagents as indicated in Section 3.2.18, and will also include:

- complying with all applicable regulatory requirements for the transportation of dangerous goods;
- ensuring vehicles and drivers are licensed and trained in the transportation of dangerous goods and tested for competency;
- selecting appropriate transportation containers, including transport trucks that are equipped with internal valves which are hydraulically operated, in the case of liquid cyanide;
- posting MSDS in transportation vehicles;
- adopting safe handling practices and procedures;
- selecting routes to reduce risks to nearby communities as practicable;
- regularly auditing third-party transportation operations and reporting all incidents, including near misses;
- regularly maintaining trucks following Transport Canada's rules and regulations
- preparing emergency and spill response plans and carrying out regular spill drills;
- ensuring emergency medical and first response equipment is available during transportation; and
- allow for constant communication with drivers and/or GPS tracking during transportation of cyanide.

13.2.19.3 Contingency and Emergency Response

In the unlikely event of a vehicular accident resulting in a cyanide spill, the emergency and spill response plan will be immediately deployed, and all relevant corporate and external personnel will be contacted. Public and worker safety will be ensured.

Contingency and emergency response plans for transportation-related emergencies will consider the condition of the transportation route. They will also describe specific remediation measures including procedures for the recovery or treatment of solutions or solids, decontamination of soils or other contaminated media and management and/or disposal of spill clean-up debris. Where a cyanide release could contaminate sources of drinking water, the plan will include appropriate emergency response measures to protect drinking water users.

Solid cyanide spilled on land will be cleaned up and safely stored and disposed of, along with any potentially contaminated soil. Should cyanide come in contact with surface waters, several available treatment methods could be employed. The use of these treatments will be defined in the detailed emergency and spill response plan.

After any major spill or accident, a review will be conducted to ensure that the required design changes and procedures and appropriate measures are in place to ensure that the incident will not be repeated.

13.2.20 Fuel, Chemical or Reagent Release from Storage Facilities and Dispensing Area

Similarly to reagents that may be stored at the ore processing plant (see Section 13.2.4), diesel fuel and gasoline will be stored at the fuel storage facility in double-walled Enviro tanks or other equivalent storage, with secondary containment such as a bermed facility with a petroleum resistant liner. The fuel storage facility will include a refuelling area for heavy, and support mining equipment, and potentially for small vehicles as well.

All chemicals such as reagents which pose a potential risk to the environment will be stored and used within contained areas if practicable, with sealed floors and sumps or drains reporting to facilities which will provide for retrieval of the spilled materials. These measures greatly reduce the release of such materials directly to the environment.

All chemicals used at the site will have a MSDS, in order to comply with the best practices in the industry for health and safety, and to provide relevant regulatory standards for the safe use of these materials. All measures related to chemicals used at the site will have continual reviews and updates in order to remain current, and will form part of the health and safety training of site personnel.

13.2.20.1 Potential Environmental Concerns

The risk of environmental effects related to fuel storage and dispensing areas is less than what will be expected from its transportation (see Section 13.2.18 and 13.2.19), as the locations are selected to be isolated or distant from water and other sensitive environmental features. Also measures such as collision barriers, secondary containment and close proximity to spill response and containment equipment will be employed.

Environmental effects associated with fuel storage and dispensing will depend in part on final fuel storage facility design, but could include:

- a catastrophic failure of a tank and/or a major collision involving a storage tank resulting in the failure of both walls of the tank at the fuel storage facility;

- an accident resulting in a catastrophic failure of the tank of the remote fuelling truck; and
- operator error during refuelling or damage to the dispensing system (such as a ruptured fuel line).

Effects will likely be limited to the immediate terrestrial environment except in the case of a major spill or a spill during a rainfall event. The fuel storage facility will be located near the crusher where drainage will flow to the mine water pond. The warehouse for storage of other chemicals and reagents will be situated near the ore processing plant and drainage will also flow towards the mine water pond. In either case, a spill/contaminated runoff will be contained and could be treated prior to any effluent being discharged from the pond.

Depending on the soil and its hydrological characteristics, a significant fuel, chemical or reagent spill that goes undetected could create a plume in the soil and leach into downstream watercourses resulting in aquatic and riparian effects.

