



Monitoring Plan	
Document Title: Acid Rock Drainage and Metal Leaching (ARD/ML) Management Plan	Document Number: MOZ-NFLD-001-MOZ-0000-000000-80-EMP-0002 Version 1.0
Owner: Environment	Review Frequency: Annual
Review Coding	
<input type="checkbox"/>	Code 1 – Reviewed with No Comments
<input type="checkbox"/>	Code 2 – Reviewed with Minor Comments
<input type="checkbox"/>	Code 3 – Reviewed with Major Comments
<input type="checkbox"/>	Code 4 – Not Accepted
<input type="checkbox"/>	Code 5 – Information Only

Rev	Rev Date	Issued For	Prepared By	Reviewed By	Approved By
A	Sept 15, 2022	Use	Stantec	James Powell	James Powell
B	March 2023	Use	Stantec	James Powell	James Powell
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**Valentine Gold Project: Acid
Rock Drainage Metal Leaching
Management Plan**



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March 2023

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List of Acronyms and Abbreviations

ABA	acid base accounting
Al	aluminum
AP	acid potential
ARD	acid rock drainage
As	arsenic
CCME	Canadian Council of Ministers of the Environment
Cd	cadmium
CN(T)	total cyanide
CN _{WAD}	weak acid dissociable cyanide
Cu	copper
CWQG-FAL	Canadian Water Quality Guidelines for Protection of Freshwater Aquatic Life
DOC	dissolved organic carbon
EA	environmental assessment
EIS	environmental impact statement
EPP	environmental protection plan
F	fluoride
FDP	final discharge point
Fe	iron
HCT	humidity cell test
Hg	mercury
HGO	high-grade ore
IAAC	Impact Assessment Agency of Canada
ICP-MS	inductively coupled plasma mass spectrometry
IR	Information Requirement
LGO	Low-grade ore
Marathon	Marathon Gold Corporation
MDD	Mineral Development Division
MDMER	<i>Metal and Diamond Mining Effluent Regulation</i>
ML	metal leaching
Mn	manganese
Mt	million tonnes
Mo	molybdenum
NAG	net acid generation

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NL	Newfoundland and Labrador
NLDECC	Newfoundland and Labrador Department of Environment and Climate Change
NLDIET	Newfoundland and Labrador Department of Industry, Energy, and Technology
non-PAG	non-potentially acid generating
NP	neutralization potential
NPP	net neutralization potential
NPR	neutralization potential ratio
P	phosphorus
PAG	potentially acid generating
Pb	lead
QA/QC	quality assurance / quality control
RC	reverse circulation
RCP	Rehabilitation and Closure Plan
SFE	shake flask extraction
Se	selenium
Stantec	Stantec Consulting Ltd.
t	tonnes
the Project	Valentine Gold Project
TMF	tailings management facility
tpd	tonnes per day
TSS	total suspended solids
Zn	zinc

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1.0 INTRODUCTION

Marathon Gold Corporation (Marathon) is proposing to develop an open pit gold mine in central Newfoundland, the Valentine Gold Project (the Project). An Environmental Impact Statement (EIS) for the Project was submitted to the Impact Assessment Agency of Canada (IAAC) on September 29, 2020 and to the Environmental Assessment (EA) Division of the Newfoundland and Labrador Department of Environment and Climate Change (NLDECC) on November 3, 2020 by Marathon. The Project was released from the provincial EA process in March 2022 and was given conditional approval to proceed by the federal government in August 2022.

The construction and operation of the Project are governed by an Environmental and Social Management System, which includes tools such as the corporate environmental and social policies, construction and operational environmental protection plans (EPPs), environmental management plans, and monitoring plans. In general, these plans are considered living documents that are updated as needed throughout the life of a project to reflect the latest project, regulatory and environmental information.

As a component of the Environmental and Social Management System, the objective of this Acid Rock Drainage and Metal Leaching (ARD/ML) Management Plan is to:

- identify Project components with the potential to generate ARD/ML
- establish and update screening criteria for identification of ARD/ML
- describe measures to manage potentially acid generating and/or metal leaching materials to avoid or reduce potential environmental effects
- describe monitoring programs to evaluate ARD/ML predictions and the effectiveness of management measures
- identify adaptive management measures/processes that may be employed should monitoring determine that additional or new mitigation measures are required

This ARD/ML Management Plan is a live document, which will be updated throughout the life of the Project. The ARD/ML Management Plan will also need to be updated in consideration of on-going ARD/ML testing and analysis and requirements identified through the permitting process.

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1.1 PROJECT OVERVIEW AND CONTEXT

The Project is located in a rural area of central Newfoundland, southwest of the Town of Millertown, Newfoundland and Labrador (NL) (Figure 1.1). The Project consists of two open pits, waste rock piles, ore stockpiling and crushing areas, conventional milling and processing facilities, a tailings management facility (TMF), staff accommodations, and supporting infrastructure including roads, on-site power lines, buildings, and water and effluent management facilities (Figure 1.2). The mine site is currently accessible year-round by an existing public access road (mine access road) that has been maintained by Marathon since 2010. The existing access road will be upgraded and maintained as part of Project construction and operation.

The mine site is subdivided into three components, from north to south, the Marathon Complex, the process plant and TMF Complex, and the Leprechaun Complex. The major Project facilities include the Leprechaun and Marathon open pits, process plant, TMF, waste rock piles, high-grade ore (HGO) and low-grade ore (LGO) stockpiles, topsoil, and overburden stockpiles. Ore from the open pits will be mined for approximately 10 years, stockpiled, and processed continuously at the plant. The plant will operate for another three years by processing ore from the LGO stockpiles of Leprechaun and Marathon deposits. Tailings will be deposited in the TMF for the first nine to ten years of operation and into the Leprechaun pit for the last three to four years of operation.

1.2 SCOPE

This Project-specific ARD/ML Management Plan has been designed to identify and manage potentially acid generating (PAG) materials and to mitigate adverse effects on the receiving environment that could result from known or potential sources of ARD/ML. The Plan describes operational requirements for management of PAG materials to reduce the risk of ARD/ML generation, and documents the steps, decisions and actions to be taken to identify and manage PAG materials throughout the life of the Project. The Plan addresses the management of potential PAG materials throughout Project construction, operation and rehabilitation and closure as described in Section 2.1 and for each of the Project components listed in Section 2.2.