13.2.20.2 Design and Operations Safeguards

The potential for environmental effects associated with accidents or malfunctions of on-site fuel storage facilities and dispensing areas will be minimized by the following design and construction features:

- all tank and storage areas will be constructed to recognized industry standards;
- storage areas are distant from water courses and sensitive habitat (except where impractical, such as the pump houses for the water intake, where a minimum buffer of 50 m will be maintained if powered by generators);
- Enviro tanks will be situated to minimize the risk from collision and puncturing of both walls and protected using bollards or similar; and
- containment berms will be placed around all permanent tanks that do not have internal secondary containment.

Operational procedures to minimize the potential of accidents or malfunctions will be incorporated into the environmental management system, and are expected to include:

- no smoking in the vicinity of the fuel storage facility or refuelling areas or chemical/reagent storage;
- at least daily inspections of all storage locations;
- formal weekly inspections using a protocol checklist to check for leakage and other operational problems;

- volumes will be confirmed at all tanks containing petroleum product at least weekly, using a dip check or other method, with the result logged for comparison; any measurements different from anticipated volumes will immediately be investigated; and
- fuel tanks will not be filled above 98% of capacity to allow for expansion due to temperature changes.

Procedures will be regularly reviewed as part of the environmental management system.

13.2.20.3 Contingency and Emergency Response

In the event that fuel, chemicals or reagents surpass a secondary containment, the emergency and spill response plan will come into effect, with a primary focus on ensuring human health and safety. The area will first be secured, and the leak or breach will be sealed if possible. A large spill kit will be available at the fuel storage facility and warehouse, including absorbent materials. A temporary berm of earth/snow can be constructed to contain the spill and/or absorbent materials can be used. All absorbent material and spilled fuel will be collected and hauled off site to be disposed of at a licensed facility.

If the spill migrates to the mine water pond or other water management infrastructure, all pumping to/from the pond will cease. The spill could be contained with a boom and removed with a skimmer, or pumped for adequate disposal at a licensed facility, or if possible, the TMF.

Soils in the vicinity of a spill will be tested for hydrocarbons or other contaminants and the contamination delineated. Contaminated soil will either be treated on site in a bioremediation area or hauled off site for treatment and disposal at a licensed facility.

13.2.21 Project-Related Fires

Fires can result from either natural (lightning) or human causes (operator error, equipment malfunctions or accidents). Effects related to natural fires are addressed in Chapter 8.

13.2.21.1 Potential Environmental Concerns

A major fire at site could pose a serious health and safety concern, and could cause property damage and operations interruptions, the extent and severity of which can vary based on the site conditions at the time of occurrence. Environmental effects could include a temporary reduction of air quality and localized terrestrial habitat loss.

13.2.21.2 Design and Operations Safeguards

The Project will be designed to meet all applicable fire protection system requirements and codes. This includes: fire detection and suppression systems, sprinkler and standpipe systems as well as a fire hydrant system.

Remote buildings such as the explosives storage, explosives plant, temporary construction buildings and pump houses will be equipped with portable extinguishers as required. A fire truck will be present at the Project site and equipped with a foam generation system in case of emergencies.

Regular fire drills will occur to ensure that all workers are familiar with fire prevention procedures, as part of the environmental management system. All workers and visitors on-site will receive an orientation which includes fire response procedures and evacuation routes, where applicable.

13.2.21.3 Contingency and Emergency Response

Priorities for fire response will be to protect human health and to ensure that the fire does not spread. Work would cease and the emergency and spill response plan would be deployed. A trained site fire response crew will provide the initial fire-fighting response. Flammable sources that could ignite will be removed if it safe to do so. Clean-up and remedial activities would follow, and may include additional monitoring if spills resulted due to a fire.

13.3 Off-Site Accidents and Malfunctions

13.3.1 Vehicular Accident

As discussed in Section 13.2.18, in addition to fuel, various chemicals and materials, including non-hazardous and hazardous substances, will be transported by road to and from the Project site. Access to the Canada-wide transport network is available via Highway 144 to the east of Mesomikenda Lake.

The same potential environmental concerns indicated under on-site vehicular accidents applies for off-site vehicular accidents, with the exception that vehicular accidents along public roads could actually have a higher risk occurring due to other road users and higher local speed limits. On-site design and operations safeguards will continue to apply on off-site roads, along with national road regulations and laws.

In the event of an off-site vehicular accident, similar contingency and emergency response procedures would be followed as for on-site vehicular accidents. Additional measures may also apply, including contacting appropriate authorities such as the Ontario Provincial Police.

13.3.2 Cyanide Spill During Transportation

Cyanide for ore processing purposes at the Project will also be transported along provincial public roads. Transportation of cyanide, on and off site, must be in compliance with all applicable regulatory requirements for transportation of dangerous goods, and/or as recommended by the International Cyanide Management Institute, at all times.

Due to the safety and operational measures that will be put in place, there is no reasonable likelihood that a cyanide spill should occur during transportation to the Project.

The same potential environmental concerns indicated under on-site cyanide spills during transportation applies for off-site accidents. Vehicular accidents on public roads may carry a higher risk as roads are shared with others. On-site design and operations safeguards for workers and contractors will continue to apply on off-site roads, along with national road regulations and laws.

In the event of an off-site vehicular accident resulting in a cyanide spill, similar contingency and emergency response procedures would be followed as for on-site accidents. Additional measures may also apply, including contacting appropriate authorities such as the Ontario Provincial Police.

13.4 Accidents and Malfunctions Summary and Risk Assessment

Each credible potential accident and malfunction discussed above was assessed according to likelihood of occurrence, and given a risk ranking of between 1 (lowest) and 9 (highest) (see Table 13-2). Each risk ranking refers to a diagonal row of cells within a risk matrix shown in the same colour (see Graphic 13-1). As shown in the risk matrix, increased risk is associated with accidents and malfunctions having a greater likelihood of occurrence and increased level of consequence.

The environmental risk assessment for these accidents and malfunctions has been approached qualitatively and intuitively. The likelihood of occurrence has been defined as follows:

- Negligible: doubtful to occur over the life of the mine (<1/10,000 events per year);
- Very Low: unlikely to happen over the life of the mine (<1/1,000 events per year);
- Low: could happen over the life of the mine (<1/100 events per year);
- Moderate: probably will happen over the life of the mine (<1/10 events per year); and
- High: will happen regularly over the life of the mine (>1/10 events per year).

The consequences of the occurrence are important from the environmental perspective. The range of malfunctions or accidents that are being considered and the varied sensitivity of the environments involved do not lend themselves to typical environment-related criteria (such as level of toxicity, surface area affected, duration of impact). As a result, a surrogate measure of environmental consequence has been used, which includes a combination of potential effect and cost of remediation, as a measure of severity:

- Low: no long-term effects, readily remediated with low cost;
- Moderate: typically limited or no long-term effects, predictably remediated with low to moderate costs;

- High: typically, moderate long-term effects expected, predictably remediated but costly;
- Very high: significant long-term effects expected, uncertain and costly remediation; and
- Extreme: highly significant long term effects likely, unlikely to be completely remediated and very high cost.

Where a range of risk ratings could occur, a conservative approach was taken. Only the highest risk ranking associated with a credible occurrence has been indicated. Risk ratings of less than or equal to 6 are considered acceptable if there is a proposed management and mitigation plan. A risk rating of 7 requires further consideration, and risk ratings of greater than or equal to 8 are considered unacceptable.

This methodology has also been applied to a number of other mining-related undertakings which were subject to a proponent-driven Class EA process under the Ontario *Environmental Assessment Act*. Results of the risk assessment are provided in Table 13-2, with highest risk identified associated with an event having a likelihood of negligible and consequence of extreme.

The identified accidents and malfunctions, consequences, contaminants, safeguards and contingency and emergency response procedures and their risk rankings with and without safeguards and contingency are summarized in Table 13-3.

No accidents and malfunctions were found to be of high residual risk (most had a risk ranking of 2 to 4) following the application of safeguards and contingencies. The following accidents and malfunctions have been assigned a 'moderate' residual risk ranking:

- cyanide destruction process failure; and
- TMF dam failure.

Their consequences may range from moderate to extreme in the event of occurrence, however the likelihood of occurrence is negligible to low and hence these risks are considered to have no reasonable likelihood of causing a significant adverse effect.