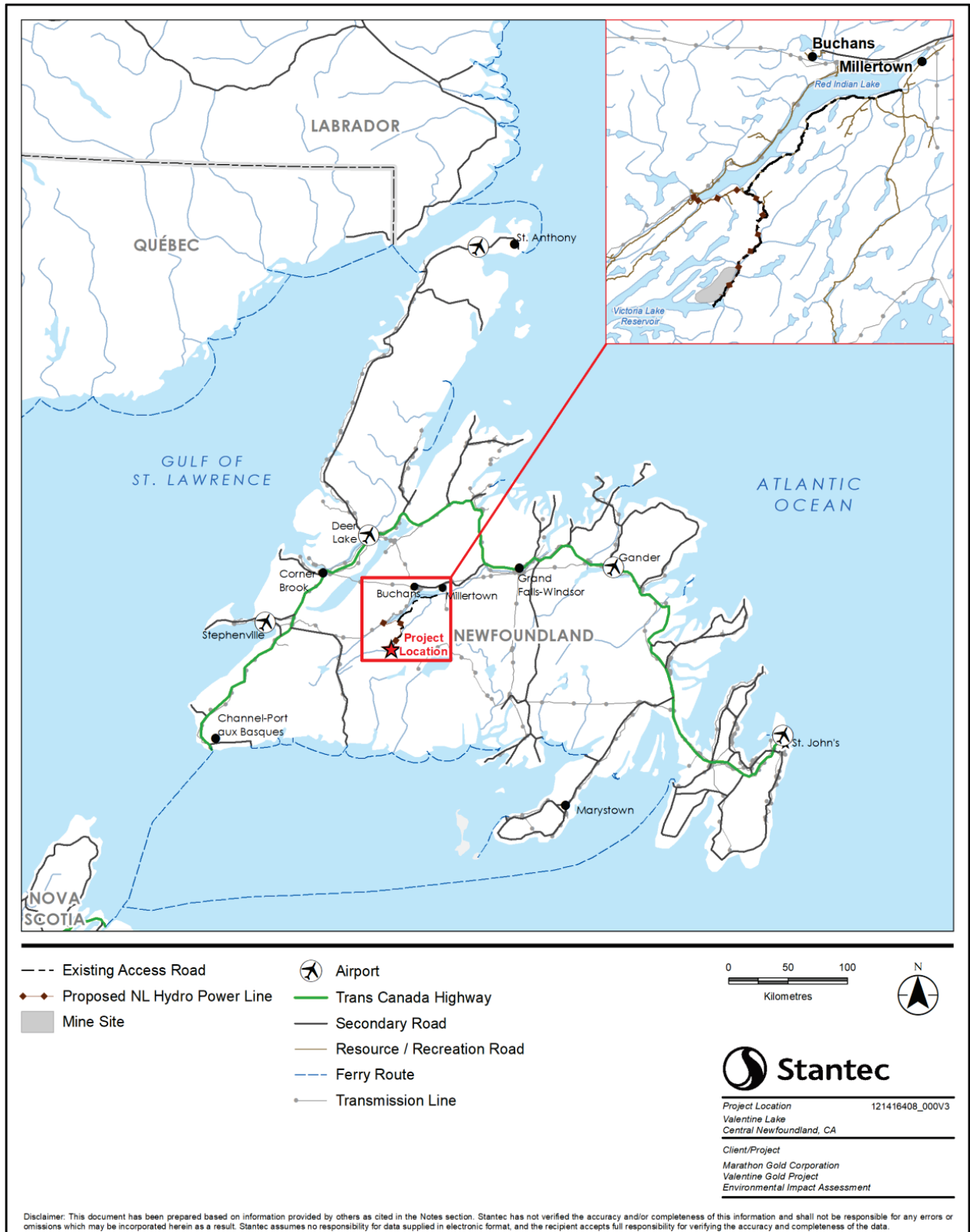


Figure 1.1 Location of Valentine Gold Project

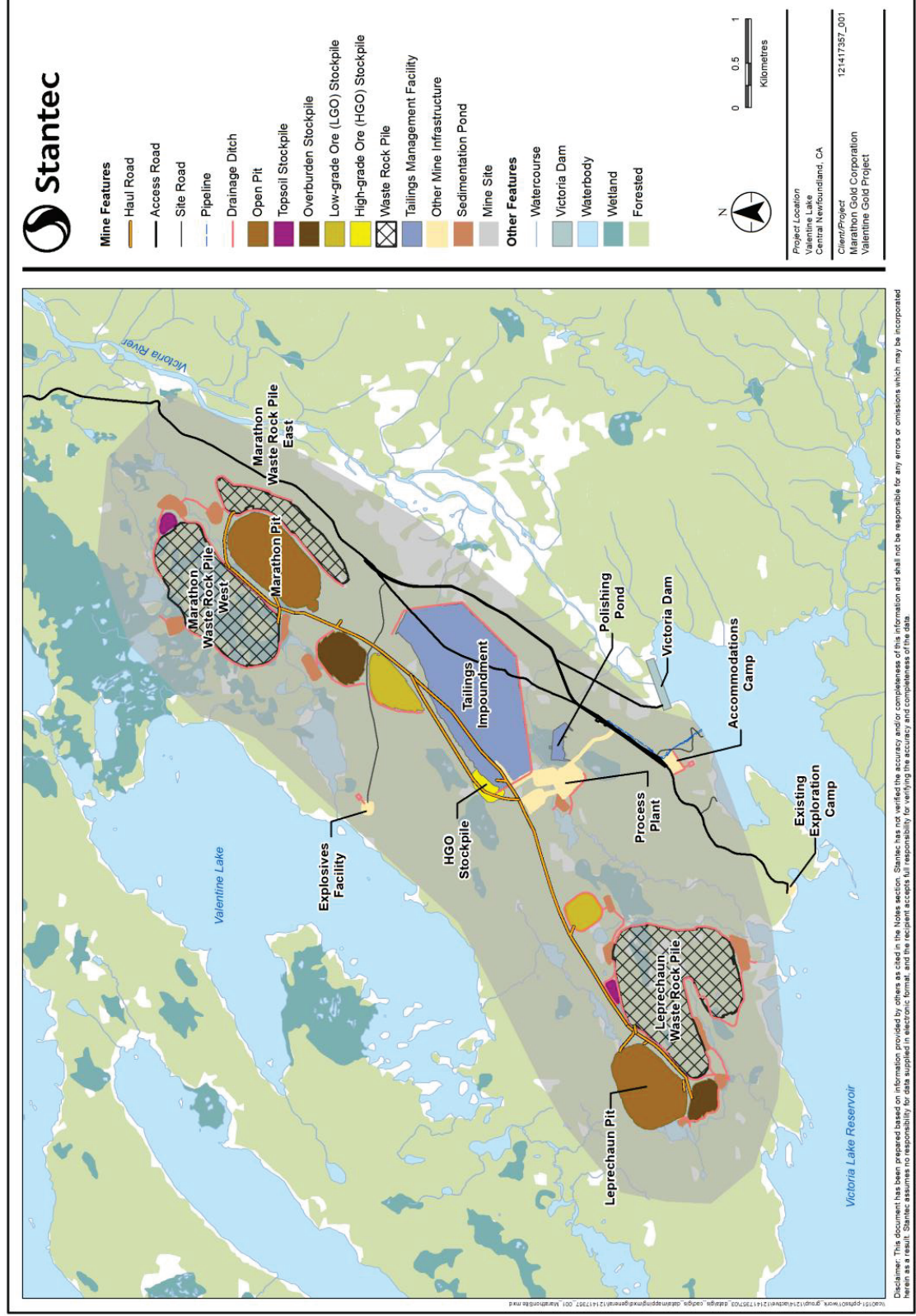


Figure 1.2 Valentine Gold Project Components

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1.3 OBJECTIVES

The overall objective of the ARD/ML Management Plan is to document the protocols to be employed to reduce the risk of long-term adverse effects on the receiving environment that may result from the exposure of mine materials, such as overburden, waste rock, ore, low-grade ore, and tailings. To achieve this overall objective, the ARD/ML Management Plan:

- Identifies the federal and provincial legislation, regulations and standards relevant to the management of PAG materials
- Identifies other Project-specific management and monitoring plans relevant to the management of ARD/ML
- Outlines the roles and responsibilities of Project team members in the implementation of this ARD/ML Management Plan
- Provides an overview of the Project phases and components included within the scope of this Plan
- Characterizes the ARD/ML potential of the materials exposed by the Project
- Outlines the procedures to monitor and document geochemical characterization of the Project components, including pre-production testing, analysis and on-site testing and criteria
- Documents the material management methods to be followed to reduce the risk of ARD/ML generation from each Project component
- Outlines the procedures to monitor contact water quality for early identification of conditions indicative of ARD/ML
- Describes the adaptive management approach to mitigation measures for each Project component
- Identifies regulatory reporting requirements
- Documents triggers and procedures for revisions to the ARD/ML Management Plan

1.4 RELATED PLANS AND DOCUMENTS

Geochemical characterization conducted to support this ARD/ML Management Plan considers recommendations provided in “Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials” (MEND Manual) produced by MEND for ARD/ML prediction (Price 2009). This manual was used in developing the geochemical study design and establishing ARD classification for the Project. ARD/ML investigations also considered the federal “Environmental Code of Practice for Metal Mines” prepared by Environment and Climate Change Canada (Environment Canada 2009).

Several other Project-specific management and monitoring plans that relate to the management of ARD/ML are in preparation and are listed in Table 1.1. The information included in Table 1.1 will be reviewed and updated as needed.


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Table 1.1 Management and Monitoring Plans Related to the ARD/ML Management Plan

Management / Monitoring Plan	Scope and Relationship to the ARD/ML Management Plan
Development Plan	<p>Submission of a Development Plan is a requirement for mining projects under the Newfoundland and Labrador (NL) <i>Mining Act</i>. The Development Plan will include an overall description of the Project – ownership, geology, mining and processing, tailings management, ARD/ML management, and infrastructure, as well as the plans and schedules and other details for construction and operation of the Project. The Development Plan must describe ARD potential and management requirements for all phases of a project, and this document is updated per a schedule developed in consultation with the NL Department of Industry, Energy, and Technology – Mineral Development Division (NLDIET – MDD), or as required based on changes to a project.</p>
Rehabilitation and Closure Plan	<p>A Rehabilitation and Closure Plan (RCP) is also a requirement under the NL <i>Mining Act</i> and describes the approach and plans for rehabilitation and closure of the project. The RCP will include details pertaining to the three key stages of rehabilitation activities that occur over the life span of the Project, which include:</p> <ul style="list-style-type: none"> • progressive rehabilitation • closure rehabilitation • post-closure monitoring and treatment <p>The RCP must describe ARD potential and management requirements for all phases of a project, specifically addressing the requirements for mine rehabilitation and closure and post-closure to avoid or reduce risk to the environment in long term. The RCP is required to be reviewed and updated regularly, or as required based on changes to a project, and reviewed by NLDIET-MDD).</p>
Construction Environmental Protection Plan	<p>The purpose of the EPP is to outline protection and response measures associated with potential environmental effects related to Project construction activities. The EPP also describes practical procedures required of all personnel (i.e., Marathon employees, contractors and suppliers) to reduce or eliminate potential adverse environmental effects, as well as instructions for addressing planned and unplanned activities/events associated with Project construction.</p> <p>The EPP is closely linked to other management and monitoring plans (such as the ARD/ML Management Plan) as it describes practical procedures required to reduce or eliminate potential adverse environmental effects, as well as instructions for addressing planned and unplanned activities/events associated with Project construction. The key linkage between the Construction EPP and the ARD/ML Management Plan is the identification and use of appropriate non-PAG materials for construction.</p>

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Table 1.1 Management and Monitoring Plans Related to the ARD/ML Management Plan

Management / Monitoring Plan	Scope and Relationship to the ARD/ML Management Plan
Water Management Plan	<p>The Water Management Plan includes the water management design for the Project, which has been developed to reduce operational risks and environmental effects of the Project. Objectives of the Plan include reducing water inventory requiring management through perimeter berms to divert external noncontact runoff; reducing the number of final discharge points (FDPs) through grading of ditches and construction of diversion channels to combine discharge points and water management ponds; maintaining flow to fish-bearing streams and wetlands by maintaining pre-development catchments to the extent feasible; and reducing water management costs during operation through grading and gravitational drainage and thereby reducing pumping requirements.</p> <p>The Water Management Plan is linked to the ARD/ML Management Plan through the water monitoring associated with Project components (waste rock piles, TMF and ore and overburden stockpiles) that may contribute to ARD/ML. Operationally, the contact water management procedures described in Section 4.2 will be a component under the Water Management Plan.</p>
Tailings Management and Deposition Plan	<p>This plan includes operational procedures and management objectives with respect to handling of tailings and effluent within the TMF. The plan will describe the methods for tailings deposition within the TMF that will address storage volumes and areas, dam raises (not with tailings) seasonal deposition considerations, dam stability and liner protection, ARD/ML management, water management, dust management, and other requirements for the safe and efficient management of tailings. The Tailings Management and Depositional Plan will include ARD/ML considerations and is thereby linked to the ARD/ML Management Plan.</p>
Groundwater Monitoring Plan	<p>A primary potential effect of mine operation on groundwater quality is the increase in concentrations of chemical parameters in seepage from the waste rock piles and TMF to groundwater, although the effect is likely limited given the long groundwater travel time (decades to centuries) to discharge points, and potential for natural attenuation of the parameters along the groundwater flow paths. The purpose of the groundwater monitoring plan is to provide a framework for monitoring potential changes in groundwater quantity and quality and to distinguish naturally occurring changes from changes related to the Project.</p> <p>Results of the Groundwater Monitoring Plan will be considered in the on-going management of PAG material associated with the Project and will help to identify the need for further mitigation and adaptive management measures.</p>


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Table 1.1 Management and Monitoring Plans Related to the ARD/ML Management Plan

Management / Monitoring Plan	Scope and Relationship to the ARD/ML Management Plan
Surface Water Monitoring Plan	<p>The objective of the Surface Water Monitoring Plan is to confirm compliance with regulatory requirements, evaluate predictions of Project effects on surface water quality and quantity, and determine if additional mitigation or response measures are required. The proposed monitoring program includes surface water quality and quantity monitoring at effluent discharges, downstream receiving locations, water treatment plant inlets and outlets, reference sites and visual inspections of facility infrastructure.</p> <p>Results of the Surface Water Monitoring Plan will be considered in the on-going management of PAG material associated with the Project and will help to identify the need for further mitigation and adaptive management measures.</p>

1.5 REGULATORY ENVIRONMENT

Several federal and provincial acts and regulations govern the requirements related to avoiding and reducing potential effects of mining on the environment and that relate directly to ARD/ML.

1.5.1 ARD/ML Assessment and Management

Per the NL *Mining Act*, Marathon shall not be permitted to operate the Project until all plans required under the Act have been submitted to the satisfaction of the Minister. While Section 4 of the *Mining Act* only specifically requires a Development Plan and a Rehabilitation and Closure Plan, the associated guidelines for these plans sets out requirements for ARD/ML assessment and management including the design, management, and rehabilitation of waste rock piles, ore and overburden stockpiles, TMF, open pits, and water management components (Mineral Development Division, 2020). These plans also address the design and rehabilitation of all other mine components – haul roads, site roads, ore pad, crusher, processing facilities, mine services and associated infrastructure and any associated ARD/ML management requirements that may apply.

Through the provincial requirements identified above, Marathon will not be permitted to proceed with the Project until the proponent has demonstrated to NLDIET that ARD/ML risks associated with the Project have been appropriately identified and procedures are in place to manage those risks.

1.5.2 Water Quality

The *Fisheries Act* regulates the protection of fish and fish habitat including water quality. Pursuant to the *Fisheries Act*, the *Metal and Diamond Mining Effluent Regulation* (MDMER) regulates potential adverse effects to fish and fish habitat. The release of metals liberated through ARD/ML has the potential to contravene the deleterious substance provisions of and the prohibition against killing fish (by means other than fishing) under the *Fisheries Act*.

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Water quality criteria applicable to ARD/ML include the following:

- Schedule 4 of MDMER enacted under the *Fisheries Act* (SOR/2002-222 2020)
- Schedule C of Newfoundland and Labrador Regulation 65/03 *Environmental Control Water and Sewage Regulations*, 2003 under the *Water Resources Act* (O.C. 2003-231) (NLR 65/03 2003)

Schedule C of the Newfoundland and Labrador Regulation 65/03 refers to Sections 3, 19.1, and 20 and Schedule 4 of the MDMER as follows:

“A person primarily in the Metal Mining Industry shall comply with sections 3 and 19.1 and 20 and Schedule 4 of the Metal Mining Effluent Regulations (Canada) SOR/2002-222, including any changes or amendments to those sections of and that schedule to those regulations over time.”

Therefore, the MDMER are the primary water quality criteria considered in the ARD/ML Management Plan.

Canadian Water Quality Guidelines for Protection of Freshwater Aquatic Life (CWQG-FAL) (Canadian Council of Ministers of the Environment [CCME] 2020) are used in ARD/ML assessment as screening criteria, which are not directly applicable to mine discharges.

1.6 ROLES AND RESPONSIBILITIES

Management of ARD/ML requires interdisciplinary coordination from several departments during mine construction, operations and rehabilitation and closure, including the mine engineering, and environmental teams. Table 1.2 provides an overview of the roles and responsibilities at various levels of the Project team.

Table 1.2 Roles and Responsibilities for Implementation of the ARD/ML Management Plan

Position	Role/Responsibility
Mine Manager / Chief Mine Engineer	<p>Understands the objectives of the ARD/ML Management Plan.</p> <p>Maintains records of source location, deposition location, and characteristics of PAG mine rock.</p> <p>Under the advisement of the Environment Manager, ensures only non-PAG mine rock is used for construction.</p> <p>Communicates plan for managing mine rock to site personnel.</p> <p>Ensures site personnel involved in blasting and excavation are trained in implementation of the ARD/ML Management Plan.</p>
Mine Superintendent	<p>Responsible for executing the ARD/ML Management Plan, including directing site personnel in fulfillment of the mine plan for management of mine rock according to the ARD/ML Management Plan.</p> <p>Responsible for managing data collection and conducting quality assurance/ quality control (QA/QC) of reporting geochemical data.</p> <p>Ensures mine and laboratory technicians are trained in sampling and testing.</p>

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Table 1.2 Roles and Responsibilities for Implementation of the ARD/ML Management Plan

Position	Role/Responsibility
Mine and Laboratory Technicians	Understand the objective of the ARD/ML Management Plan and follows direction of the Mine Superintendent and Environmental Superintendent. Responsible for collecting mine rock samples in support of the ARD/ML Management Plan, recording field data, submitting samples to the laboratory, conducting QC/QA or the results and maintaining a database.
Construction Manager	Understands the objectives of the ARD/ML Management Plan. Works with the Mine Engineering/Management team to manage non-PAG mine rock for use in construction. Coordinates with the Mine Engineering and Environmental teams to address testing requirements for any earthworks construction materials that require ARD/ML evaluation prior to use.
Environmental Manager	Responsible for updating ARD/ML Management Plan as needed. Liaises with and reports to regulators on compliance with conditions of authorizations/permits.
Environmental Superintendent / Coordinator	Supports and advises personnel in adhering to the ARD/ML Management Plan. Responsible for monitoring and reporting on adherence with the ARD/ML Management Plan and compliance with regulatory requirements and conditions of authorization. Responsible for reporting results of water quality and mine rock sampling in accordance with conditions of authorization and MDMER. Ensures environmental technicians are trained in sampling and testing.
Environmental Technicians	Responsible for collecting, recording and submitting water quality samples to the laboratory.
Equipment Operators	Understand the objective of the ARD/ML Management Plan and follow direction of the Site Superintendent.

2.0 PROJECT DEVELOPMENT AND COMPONENTS

2.1 PROJECT DEVELOPMENT

2.1.1 Construction Phase

Project construction is anticipated to begin in 2022 with upgrading the access road, constructing site roads, removing vegetation for site infrastructure, and pre-stripping the open pits. Civil earthworks including for the TMF, foundations and subsurface utilities, and mill and infrastructure construction will occur over a 24 to 28-month period.

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2.1.2 Operation Phase

Standard surface mining techniques will be used to mine material from the Marathon and Leprechaun open pits, including blasting, loading, hauling ore from the pit to the mill or stockpiles, processing ore, tailings deposition, hauling and placement of waste rock on the waste rock piles, and phased development of the TMF. The Marathon and the Leprechaun pits will be mined simultaneously.

For the first 3 years of operation, ore will be processed through the mill where it will be crushed, milled, and processed through gravity and cyanidation processes to recover the gold. Initially, 6,800 tonnes (t) of ore will be processed daily, with this quantity anticipated to increase to 11,000 tonnes per day (tpd) in Year 4 through the addition of the flotation process. Tailings slurry will be treated to reduce cyanide concentrations prior to disposal. Tailings will be disposed in an engineered TMF for Year 1 to Year 9/10 and will be backfilled into the Leprechaun pit after mining of the pit is complete.

2.1.3 Rehabilitation and Closure Phase

Once mining ends, site buildings and infrastructure will be dismantled and removed, sedimentation ponds will be breached (following water quality testing for regulatory compliance) and graded to reestablish drainage patterns, and disturbed areas will be graded, covered with overburden and organic materials, and revegetated. The open pits will be flooded with surface water runoff, precipitation, and groundwater seepage. Excess site contact water will be directed to the pits where practicable to expedite pit flooding. The site will be rehabilitated to as close to pre-development conditions as practicable, or to a suitable condition for an alternate use upon Project closure. The RCP will detail methods to be used for progressive and closure rehabilitation and post-closure monitoring.

2.2 PROJECT COMPONENTS AND ACTIVITIES

2.2.1 Overburden Stockpiles

Approximately 3.1 Mt of overburden will be excavated from the Leprechaun open pit and 6.5 Mt will be excavated from the Marathon open pit. Overburden will be placed in a managed stockpile and will be retained for use in progressive and closure rehabilitation activities. Drainage from the Marathon overburden pile will flow to Valentine Lake and drainage from the Leprechaun overburden will flow to Victoria Lake Reservoir via engineered ditches and sedimentation ponds that make up the operational site-wide water management system. After closure, the overall direction of flow and the environmental receivers remain the same regardless of whether the ponds are decommissioned and some of the ditches are rerouted to the open pits and/or rehabilitated.

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2.2.2 Construction Material

Construction rock will be primarily sourced from waste rock generated during development of the open pits. Waste rock types have been characterized with respect to ARD potential as described in Section 3.2 prior to use in construction to verify that only non-PAG material with low metal leaching potential is used in construction.

2.2.3 Waste Rock Piles

The Leprechaun waste rock pile will be located southeast of the Leprechaun open pit. The Marathon waste rock pile will be located northwest of the Marathon open pit. Up to 151.2 Mt and 179 Mt of waste rock will be excavated from the Leprechaun and Marathon open pits, respectively. Waste rock piles will be constructed in accordance with design recommendations for lift heights, slopes and benching, and assume an overall final closure slope angle of 30 degrees. To accomplish this, the waste rock piles will be constructed by placing single lifts of 15 m, with a 35-degree face angle and a 6.1 m safety bench using bottom-up construction.

As part of progressive and closure rehabilitation, the waste rock piles will be appropriately sloped and benched and covered with overburden and organic soils (0.3 m of each) and revegetated to reduce the risk of ARD/ML. The design of the waste rock pile slopes and placement of these materials is presented in Valentine Gold Rehabilitation and Closure Plan (no reference provided as this document will be updated regularly). Drainage from the Marathon waste rock pile will flow to Valentine Lake and the Victoria River and drainage from Leprechaun waste rock pile will flow toward Victoria Lake Reservoir via engineered ditches and sedimentation ponds that make up the operational site-wide water management system. After closure, the overall direction of flow and the environmental receivers remain the same regardless of whether the ponds are decommissioned and some of the ditches are rerouted to the open pits and/or rehabilitated.

2.2.4 Low Grade Ore Stockpiles

Low grade ore (LGO) not immediately destined for the process plant will be stockpiled for future processing, either for blending with higher grade ore or processing towards the end of the mine life. Each of the open pits will have an adjacent LGO stockpile. The Marathon LGO stockpile has a capacity of 7.0 Mm³ and the Leprechaun LGO stockpile has a capacity of 4.1 Mm³. LGO will be placed on engineered pads with runoff collection systems, which allows for water treatment, if required. Drainage from the Marathon LGO stockpile will flow to Valentine Lake and drainage from the Leprechaun LGO stockpile will flow toward Victoria Lake Reservoir during operations. At closure, the LGO stockpiles will be removed and associated ponds and ditches will be decommissioned.

2.2.5 High Grade Ore Stockpiles

High grade ore (HGO) from the Leprechaun and Marathon deposits will be stockpiled together with approximately 30% of the material on average originating from Leprechaun and the remainder from

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Marathon. The HGO stockpile will have a capacity of 1.5 Mm³ and will be placed on an engineered pad with runoff collection systems. During operations, drainage from the HGO stockpile flows by gravity to the TMF pond. The HGO stockpile will only be required for the first 5 to 6 years of operation, at which time it will be decommissioned.

Open Pits

Figure 1.2 shows the Marathon ARD block model and pit geometry above the estimated pit flood level of 330 m. Materials characterized as PAG will be exposed in the pit walls during operations. Based on the most recent ARD block model, PAG gabbro constitutes only 0.2% of total gabbro tonnage within the pit. During the post-closure period, only materials within the south-east highwall above the flooded water level within the pits will remain exposed and these rock types are predicted to be composed of non-PAG conglomerates. The north-west wall contains gabbro that may be above the expected level of the pit lake, although samples of gabbro in this area were non-PAG. Water quality predictions show that the ARD/ML effects of exposed PAG material on the pit lake water discharge is low. If it is determined that sufficient PAG material is above flooded elevation of the pit, adaptive measures will be triggered to address PAG exposed in the highwalls, whether PAG or other rock types, as described in Section 5.1.7. Mine water discharged from the Marathon open pit will flow to the Victoria River, whereas mine water from the Leprechaun open pit will flow to Victoria Lake Reservoir. The open pits will be flooded and PAG material exposed in the pit walls will be submerged preventing ARD from these materials in the post-closure period. Drainage from the flooded pits will flow to the same receptors as during operation.