Graphic 13-1: Environmental Risk Matrix

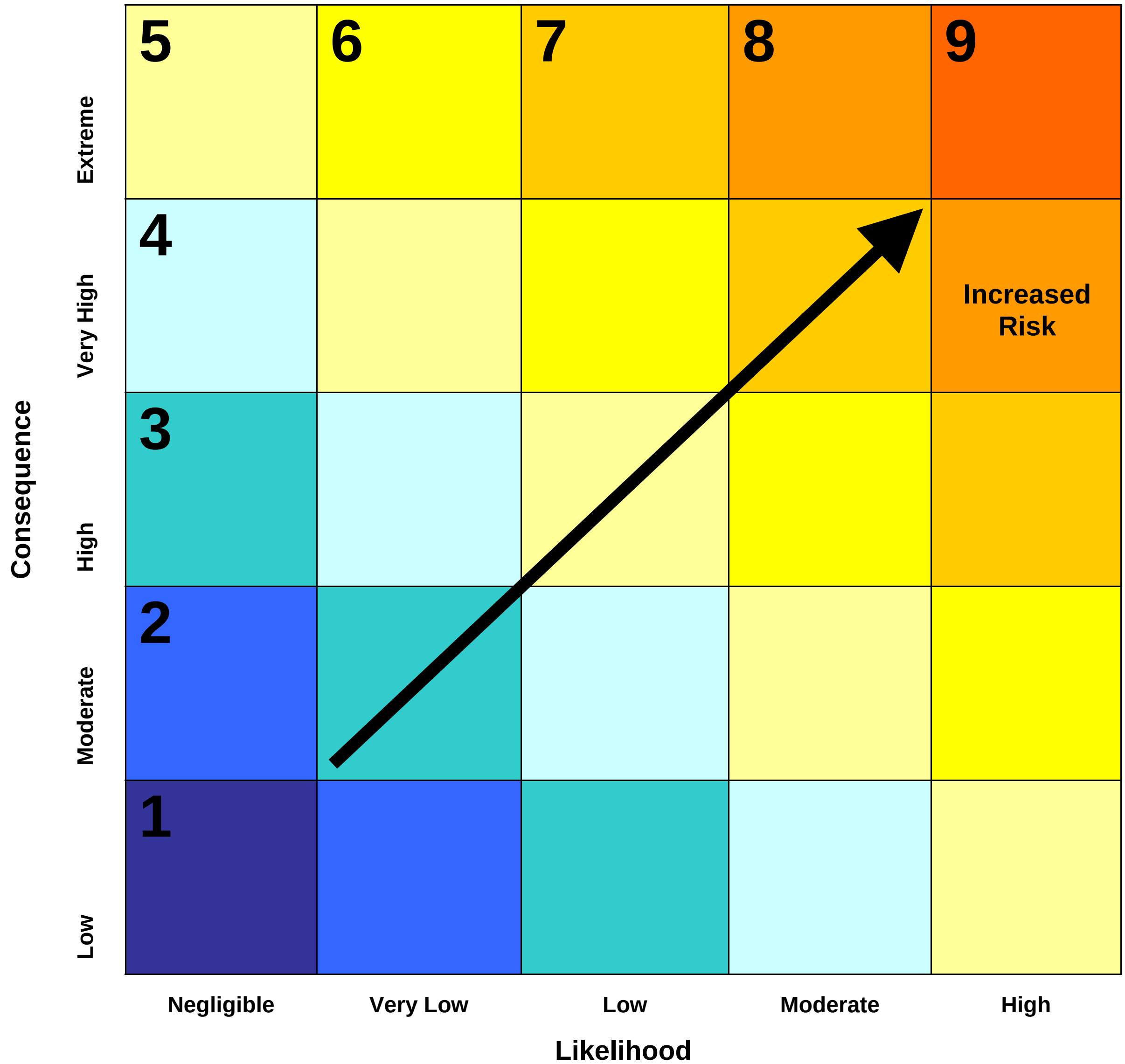

Table 13-2: Accidents and Malfunctions Risk Summary

Malfunction / Accident	Potential Issues of Concern	Likelihood	Consequence	Risk Ranking
On-Site Accidents and Malfunctions				
Open Pit Slope Failure	Damage to habitat, limited flooding of open pit	Very Low	Moderate	3
MRA/ Low-Grade Ore Stockpile Slope Failure	Damage to terrestrial habitat, aquatic life	Very Low	High	4
Seepage Collection System Failure	Damage to terrestrial habitat, aquatic life	Low	Moderate	4
Ore Processing Plant Reagent Release	Damage to property, habitat and aquatic life	Very Low	High	4
Ore Processing Plant HCN Gas Release	Damage to property and habitat	Low	High	5
Cyanide Destruction Process Failure	Damage to property, human environment and habitat	Low	High	5
TMF Dam Failure	Damage to terrestrial habitat, aquatic life and downstream	Negligible	Extreme	5
TMF Seepage	Damage to aquatic life	Negligible	Moderate	2
TMF Overflow	Damage to habitat and aquatic life and downstream	Negligible	Moderate	2
Tailings Pipeline Failure	Damage to habitat and aquatic life	Very Low	High	4
Effluent Discharge Pipeline Failure	Damage to habitat and aquatic life and downstream	Very Low	Low	2
Mine Water Pond Failure	Damage to property and habitat	Negligible	Moderate	2
Water Pipeline Failure	Damage to habitat and aquatic life	Very Low	Low	2
Watercourse Realignment Failure	Damage to property, habitat and aquatic life	Low	High	5
Retention Dam Failure	Damage to property, habitat and aquatic life	Very Low	Moderate	3
Emulsion Plant and Explosives Accidents	Damage to human environment	Negligible	Low	1

Malfunction / Accident	Potential Issues of Concern	Likelihood	Consequence	Risk Ranking
Landfill Leachate or Methane Gas Release	Damage to habitat and aquatic life	Negligible	Low	1
Vehicular Accident	Damage to human environment, habitat and aquatic life	Low	Moderate to High	4 to 5
Cyanide Spill During Transportation	Damage to human environment, habitat and aquatic life	Very Low	Moderate	3
Fuel, Chemical and Reagent Release from Storage Facilities and Dispensing Area	Human environment, habitat and aquatic life	Low	Low	3
Project-Related Fires	Damage to human environment and habitat	Low	Moderate to Very High	4 to 6
Off-Site Accidents and Malfunctions				
Vehicular Accident	Damage to human environment, habitat and aquatic life	Low	Moderate to High	4 to 5
Cyanide Spill during Transportation	Damage to human environment, habitat and aquatic life	Very Low	High	4

See Section 13.4 for explanation of colour coding and ranking system.

Table 13-3: Potential Accidents and Malfunctions Summary for the Côté Gold Project

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Open pit slope failure	3	Failure on surface leading to failure of retention dams towards the west consequently draining Clam Lake into the open pit. Ground surface slump or disturbance of adjacent areas and infrastructure. Worker safety.	None	Proper best practice engineering slope design. Setback of retention dams at a safe distance from the open pit. Thorough understanding of geotechnical conditions. Regular slope stability inspections.	Cease all work in the area to ensure worker safety and secure the area. Depending on the scale of the failure, slopes would be re-contoured in place and stabilized, and any affected perimeter ditches and nearby roads would be repaired.	Likelihood – Very Low Consequence - Moderate	3
MRA / low-grade ore stockpile slope failure	4	Potential for mine rock and low-grade ore to reach nearby watercourses. Disturbance/damage of adjacent areas and infrastructure; worker safety.	Suspended solids Heavy metals Ammonia	Best practice engineering design of MRA and low-grade ore stockpile slopes to achieve long-term stability. Thorough understanding of geotechnical conditions. Regular slope stability inspections and maintenance.	Cease all work in the area and ensure worker safety and secure the area. Depending on the scale of the failure, stockpiles would be re-countered in place, and any affected perimeter ditches would be excavated, returned to the stockpile and repaired.	Likelihood – Very Low Consequence - Moderate	3

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Seepage collection system failure	4	Release of seepage from seepage collection ponds to ground and/or surface water.	Suspended and dissolved solids Heavy metals Ammonia	Best practice engineering design of seepage collection systems. Thorough understanding of geotechnical conditions (rock and hydrogeological conditions). Regular monitoring and inspections.	Silt fencing and/or excavation at and around seepage area, fill with well-compacted or low-permeability material to limit the extent of discharge to the environment and to divert the flow of seepage back into unaffected seepage collection ponds, if possible. Pumping to the mine water pond for treatment. Follow-up monitoring and potential remedial action.	Likelihood – Low Consequence - Moderate	3

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Ore processing plant reagent release	4	Release of process agents to groundwater and surface water during operations at the ore processing plant. Worker safety and damage to infrastructure.	Processing reagents Sulphur dioxide gas	Best practice design of appropriate usage/dispensing facilities or areas at the ore processing plant - including sealed floors, containment berms/dykes and security measures. Training of personnel, signage and spill response kits. Regular inspections of tanks and operational procedures. (See fuel, chemical or reagent spills.)	Cease all work in the area to ensure worker safety and secure the area. Construction of temporary earth/snow dams to limit extent of spill migration, including the use of spill containment materials. Pumping from mine water pond would cease if the spill affects it. Follow-up monitoring and potential remedial action. (See fuel, chemical or reagent spills.)	Likelihood – Very Low Consequence - High	4