2.2.6 Tailings

Approximately 47 Mt of tailings will be produced during processing of both HGO and LGO with about 38% of the tailings originating from the Leprechaun pit and the remainder from the Marathon pit. Ores from the two open pits will be blended during handling, crushing, milling, and processing such that tailings deposition will be a 'composite' of materials from both pits. Blending the materials from both pits is necessary to achieve the grades required for the process design and production requirements for the Project.

Tailings will be managed for the first 9 to 10 years of operation in the TMF (31.6 Mt of tailings). After Year 9/10 of the operation phase, tailings will be slurried to the Leprechaun open pit until cessation of the milling operation (15.5 Mt of tailings). After tailings disposal transitions to the Leprechaun pit, tailings beaches formed in the TMF will be covered with overburden and organics and revegetated. Tailings contained in the Leprechaun pit will be flooded at closure.

Water produced by the TMF will be reclaimed to the mill process plant to satisfy the process water demand and limit the volume of discharge from the tailings impoundment to the environment. Water from the TMF not used in ore processing will be treated via the water treatment plant and discharged to a polishing pond prior to discharge to Victoria Lake Reservoir during operations. During closure, drainage from the TMF will flow to the Victoria River.

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2.2.7 Water Management

As described in the Water Management Plan (refer to Table 1.1), water management across the site will be implemented to divert non-contact water where feasible. Contact water treatment will focus on sedimentation, as this will reduce total suspended solids (TSS) and the particulate fraction of metals. Water management in each of the three site complexes (Marathon, Process Plant and TMF, and Leprechaun) will function independently, with decentralized water treatment and management in each. Water management components consist of sedimentation ponds, berms, drainage ditches, and pumps to collect and contain surface water runoff from waste rock, LGO stockpiles, overburden stockpiles, open pits and site infrastructure where required.

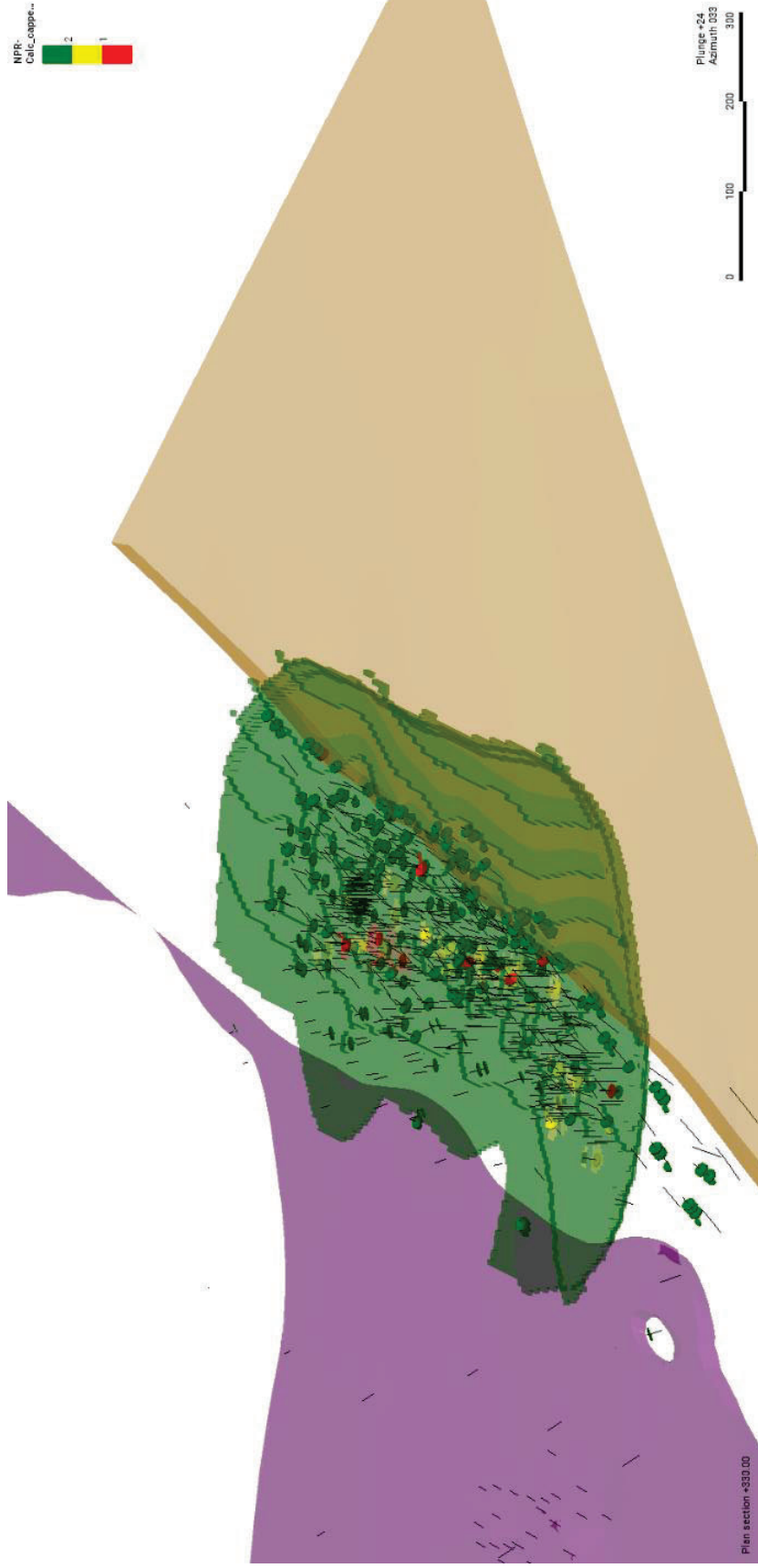


Figure 2.1 Marathon ARD Block Model and Pit Geometry Above the Estimated Flooded Level of 330 m

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3.0 ARD/ML CHARACTERIZATION


3.1 INFORMATION AND DATA SOURCES

The following documents related to ARD/ML have been prepared to support the geochemical evaluation of the Project:

- Stantec Consulting Ltd. (Stantec). 2018. Preliminary Results of Phase I ARD/ML Assessment. Final report prepared for Marathon Gold Corp. on 23 March 2018. (Also submitted as Baseline Study Appendix 5, Attachment 5-A of the EIS).
- Stantec Consulting Ltd. (Stantec). 2020. Acid Rock Drainage/Metal Leaching (ARD/ML) Assessment. Final report prepared for Marathon Gold Corp. on 22 September 2020. (Also submitted as Baseline Study Appendix 5, Attachment 5-B of the EIS).
- Stantec Consulting Ltd. (Stantec). 2020. Valentine Gold Project Water Quality and Water Quality Modelling Report: Leprechaun Complex and Process Plant & TMF Complex. Final report prepared for Marathon Gold Corp. on 23 September 2020. (Also submitted as Appendix 7A of the EIS).
- Stantec Consulting Ltd. (Stantec). 2020. Valentine Gold Project Water Quality and Water Quality Modelling Report: Marathon Complex. Final report prepared for Marathon Gold Corp. on 25 September 2020. (Also submitted as Appendix 7B of the EIS).
- Marathon 2022. ARD/ML Management Plan (preliminary). January 2022
- Stantec Consulting Ltd. (Stantec 2022). Phase III ARD/ML Acid Rock Drainage/Metal Leaching (ARD/ML) Assessment. September 2022.

Since the submission of the EIS, Marathon has continued ARD/ML testing and analysis to address data gaps and requests for additional information that have been identified through the federal and provincial technical review of the EIS. The additional testing and data analysis include the following:

- Marathon completed static testing of approximately 250 additional samples from the Marathon pit and 150 samples from the Leprechaun pit to conform with minimum number of samples required by MEND.
- Marathon completed testing of approximately 1,600 additional samples for sulphur and total inorganic carbon (TIC) to support development of the ARD block model for the Marathon pit.
- An ARD block model was generated and updated for the Marathon pit to provide production schedules for ARD classes of rock and ore.
- Marathon completed two humidity cell tests (HCTs) containing carbonate depleted LGO and tailings from the Marathon deposit (started in 2020), and on a tailing sample from on-going metallurgical work (started in 2021).
- Marathon conducted additional water quality model runs to evaluate the sensitivity of results to a reduction in the ARD onset time for Marathon's ore, LGO and waste rock (IR 21b in Appendix A, Marathon 2022).

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- Marathon started a new set of kinetic tests of materials with high ARD/ML potential. This set of laboratory kinetic tests is focused on PAG materials with total sulfur and metal content above median values for respective material / lithology. These samples have been analyzed for static test properties, Net Acid Generating (NAG) tests and static test results will be presented in the ARD/ML Phase III Report.

The methods of geochemical testing and analysis are the same as described in Stantec 2022. The current estimates of PAG material in the deposits are based on tonnages of major lithologies calculated from the geological block models. Some lithologies, which were separately assessed in the EIS, are currently combined as indicated in Table 3.1 and Table 3.2. For example, sediments and sediments with quartz-tourmaline-pyrite veins are currently combined in Leprechaun model. For the Marathon deposit, an ARD block model was developed in addition to the geological block model. Further development of the geological block model allowed separation of mafic dykes and non-ore quartz vein zones included in the ARD block model as presented in Table 3.2. However, gabbro volume was combined with quartz-porphyry in the ARD block model due to limited spatial coverage. The volume of gabbro will be refined as data becomes available and verified in the field through geological mapping and confirmatory sampling. Tonnages of PAG materials were estimated by either of the following two methods.

The first method involved multiplying the fraction of PAG samples by lithology tonnage extracted from the most recent geological model (referred to as sample count tonnage in Table 3.1 and Table 3.2). This method is less accurate, but more conservative and allows estimation of PAG tonnages for gabbro and overburden.

In the second method, direct tonnage output was derived from the ARD block model, which should be more accurate than estimates from sample count.

This section of the ARD/ML Management Plan will require specific updates as the Project advances through environmental assessment, detailed engineering, additional ARD/ML test work, assessment and reporting, and permitting to reference and consolidate the appropriate information and data supporting this Plan.

3.2 ARD/ML ASSESSMENT SUMMARY

This section summarizes the ARD/ML characterization of materials excavated or exposed by the Project.

3.2.1 Marathon Deposit

- Overburden: The estimated percentage of PAG (neutralization potential ratio [NPR] <1) plus uncertain waste rock (1<NPR<2) is 10% of the total tonnage. The test results show no exceedances of MDMER limits observed in leachates from overburden. In SFE tests, fluoride (F), aluminum (Al), arsenic (As), cadmium (Cd), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), lead (Pb), selenium (Se), and zinc (Zn) exceeded respective CWQG-FAL, but recent kinetic testing confirmed that only Cd, Mn, Se, and Zn exceeding CWQG-FAL thresholds.

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- Waste Rock: The overall percentage of PAG rock (NPR<2) is estimated to be between 1.5% and 4% based on the ARD block model and sample count methods, respectively. Sediments are classified as non-PAG rock regardless of method used. The geological and ARD block models provide the following percentages of PAG rock tonnages in modeled lithologies: quartz zones of non-ore QTP veins (7.4-15%), Quartz Porphyry varieties (1.9% - 4.7%), gabbro (0.2% - 2.6%) and, mafic dykes (0.4 - 0.9%). PAG QTP veins, Quartz Eye Porphyry and gabbro are not expected to generate acidity within 31, 45 and 4.7 years of exposure, respectively. These estimates of ARD onset are based on NP depletion times in HCTs containing PAG rock from the respective lithologies (Stantec 2022, Appendix B, Table B-8).

There are no exceedances of MDMER limits observed in kinetic tests and SFE, except for the humidity cell test (HCT) containing the only PAG sample of gabbro. Leachates from this cell show MDMER exceedances for As under neutral conditions (before ARD onset) and for Cu and Ni when/if ARD occurs. Drillhole logs indicate that PAG gabbro with is rare and occurs in short intervals up to 2 m, which likely results in mixing PAG and non-PAG rock during mining. Other waste rock lithologies show CWQG-FAL exceedances for Al, P, Cu, Mn, Pb, Hg, Se, and Zn in leachates from kinetic tests. Exceedances for Pb, Hg, Zn and P are single events which are attributed to laboratory error or first flush at week zero of kinetic tests (Stantec 2022).
- LGO: 18% to 49% of the low-grade ore is conservatively classified as PAG (NPR<2) based on ARD block model and sample count methods, respectively. The average ARD onset time in PAG LGO is between 14 and 22 years based on average inputs from humidity cells (Stantec 2022). Comparison of laboratory and field kinetic test shows that field NP depletion time is ~13 times greater than estimated based on laboratory rates. Overall estimates of ARD onset time indicate that PAG LGO is unlikely to produce ARD before the material is processed. There are no exceedances of MDMER limits observed in LGO leachates under neutral conditions. Exceedances of CWQG-FAL for Al, Cd, Cu, P, Pb, Se, and Zn were observed in field and/or laboratory kinetic tests. A marginal exceedance of MDMER for Cu was observed in one carbonate depleted HCT used to simulate acidic conditions in the LGO.
- HGO: Between 23% and 51% of Marathon high-grade ore is conservatively classified as PAG material (NPR<2) based ARD block model and sample count methods, respectively. The ARD onset time is approximately 14 years and was reevaluated using estimates from HCT containing PAG HGO (Stantec 2022). The HGO stockpile is only required for the first 5 years of operation. In addition, continuous withdrawal of ore to the mill and replenishment with new materials from the open pits will further reduce the risk of ARD. There are no exceedances of MDMER limits or CWQG-FAL observed in recent HCT containing PAG HGO under neutral conditions. Under mildly acidic conditions (pH~5), PAG HGO shows MDMER limits for Cu up to 1.3x in exceedances of carbonate depleted humidity cell. In addition to Cu exceedances of CWQG-FAL for Zn (3.7x) Cd (3.5x) and marginally for Al in leachates from this kinetic test.

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The updated tests summarized above improve the confidence in the interpretation of ARD/ML test results and the related predictions and mitigation measures presented in the EIS. Additionally, there is a reduction in ARD risk for waste rock within the Marathon deposit. Recent results show metal leaching risks for:

- As leaching above MDMER limits from the sample of PAG gabbro under neutral conditions and Cu and Ni under acidic conditions.
- Cu that may be above MDMER limits in PAG pockets of LGO and HGO if acidic conditions develop.

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Table 3.1 Tonnages of lithological units from geological block model of the Leprechaun deposit and numbers of samples per unit

Block Model Lithology	Material type	2021 geological block model Tonnage, Mt	Suggested frequency per Table 8-2, MEND (2009)	# of samples tested to date	samples with NPR<2 (PAG + uncertain)		Tonnage of materials with NPR<2 (PAG + uncertain)	
					#	%	Mt	%
Leprechaun Deposit								
Metasediments*	Waste Rock	41.2	80	80	1	1.3%	0.52	1.0%
Trondhjemite**	Waste Rock	110	80	112	1	0.9%	1.0	
High Grade Ore	Ore	12.4	80	81	3	3.7%	0.46	3.7%
Low Grade Ore	Ore	5.0	26	28	1	3.6%	0.18	3.6%
Overburden	Waste	3.1	26	29	1	3.4%	0.11	3.4%
Total		171.7	292	330	7	2.1%	2.2	1.3%

Notes:

*Sample count and geological model includes conglomerate and sediments with QTP veins (OZ-STQP).

**Sample count geological model includes Trondhjemite/Granodiorite, Mafic dykes and non-ore QTP veins in Trondhjemite/Granodiorite and Mafic dykes.

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Table 3.2 Tonnages of lithological units from geological and ARD block models of the Marathon deposit and numbers of samples per unit


Block Model Lithology	Material type	2021 geological block model Tonnage, Mt	ARD BM output Tonnage, Mt	# of samples tested	Suggested frequency per Table 8-2, MEND (2009)	samples with NPR<2 (PAG + uncertain)	blocks with NPR<2 (PAG + uncertain)	Sample count tonnage with NPR<2, Mt	ARD BM NPR<2 Tonnage, Mt
Metasediments*	Waste Rock	33.4	37.9	94	80	0	0%	0	0
Gabbro (GB)	Waste Rock	8.3	13.4	39	26	1	2.6%	0.3	0.03
Mafic Dike	Waste Rock	-	2.3	215	26	2	0.9%	0.02	0.01
QEPOR**	Waste Rock	136.1	124.1	654	80	31	4.7%	5.8	2.1
High Grade Ore	Ore	21.1	21.1	370	80	187	51%	10.7	3.1
Low Grade Ore	Ore	8.6	8.6	338	26	166	49%	4.2	1.1
QTP, Au<0.3 g/t	Waste	-	1.8	299	26	22	7.4%	0.1	0.28
Overburden	Waste	7.6	5.8	30	26	3	10%	0.6	not modeled
Total		215.0	215.0	2039	370	412	20%	21.8	6.7

Notes:

*Sample count and geological model includes conglomerate and sediments with QTP veins (QZ-STQP).

**Sample count and geological model includes Quartz Porphyry Varieties, Mafic Dike and non-ore QTP veins in Quartz Porphyry and Mafic Dike. In ARD block model, Quartz Porphyry (QEPOR) includes Quartz Porphyry Varieties.

*** Tonnage from 2022 geological block model, which was not included in the ARD block model.

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3.2.2 Leprechaun Deposit

- **Overburden:** Overburden has only one sample of 29 that classifies as uncertain, contributing to 3.4% of the total tonnage. There are no exceedances of MDMER limits observed in leachates from overburden, including the latest test results. No exceedances of the MDMER limits are observed in SFE, but Al, As, Cu, Fe, Pb, and Zn are above the CWQG-FAL's.
- **Waste rock:** The overall estimated percentage of PAG (1<NPR) and uncertain waste rock (1<NPR<2) is 1.0% of the total rock tonnage (Table 3.1). There are no exceedances of MDMER limits observed in SFE, humidity cells, and field bins, including the results of the latest kinetic tests. PAG rock is only associated with quartz zones of non-ore QTP veins in Sediment (SQTP) and in Trondhjemite/Granodiorite (QZ-TQTP), while all samples of pure trondhjemite/granodiorite and sediments, are non-PAG. Samples of mafic dykes, even with non-ore QTP veins are all non-PAG. Therefore, operational testing of non-PAG lithologies will be revisited after the initial phase of confirmatory sampling of the Leprechaun pit. There are no exceedances of MDMER limits observed in SFE, humidity cells, and field bins, including results from the latest kinetic tests. Waste rock shows exceedances of CWQG-FAL for F, Al, P, Cu, Pb, Se, and Zn based in leachates from kinetic tests. Exceedances for Pb, Zn and P are single events which are attributed to laboratory error or first flush in samples containing non-ore QTP veins (QZ-TQTP and QZ – QTP). Concentrations of identified PoPC (Parameters of Potential Concern) typically decline below the respective CWQG-FAL threshold in most of kinetic tests during the testing periods.
- **LGO:** Approximately 3.6% of low-grade ore would classify as PAG. Estimates time of NP depletion time of LGO are approximately 33 and 287 years for laboratory and field conditions, respectively. Therefore, isolated PAG pockets in the low-grade stockpile are not expected to generate ARD before the stockpile is processed in the mill. No exceedances of the MDMER limits are observed in leachates from LGO. Kinetic testing shows exceedances of CWQG-FAL thresholds for Al, P and Se.
- **HGO:** Only 3.7% of Leprechaun high-grade ore is conservatively classified as PAG (NPR<2). There are no exceedances of MDMER limits observed in SFE and in recent HCT from high grade ore. A single exceedance of CWQG for Zn was observed in week 8 of humidity cell testing and likely attributed to analytical error.

The updated results summarized above improve the confidence in the ARD/ML predictions presented in the EIS. As a consequence of this update, materials from the Leprechaun deposit show a slight increase in the percentage of waste rock and overburden material classifying as PAG and uncertain; however, there is also a significant reduction in ARD risks for LGO and HGO. Metal leaching risks are similar to that presented in the EIS.

3.2.3 Tailings

Based on the ARD block model, 23% or less of Marathon ore blocks are classified as PAG, and all of Leprechaun ore blocks are non-PAG (Table 3-1 and 3-2). Composite samples of tailings from both deposits classify as non-PAG and are not expected to generate ARD. One additional sample of tailings was tested and classified as non-PAG.