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Ore processing plant HCN gas release	5	Ore processing plant shutdown. Worker safety and damage to infrastructure (fire hazard).	HCN gas	Ore processing plant best practice design and operating procedures, including appropriate ventilation systems. HCN gas detectors, fire extinguishers, personnel training, signage.	Cease all work in the area and ensure worker safety and secure the area. First aid and evacuation measures by trained personnel, personal and eye wash stations. Fire fighting measures: let burn unless leak can be stopped immediately; use regular foam or flood with water spray for large fires.	Likelihood – Very Low Consequence – High	4
Cyanide destruction process failure	5	Ore processing plant shutdown.	HCN gas SO_2 gas	Best practice engineering design of the ore processing plant and regular maintenance.	Cease all work in the area and secure the area. Cease pumping of all inputs and outputs (water, tailings) - shutdown ore processing plant procedures. Other procedures as per ore processing plant reagent release or HCN gas release.	Likelihood – Low Consequence - High	5

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
TMF dam failure	5	Release of tailings and tailings effluent to the environment (Bagsverd Creek, Neville Lake and Mesomikenda Lake) which could lead to fish fatalities and contamination of the Timmins drinking water supply.	Suspended and dissolved solids Heavy metals Process reagents Low level cyanide Low pH process water	Best practice engineering designs for TMF dam. Thorough understanding of geotechnical conditions. Choice and use of appropriate construction materials and construction supervision. Proper operation within design parameters. Regular dam stability inspections, maintenance and monitoring.	Cease pumping of tailings to the TMF and work in the area, ensuring worker safety and secure the area. Use of temporary earth/snow dams to contain extent of discharge. Water from TMF reclaim pond may be pumped to the mine water or polishing pond to limit the volume of effluent discharged. Follow-up monitoring and potential remedial action, including excavation of spilled tailings and hauling back to repaired TMF.	Likelihood – Negligible Consequence - Extreme	5

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
TMF seepage	2	Release of tailings water to groundwater and, potentially, surface water	Suspended and dissolved solids Heavy metals Low level cyanide Ammonia	Best practice engineering design of TMF to achieve long-term integrity, and seepage collecting systems. Regular monitoring and inspections. Thorough understanding of geotechnical conditions (rock and hydrogeological conditions).	Silt fencing and/or excavation at and around seepage area to be filled with well-compacted or low-permeability material, to limit the extent of discharge to the environment and to divert the flow of seepage back into seepage collection ponds or the TMF reclaim pond. Follow-up monitoring and potential remedial action.	Likelihood – Negligible Consequence - Moderate	2

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
TMF overflow	2	Release of tailings water, and potentially tailings, to Mesomikenda Lake or Bagsverd Creek due to flooding or tailings dam erosion.	Suspended and dissolved solids Heavy metals Process reagents Low level cyanide Ammonia Low pH process water	Best practice engineering designs for TMF dam. Choice and use of appropriate construction materials and construction supervision. Proper operation within design parameters. Regular dam inspections, maintenance and monitoring.	Cease pumping of tailings to the TMF. Water from TMF supernatant pond may be pumped to the mine water pond to limit the volume of effluent discharged. If discharge cannot be fully or partially contained, discharge extent would be limited to the extent possible with temporary earth/snow dams. Follow-up monitoring, repair and potential remedial action.	Likelihood – Negligible Consequence - Moderate	2

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Tailings pipeline failure	4	Release of tailings slurry to the environment (could lead to fish fatalities).	Suspended and dissolved solids Heavy metals Process reagents Low level cyanide Ammonia Low pH process water	Double-walled HDPE pipeline. Pressure monitoring of pipeline (immediate automatic shutdown piping system to protect against leaks/breach). Secondary containment - emergency retention ponds. Avoid crossing of surface waters. Regular inspections and maintenance.	Cease pumping of tailings to the TMF. Containment of spill with temporary earth/snow dams along with spill containment materials. Follow-up inspections, monitoring and potential remedial action, including excavation of spilled tailings and hauling to the TMF.	Likelihood – Very Low Consequence - Moderate	3
Effluent discharge pipeline failure	2	Flooding of areas between the polishing pond and the final discharge location at Bagsverd Creek.	None	Single-walled HDPE pipeline. Regular inspections and maintenance.	Cease all pumping. Containment of excess water with temporary earth/snow dams to prevent/reduce potential damage to nearby TMF dam walls. Follow-up inspections and maintenance.	Likelihood – Very Low Consequence - Low	2