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Sensitivity analysis of tailings chemistry indicates that tailings are not expected to be PAG as a result of mixing of Marathon and Leprechaun ores (refer to response to IR-21, Appendix A in Marathon 2022). During operation, the TMF pond and pore water will likely exceed the MDMER limits for total cyanide (CN(T)), un-ionized ammonia, and Cu sourced from process water. In addition, high leaching potential is also determined for total ammonia, weak acid dissociable cyanide (CN_{WAD}) (surrogate for free CN), F, Hg, P, and Fe. Seepage from the TMF is conservatively predicted to exceed MDMER limits for CN(T), un-ionized ammonia, and Cu in post-closure. The CWQG thresholds were exceeded in kinetic tests for Ag, As, Cd, F, Fe, CN_{WAD} (a surrogate for CN_{Free}), Hg, Mn, Mo, P, NH₃+NH₄, Se, and Zn. Among these parameters, the water quality model results confirm exceedances of CWQG for As, F, Fe, Cd, CN_{WAD} (a surrogate for CN_{Free}), Hg, Mn, P, NH₃+NH₄, and Se in discharge from the TMF pond (Stantec 2020b). An assimilative capacity study indicates that if TMF pond effluent treated for all parameters to meet MDMER discharge limits would also be below the CWQG thresholds or background concentrations within 300 m of the regulatory mixing zone (Stantec 2020d).

3.2.4 Open pits

Materials characterized as PAG will be exposed in the pit walls during operations, but the majority of these materials are not expected to generate ARD before the pits are flooded during the mine closure period based on ARD onset estimates. In post-closure, only materials within the highwall above the flooded elevation of the pit lake will remain exposed. As described in Section 2.2.6 exposed rock types are mostly represented by conglomerates that showed a low risk of ARD/ML based on testing completed to date. Minor amounts of gabbro may be exposed on the north-western wall of the flooded pit. This area had samples of gabbro that were non-PAG, however, gabbro does have some ARD/ML potential. Management of potential ARD/ML from minor amounts of gabbro is further discussed in Section 4.1.4. During tailings deposition, elevated concentrations of Cu, unionized and total NH₃, and total and free CN are predicted in Leprechaun pit lake water during discharge of tailings slurry from the Plant and overflow from tailings pond in the final years of operation. Concentrations of these parameters show a significant decline during closure before the pit lake is full due to degradation and dilution with groundwater. No exceedances of MDMER guidelines are predicted in mine water or pit lake overflow from both sites based on probabilistic water quality modeling (Stantec 2020b and 2020c).

3.3 PRE-PRODUCTION TESTING AND ANALYSIS

Pre-production ARD/ML laboratory testing and analysis will guide final design of Project components and management of mined, processed and exposed rock materials. Additional ARD/ML work will be used, along with the results obtained to date, to refine the ARD/ML mitigation measures related to waste rock management, stockpile management, and tailings management via this ARD/ML Management Plan, such that PAG materials are managed to avoid or limit potential long-term effects. The continuing pre-production testing and analysis program is detailed as follows:

- Confirmatory testing of rock from Leprechaun and Marathon starter pits that will be used as construction material including development of the TMF and subsequent TMF dam raises

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- Field kinetic (bin) tests of composite materials initiated in 2020 will be continued for a minimum of 2 years and will then be assessed to determine if continuation of the tests is warranted.
- The ARD block model will be integrated with the mine block model to forecast the ARD potential for mine rock within the pit, and plan for ARD management at the waste rock pile (e.g., planning and creation of areas for encapsulation).
- Water quality predictions will also be updated during the detailed engineering based on results of the additional testing and analysis, including results from new humidity cells, field kinetic tests, and ARD block model for the Marathon pit.

4.0 ARD/ML MANAGEMENT

4.1 SAMPLING, TESTING AND ARD CLASSIFICATION OF SOLIDS

4.1.1 Operational Sampling

During construction and operation, sampling will be conducted to refine the ARD block model and improve the accuracy (quantity and delineation) of PAG and non-PAG materials. Sampling is planned to be conducted at rate indicated in Table 4.1. The details of sampling of each material are discussed in Section 4.1.4.

Table 4.1 Summary of Operational Sampling Program

Component	Estimated Tonnage	Sampling Rate	Estimated number of Samples (Life of Mine)
Overburden	11.7 Mt	1 per 50,000 t	234
Waste / Construction Rock	317 Mt	1 per 9,000 t	~35,200 ¹
Low Grade Ore	33.5 Mt	1 per 9,000 t	~3,720 ¹
High Grade Ore	13.6 Mt	1 per 9,000 t	~1,150 ¹
Tailings (End of Pipe)	47 Mt	1 per 48,000 t (Year 1 to 3) 1 per 77,000 t (Year 4 to 9/10)	~ 620
Tailings (Beaches)	TBD	1 per 10,000 m ² at closure	~250
Notes: ¹ sampling rate may be reduced during operations following reconciliation of the ARD block model and results from the confirmatory sampling program. Mt million tonnes TBD to be determined			

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4.1.2 Laboratory Analyses

Samples will be tested at the on-site laboratory for sulphur, total inorganic carbon, and trace elements (by portable X-ray fluorescence or a similar method). A split of one in every ten samples will be analyzed at an external laboratory for standard static tests including acid base accounting (ABA), SFE, and total metals. The split sampling frequency may change depending on the reconciliation of external laboratory results and on-site test results.

Samples that are sent to the external lab will be tested according to methods consistent with Price (2009):

- ABA package including, modified Sobek neutralization potential (NP) with siderite correction, carbonate NP calculated from total inorganic carbon, fizz rating, paste pH, total sulphur by LECO, sulphate sulphur by HCl extraction and acid potential (AP) calculated from the difference between total and sulphate sulphur
- SFE testing method, involving continuous mixing of a crushed sample (85% passing 6.3 mm) with deionized water (1:3 rock to water ratio) for 24 hours, and leachate analysis by inductively coupled plasma mass spectrometry (ICP-MS) for trace elements. In addition, SFE leachates will be analyzed for pH, alkalinity and acidity by titration, and sulphate by colourimetry.
- Total metals by aqua regia digestion with ICP-MS detection.

4.1.3 ARD Screening Criteria

ARD potential is required for classification and management of mine materials. ARD potential is evaluated using the NPR that is calculated as the ratio between NP and AP. Samples are classified as non-PAG if $NPR > 2$ and classified as PAG if $NPR < 2$. Preliminary acid generating potential of the samples is determined using total inorganic carbon (TIC) and total sulphur data generated by the on-site laboratory. Values of NP, AP, and NPR are calculated using the following equations (Price 2009):

$$NPR = \frac{NP}{AP} \qquad NP = \% \text{ total inorganic carbon} \times 83.33 \qquad AP = \% \text{ sulphur} \times 31.25$$

Comparison of siderite corrected NP and carbonate NP typically produce similar results when carbonate NP is greater than 40 kg calcium carbonate (CaCO_3) per tonne for the Leprechaun deposit and greater than 20 kg CaCO_3 per tonne for the Marathon deposit. At lower carbonate NP, siderite corrected NP results are greater than carbonate NP. Carbonate NP is selected for ARD/ML assessment for the Project because it results in more conservative ARD classification of samples (Stantec 2020a). The exception for using TIC for calculation of NP could be for the graphitic metasediments (mudstones), which occur outside the design footprint of the open pits, but could be found in prospects for construction materials. These rock types should be tested for carbonate content using HCl evolution method and as input instead of TIC for calculation of NP and ARD classification.

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4.1.4 Material Management

4.1.4.1 Overburden

Most of overburden from the Leprechaun and Marathon deposits is non-PAG with 3.4% and 10% of samples conservatively classified as PAG (NPR<2), respectively. Confirmatory samples will be collected and tested as overburden is excavated at rate of one sample per 50,000 t per MEND Manual recommending a frequency of 50,000 t to 100,000 t “where all the rock is either PAG or non-PAG and the purpose of sampling is documenting the elemental concentrations and ABA parameters” (Price 2009, page 8-23). If PAG overburden is identified by testing, it will be segregated from non-PAG overburden and placed in the waste rock pile in accordance with the management protocols for PAG waste rock.

4.1.4.2 Construction Rock

Non-PAG waste rock generated during open pit development will be used for construction of pads, roads, and building foundations, or will be placed in the waste rock pile. Based on the current development plan, all waste rock will be used for construction during the construction phase of the Project. Geochemical characterization indicates that coarse sediments (conglomerates) without QTP veins from both deposits could be good sources of non-PAG rock. In addition, pure trondhjemite/granodiorite, without non-ore QTP and of mafic dykes from Leprechaun pit do not contain PAG samples. All these lithologies and do not show exceedances MDMER limits or CWQG-FAL thresholds in average concentrations from kinetic tests, except for marginal exceedance for CWQG-FAL for aluminum, which is also above this threshold at the baseline conditions. Sources of rock will be tested and further evaluated prior to use in construction to confirm that only non-PAG material with a low potential to generate metal leaching is used in construction.

During pit development and excavation of waste rock for construction, confirmatory samples of cuttings from reverse circulation (RC) drilling in material that are identified as construction material will be collected from 5 m depth intervals from holes spaced at 25 m by 25 m, as is common practice in open pit mines. Any material characterized as PAG will be excluded from use in construction and will be managed as described in Section 4.1.4.3.

4.1.4.3 Waste Rock

A higher proportion of PAG waste will be generated from Marathon open pit development compared to Leprechaun open pit as described in Section 3.2. As such, an ARD Block Model for the Marathon deposit will be updated based on confirmatory and operational sampling and testing as described in this section. A similar confirmatory and operational sampling approach will be applied to the Leprechaun pit; however, ARD classification will be prescribed by the mine / resource block model to forecast the location and timing of PAG waste to be mined from the pit and to plan for ARD management.

Confirmatory samples of cuttings from RC drilling in material identified as waste rock will be collected from 5 m depth intervals from holes spaced on a 25 m by 25 m grid. This additional data will be integrated with the Marathon ARD block model to improve the accuracy (quantity and delineation) of PAG and non-

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PAG rock 3 to 4 months ahead of mining. As mining progresses, samples will also be collected from blast hole cuttings for additional testing to confirm the data within the block model prior to mining. The sampling rate may be reduced following validation of the ARD block model based on ARD/ML QP recommendations and approval under the Mining Act. The ARD block model will be considered validated when PAG rock is identified with a minimum accuracy of 95% in a calendar year.

The Mine Superintendent (and/or designates) will work with the mine geology and surveying teams to review the ARD block model data, complete geological/mine mapping, and use 3D mine mapping to identify PAG zones and confirm through additional testing. PAG waste rock will be demarcated (stakes, paint, etc.) prior to and post-blast. The material characterized as PAG waste rock (NPR <2), extending to the adjacent borehole samples with NPR greater than two (Figure 4-1), will be marked after the blast, excavated, and dispatched to the waste rock pile. A process will be set to clearly communicate to the equipment operators what material is PAG prior to excavation and haul to the WRSF.

Similarly, at the WRSF, the mine geologist and survey team will demarcate bench geometries (toes, offsets, etc.) and disposal locations for waste rock to achieve the blending and encapsulation requirements within the pile. A process will also be set at the WRSF to communicate to the equipment operators where and how materials will be placed. PAG rock will be deposited no closer than 9.1 m (bench width 6.1 m + 50% safety factor) from final lift face and over a non-PAG truck load (Figure 4.2). Surveying of the overall WRSF and the placement locations for PAG materials will ensure these materials are properly placed within the pile and tracked to ensure PAG materials in successive benches are segregated.

The method of waste rock pile construction such as end-dumping and paddock fill will depend on the bench geometry, PAG volume, and other constraints at time of mining. The starter lift will be more efficiently constructed by paddock method until the initial lift reaches full height (e.g., 15 m for WRSF). After the full height is reached, end-dumping will likely be the preferred method of deposition.

In the paddock deposition method, grading will provide partial mixing of the top portions of PAG/non-PAG loads. During end-dumping, PAG rock mixes with non-PAG rock as the end-dumped material rolls down the lift face (Figure 4.2).

A portion of PAG and non-PAG rock loads will be mixed on the pile face and during grading each lift of the stockpile. This mixture will be encapsulated with non-PAG rock (buffer) and deposited as described previously. The blended PAG and non-PAG will be covered with a non-PAG layer forming the final topmost lift(s) of the stockpile. Non-PAG rock will reduce oxygen flux into the interior of the pile and provide alkalinity to infiltrating water.

The maximum thickness of the PAG layer for blending was estimated to be 2.1 m using the approach described in Day (2021). The maximum thickness was rounded down to 2 m for ease of measurement with no reduction in protection. Therefore, starter lift layers containing PAG rock should not exceed 2 m and should be covered with a layer of non-PAG rock of the same thickness. The topmost lift of the WSFs will be covered with a minimum of 2 m of non-PAG rock. There are successful examples of blending with waste rock that contain higher contents of PAG material than predicted for the Marathon WRSF.

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For example, at the Quintette Coal Project (British Columbia) blending of PAG and non-PAG waste rock was selected due to the low overall percentage of PAG waste rock (12%). In addition, PAG rock had been mined historically at the same location without specialized engineering controls to address the potential for acidification, but no ARD has been detected by drainage monitoring (Day, 2021). Field tests including pore gas monitoring will be initiated to evaluate effectiveness of the proposed waste rock blending and encapsulation methods as material becomes available during early operations phase.

The exception from rock management, which is discussed in the previous paragraph, will be PAG gabbro lithology (NPR <2). This material may result in leaching arsenic above the MDMER limit upon exposure. PAG gabbro will be segregated during excavation and transported to the footprint of the LGO stockpile, allowing for treatment in case of development of ARD/ML. This material will be returned to the Marathon pit when mining is complete. Other lithologies in Marathon or Leprechaun waste rock stockpiles are not expected to produce seepage that exceeds MDMER limits based on water quality modeling prediction (Stantec 2020 b and c). The assimilative capacity assessment showed that the levels of the PoPC in the receiving water bodies from waste rock discharges meet the CWQG thresholds at the edge of mixing zone (2020d). Water quality predictions will be verified by monitoring and the need for mitigation will be evaluated as part of adaptive management discussed in Section 5.0.

The waste rock piles will be developed from the bottom up, in lifts with specified slopes and benching per closure requirements and will be progressively rehabilitated over the operations phase of the Project. As part of the progressive and closure rehabilitation, the waste rock piles will be covered with soil, and revegetated, further inhibiting oxygen and water migration through the piles.

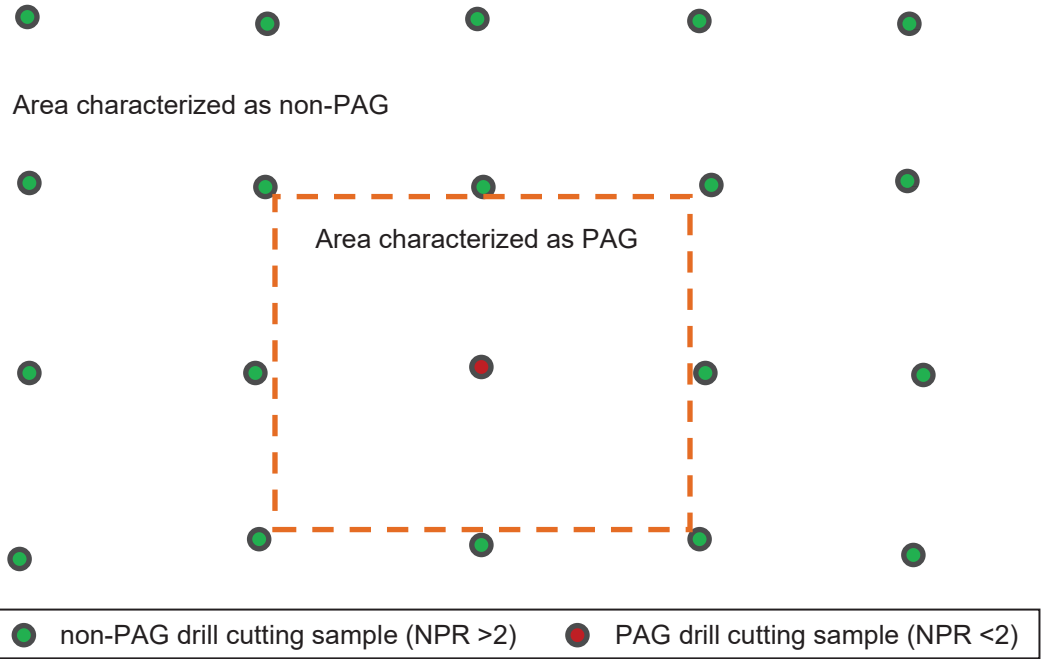


Figure 4.1 Delineation of PAG Material Based on Drill Cuttings (Plan View)

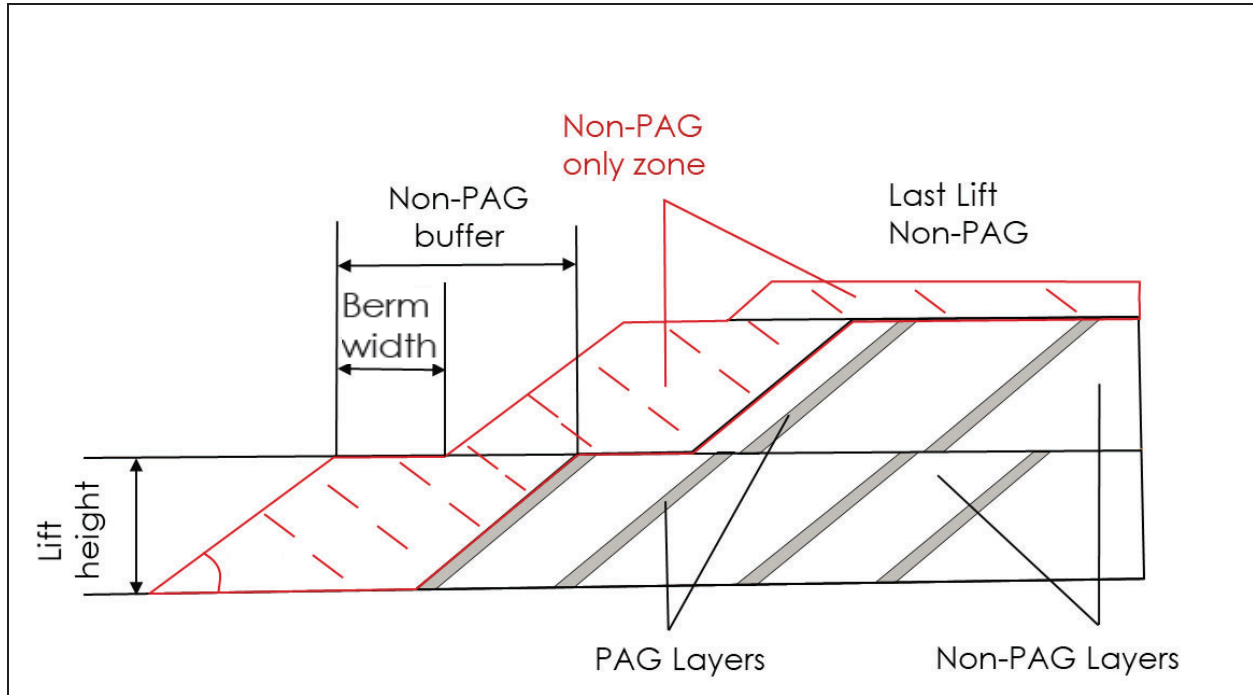


Figure 4.2 Conceptual Cross-Section of Waste Rock Pile

4.1.4.4 Low Grade Ore

Up to 49% of the Marathon's LGO is classified as potentially non-PAG while most of LGO from Leprechaun (96%) predominantly is non-PAG with excess of NP. Therefore, ARD risk related to Leprechaun LGO stockpile is low and does not require specific ARD management. ARD and associated metal leaching from Marathon's LGO is unlikely to occur before all the LGO has been processed at the mill. Nevertheless, non-PAG LGO will be preferentially stockpiled and PAG LGO will be preferentially directed to the mill feed, as long as the grade requirement for the mill feed is met to further reduce ARD/ML risks.

4.1.4.5 High Grade Ore

Approximately 4% and up to 51% of ore samples from Leprechaun and Marathon pits, respectively, are conservatively classified as PAG. The overall mixture of Leprechaun and Marathon HGO is classified as non-PAG due to excess NP, and the HGO stockpile is not expected to generate ARD during its lifetime of 5 to 6 years, as discussed in detail in the response to IR DIET-09 (Appendix A in Marathon 2022). Even though ARD is not expected, to limit exposure of PAG high grade ore within the stockpile, PAG HGO will be preferentially directed to the mill feed, while non-PAG high grade ore will be allocated to the stockpile, as long as the grade requirement for the mill feed is met.

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4.1.4.6 Tailings

Tailings will be deposited in the TMF during Year 1 to 9/10 of operation and in the Leprechaun pit during the last three to four years of operation. During operation, samples of thickened tailings representative of end-of-pipe discharge will be collected weekly. This will result in a sampling rate of one sample per approximately 50,000 t during Years 1 to 3 and one sample per 77,000 t starting in Year 4.

Tailings beaches in the TMF will be rehabilitated prior to closure when tailings deposition transitions to the Leprechaun pit. Testing of composite samples of tailings and additional assessment of the ARD block model indicate that combined Marathon ore (LGO and HGO) will be non-PAG (NPR>2) for all years of mining without segregation and blending for the purposes of ARD/ML management. Therefore, even if ore from Marathon was not mixed with Leprechaun ore, the tailings is not expected to be acid generating. However, to further reduce risks of PAG tailings, non-PAG LGO will be preferentially stockpiled and in the unlikely event that operational management and monitoring indicate exposed PAG tailings within the TMF in the final year prior to closure of the TMF, this non-PAG LGO will be processed to produce tailings which will then be used to cover any areas of PAG tailings. The approach of preferentially stockpiling non-PAG LGO will create a non-PAG layer of tailings on the surface of the TMF. This non-PAG layer is expected to consume oxygen, reducing oxygen diffusion into tailings deposited earlier. Once the TMF is full and ready for closure, tailings will be directed to the Leprechaun pit for final disposal.