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Mine water pond failure	2	Flooding/erosion of or water damage to immediate adjacent areas. Worker safety and damage to infrastructure.	None (depending on the extent of the failure, may disperse process reagents and other contaminants from adjacent facilities)	Best practice engineering designs for pond. Thorough understanding of geotechnical conditions (rock and hydrogeological conditions). Choice and use of appropriate construction materials and construction supervision. Proper operation within design parameters. Regular pond stability inspections, maintenance and monitoring.	Cease all work in the area to ensure worker safety and secure the area. Cease pumping to the mine water pond. Containment of waters with temporary earth/snow dams, possibly along with spill containment materials. Water may be pumped to the TMF, and the pond repaired if necessary. Follow-up inspections and potential remedial action.	Likelihood – Negligible Consequence - Moderate	2

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Water pipeline failure	2	Flooding/erosion of or water damage to areas between intake location on Mesomikenda Lake and the ore processing plant.	None (depending on the extent of the failure, may disperse process reagents and other contaminants from adjacent facilities)	Single-walled HDPE pipeline. Regular inspections and maintenance.	Cease pumping from Mesomikenda Lake. Containment of waters with temporary earth/snow dams, possibly along with spill containment materials. Repair, follow-up inspections and potential remedial action.	Likelihood – Very Low Consequence - Low	2
Watercourse realignment failure	5	Change channel planform and impacts to flow resulting in erosion, loss in habitat productivity and fish migration.	Potentially suspended solids (depending on the extent of the failure and erosion damage)	Best practice natural channel/engineering design. Thorough understanding of geotechnical and hydrological conditions. Choice and use of appropriate construction materials, timing of construction and construction supervision. Regular inspections and maintenance.	Ensure worker safety and secure the area. Containment of waters with temporary earth/snow dams or other erosion control measures, as appropriate. Repair, follow-up inspections and potential remedial action.	Likelihood – Low Consequence - Moderate	4

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Retention dam failure	3	Flooding of the open pit, MRA, low-grade ore stockpile and/or associated infrastructure, uncontrolled flooding of surrounding areas.	Potentially suspended solids (depending on the extent of the failure, may disperse reagents, heavy metals, ammonia and suspended solids from surrounding facilities)	Best practice engineering design, regular inspections. Setback of retention dams at a safe distance from Project components. Thorough understanding of geotechnical conditions (rock and hydrogeological conditions). Regular inspections and maintenance.	Cease all work in the area to ensure worker safety and secure the area. If dams along Clam lake fail, work in the open pit will cease (alarm system). Containment of waters with temporary earth/snow dams. Repair and follow-up inspections.	Likelihood – Negligible Consequence - Moderate	2
Emulsion plant and explosives accidents	1	Worker safety and damage to infrastructure.	None	Explosive components are stored such that they are not explosive. Storage location is away from site infrastructure and receptor locations as per applicable regulations and guidelines. Only trained personnel to handle explosive components and prepared explosive.	Appropriate authorities and personnel will be immediately contacted. Evacuation procedures and first response.	Likelihood – Negligible Consequence - Low	1

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Landfill leachate or methane gas release	1	Release of leachate to ground and/or surface water, methane gas build-up (explosion hazard).	Dissolved and suspended solids Dissolved organic matter Potentially heavy metals Potentially ammonia Methane	Best practice engineering design, regular inspections and monitoring. As the landfill will be less than 1.5 Mm^3, under O. Reg. 347 and O. Reg. 232/98 a landfill gas management strategy is not required (area and gas volumes generated will be too low).	Leachate release: excavate the area around the seepage and fill it with well-compacted or low-permeability material to divert the flow of leachate back into the landfill. Follow-up monitoring and potential remedial action.	Likelihood – Negligible Consequence - Low	1

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Vehicular accident	4 to 5	Fuel and/or oil and hazardous materials spills, potentially reaching off-site surface waters. Worker safety.	Fuel and oil Potentially other chemicals and reagents (as per below)	Transportation of materials as per guidelines/regulations in appropriate containers (sealed, double-walled, etc.). Strict compliance with speed limits, signage, avoid transportation if visibility is limited, oversized loads transported during daylight. Penalties for operational violations. Regular vehicle maintenance. Training of drivers in spill response procedures, vehicles will carry basic emergency and first aid supplies.	Ensure worker safety. Flammable sources that may ignite will be removed if safe to do so. Appropriate authorities and personnel will be immediately contacted. Spill emergency response plans will be employed if fuel/oil is spilt or hazardous materials. Clean-up and remedial action may be required.	Likelihood – Low Consequence - Moderate	4

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Cyanide spill during transportation	3	Solid cyanide being washed into a lake or river causing fish fatalities, worker safety	Cyanide	Transport of solid sodium cyanide pellets, as per guidelines/regulations in appropriate containers. Safe transport of cyanide with a certified company and trained drivers. Well maintained onsite access roads. Safe handling procedures on site.	Ensure public and worker safety. Appropriate authorities and personnel will be immediately contacted. Spill emergency response plans will be employed. Clean-up and remedial action may be required.	Likelihood – Very Low Consequence - Low	2

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Fuel, chemical or reagent release from storage facilities and dispensing areas	3	Fuel and other spills eventually reach nearby surface waters. Worker safety, fires and/or damage to infrastructure.	Fuel and oil Chemicals and reagents (flocculant, caustic soda, coolant, lubricants, etc.)	Designated fuelling areas at the site, on-site procedures for fuel and oil capture and clean-up, capture of site water and, if required, treatment.	Cease all work in the area to ensure worker safety and secure the area. Flammable sources that may ignite will be removed if safe to do so. Appropriate authorities and personnel will be immediately contacted. Containment of spills with temporary earth/snow dams, possibly along with spill containment materials. Clean-up and potential remedial action, with follow-up monitoring.	Likelihood – Low Consequence - Low	3

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Project-related fires	4 to 6	Natural or human caused fires within the Project site potentially affecting air quality and vegetation surrounding affected site infrastructure. Worker safety.	Air pollutants depending on the materials consumed in the fire.	Fire detection and suppression systems, sprinkler and standpipe systems as well as fire hydrant systems. Remote buildings to be equipped with portable fire extinguishers. Fire truck at the Project site equipped with foam system. Regular fire drills for staff.	Cease all work in the area to ensure worker safety and secure the area. Trained on-site personnel to provide initial fire fighting response, including measures to reduce/stop the spread of fire. Appropriate authorities and personnel will be immediately contacted. Evacuation plans and first response procedures could be employed. Repair and follow-up inspections.	Likelihood – Very Low Consequence - Moderate	3

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Vehicular accident	4-5	Fuel and/or oil and hazardous materials spills, potentially reaching off-site surface waters. Public and worker safety.	Fuel and oil Potentially other chemicals and reagents (as per below)	Transportation of materials as per guidelines/regulations in appropriate containers (sealed, double-walled, etc.). Strict compliance with speed limits, signage, avoid transportation if visibility is limited, oversized loads transported during daylight. Penalties for operational violations. Regular vehicle maintenance. Training of drivers in spill response procedures, vehicles will carry basic emergency and first aid supplies.	Ensure public and worker safety. Flammable sources that may ignite will be removed if safe to do so. Appropriate authorities and personnel will be immediately contacted. Spill emergency response plans will be employed if fuel/oil is spilt or hazardous materials. Clean-up and remedial action may be required.	Likelihood – Low Consequence – Moderate to High	4-5

Event	Risk Ranking*	Potential Consequences (Worst Case Scenario)	Contaminants	Safeguards	Contingency and Emergency Response Procedures	Residual Risk	Residual Risk Ranking
Cyanide spill during transportation	4	Solid cyanide being washed into a lake or river causing fish fatalities. Public and worker safety.	Cyanide	Cyanide spills during transportation off-site will be handled in a similar manner to on-site spills. Transport of solid sodium cyanide pellets, as per guidelines/regulations in appropriate containers. Safe transport of cyanide with a certified company and trained drivers. Well maintained onsite access roads. Safe handling procedures on site.	Ensure public and worker safety. Appropriate authorities and personnel will be immediately contacted. Spill emergency response plans will be employed. Clean-up and remedial action may be required.	Likelihood – Very Low Consequence - Moderate	4

* See Section 13.4 for explanation of the ranking system.