Tailings deposited in the Leprechaun pit will be flooded as quickly as practicable limiting further oxidation and ARD/ML. Additional investigation and assessment, such as one-dimensional modelling or unsaturated column tests, will be initiated once closure designs and experimental materials are available in the first years of operation. These investigations will be designed to assess the efficacy of the closure and rehabilitation plan for tailings in the TMF.

Prior to rehabilitation (soil cover and revegetation) of the tailings beaches, a confirmatory sampling program will be conducted to verify the tailings exposed at closure are non-PAG. A minimum of one tailings sample will be collected for every 10,000 m² (100 m x 100 m) from exposed beaches and composed over a depth interval from surface to 0.5 m deep, where most of oxygen is consumed and ARD could occur in PAG patches. If a PAG sample is identified, additional samples will be collected at closer spacing to identify the extent of PAG tailings and further mitigation measures, as described in Section 5, may be required. The tailings sampling program will be reviewed annually and updated as additional information becomes available. In closure, exposed tailings will be covered with overburden and organic soil materials and revegetated. Water from the tailings impoundment will be channeled to release directly to the environment once testing confirms that water quality meets the appropriate guidelines for release. Subsequently, the emergency spillway will be lowered/breached to allow passive drainage from the facility as a closure spillway and complete removal of the supernatant pond. Toe seepage from the TMF is predicted to require additional treatment in closure and post-closure, and two seepage treatment options may be employed to comply with MDMER: (1) conversion of the perimeter conveyance ditches into subsurface flow Permeable Reactive Barrier (PRB) trenches; and/or (2) conversion of the perimeter conveyance ditches into subsurface “French Drains” to convey effluent to an engineered wetland treatment system (for further details refer to response to IR DIET-05 in Appendix A, Marathon 2022) .

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4.1.4.7 Open Pits

Further updates of the ARD block model and operational monitoring will allow to map PAG materials on pit walls/benches. At closure, the majority of these materials will be saturated following accelerated flooding of open pits to reduce the risk of ARD/ML generation.

Modelling of water quality discharges from open pits considers potential ARD/ML from pit walls and rock rubble accumulated on pit benches. The results of current modelling indicate that discharges from the pits are expected to be near-neutral and will not exceed MDMER limits. This modelling will be updated as additional information becomes available as part of detailed engineering and permitting.

4.2 CONTACT WATER MONITORING, TESTING AND ANALYSIS

A contact water monitoring program will be established to verify the prediction that that ARD/ML should not occur and identify any potential early-stage ARD/ML. Details of this monitoring program are included in the Surface Water Management Plan (Table 1.1). The proposed monitoring program includes surface quality monitoring at effluent discharges, downstream receivers, water treatment plant inlets and outlets and reference sites and visual inspections of facility infrastructure. FDPs will be sampled weekly as part of contact water monitoring.


Seepage monitoring locations from overburden, waste rock, LGO stockpiles, open pits and TMF will be identified (e.g., sumps, ditches) to trace potential ARD/ML sources before it appears at discharge locations. The current plan is to sample seepage monitoring locations on monthly basis. A detailed sampling schedule will be developed and incorporated into future updates of this Plan when exact seepage monitoring locations are established during detailed engineering. Details regarding the testing and screening criteria to detect potential early-stage ARD/ML are presented in this section.

4.2.1 Laboratory Analyses

Field measurements of pH, temperature, conductivity, oxidation-reduction potential, dissolved oxygen, and turbidity will be completed and samples will be collected for laboratory analysis of the following parameters:

- Physical parameters (pH and conductivity), total hardness, total dissolved solids, TSS, alkalinity, acidity, ammonia nitrogen and selected anions (chloride, fluoride, bromide, sulphate, nitrate, and nitrite)
- Total metals
- Dissolved metals
- Dissolved organic carbon

This list will cover the MDMER requirements for effluent testing and a set of relevant parameters with CWQG-FAL including input values for calculations of site-specific guidelines (pH, temperature, hardness and dissolved organic carbon (DOC)) for linkage with the Surface Water Monitoring Plan.

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4.2.2 Screening Criteria

Screening criteria proposed for contact water samples are presented in Table 4.2. Contact water sample results from the laboratory analyses described above will be screened against a value that is 75% of the maximum authorized monthly mean concentration for parameters included in Schedule 4 of the MDMER. In addition to the screening criteria presented in Table 4.2, effluent samples from each final FDP will be tested for acute lethality in accordance with the MDMER.

Table 4.2 Proposed Screening Criteria

Parameter (units)	Screening Criteria
TSS (mg/L)	11.25
Un-ionized ammonia as N (mg/L)	0.375
CN(T) (µg/L)	375
As (µg/L)	50
Cu (µg/L)	75
Pb (µg/L)	60
Ni (µg/L)	187
Zn (µg/L)	300
Radium 226 (Bq/L)	0.278


5.0 ADAPTIVE MANAGEMENT

Marathon will use an adaptive management framework that allows for adjustment of mitigation measures and management actions in response to monitoring results. The adaptive management framework establishes a process to evaluate monitoring outcomes relative to desired goals for specific mitigation measures as well as broader Project effects.

The premise of adaptive management is to use a cycle of planning, implementation, monitoring, and analysis / learning to systematically determine whether mitigation measures are effective relative to the goals and objectives, while allowing for adjustments to mitigation when monitoring results indicate that the goals and objectives are not being achieved.

The adaptive management framework includes the basic elements functioning together as a feedback system. This framework is inherently linked to each mitigation or management measure, and broadly to each monitoring objective. The basic elements are illustrated in Figure 5.1 and summarized as follows:

- Plan: states the goal, which is supported by targets and performance indicators and presents current actions for ARD/ML management.

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- Monitor: seeks to collect data/information on the performance indicators and to report on standard or additional action in respect of the targets/triggers.
- Is adaptive management triggered? This is a logical element defining whether additional mitigation action(s) is needed to meet the performance targets/indicators or that the current material management plan is working.
- Select and evaluate mitigation options: This element corresponds to the evaluation of the effectiveness of a mitigation action in terms of meeting the target. Typically, mitigation measures that meet the target will result in no change to the Plan; whereas mitigation measures that do not meet the target will be reviewed in detail to identify the root cause of the deficiency and to identify adaptations needed to meet the target. This element can include consultation and engagement with regulators regarding monitoring results and proposed corrective actions
- Implement mitigation: the 'doing' of specific actions, such as implementing one or more mitigation measures. This element circles back to the 'Monitor' element as part of understanding whether the corrective actions are effective in achieving the stated goal.

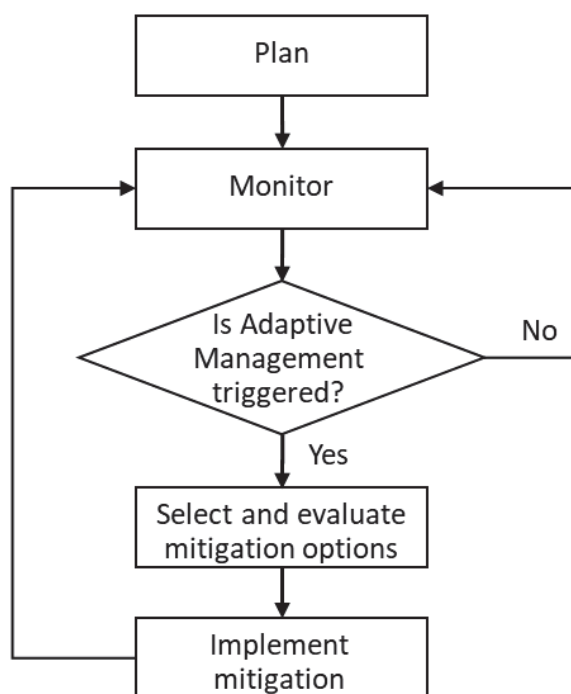


Figure 5.1 Adaptive Management Flow Diagram

Adaptive management will be key to the effective integration of new information acquired through the construction, operation, and closure phases of the Project into the ARD/ML Management Plan. The adaptive management actions will be triggered if planned management activities for the prevention of ARD/ML are not effective. The triggers will include:

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- Percentages of PAG materials produced does not allow for planned ARD management proposed in Section 4.1.4 (e.g., potential for development of ARD in an LGO stockpile).
- Contact water quality screening criteria in any site contact water and at discharge points are exceeded by values in monitoring results during a consecutive number of sampling events (e.g., three consecutive measurements).

The potential adaptive mitigation options for specific mine components/materials are outlined in the following separate sections.

5.1.1 Overburden

As described in Section 4.1.4.1, most of overburden from the Leprechaun and Marathon deposits is classified as non-PAG with 3.4% and 10% of samples classifying as PAG, respectively. PAG overburden will be segregated from non-PAG overburden that will be stockpiled for rehabilitation and encapsulated in the waste rock pile in accordance with the management protocols for PAG waste rock.

If additional overburden materials are identified as PAG through further testing, as most overburden will be stripped in the first five years of mining, waste rock piles are expected to be able to accommodate this additional PAG overburden, particularly within the Leprechaun waste rock pile. In the unlikely event that the waste rock piles do not have capacity to accommodate the additional PAG material, the excess will be segregated and stored in the footprint of the overburden stockpile and moved to the open pits at the closure. The ARD QP must approve the “temporary” stockpiling of PAG overburden in the overburden stockpile. The amount of PAG overburden in the stockpile will be reported in the annual report.

If testing of contact water discharge quality from overburden stockpiles exceed trigger levels identified in Section 4.2, the adaptive management protocol will be implemented to address the drainage water quality issue.

Any reduction in the volume of overburden available for progressive and final rehabilitation will need to be reviewed and adaptive management applied with respect to the materials required for rehabilitation. These potential issues will be considered within the relevant documents listed in Section 1.4.

5.1.2 Construction Rock

The amount of waste rock needed for use as construction materials is small compared to the total volume of waste rock generated from the open pits. The predicted volume of PAG material within waste rock is also relatively low, up to 3.7% and 1% from the Marathon and Leprechaun pits, respectively. Even if the amount of PAG waste rock expected from the pits increased significantly, the risk is low that a change in the amount of PAG waste rock would affect the availability of non-PAG rock for construction. The only adaptive management considered to maintain the required supply of non-PAG rock during construction (or during periodic TMF dam raises) may be selective/targeted excavation of non-PAG materials if the scheduled requirements for construction rock do not align with the mine plan (to be assessed in part via the ARD block model).

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5.1.3 Waste Rock

In consideration of the risk that additional test work (pre-development and confirmatory) determines that PAG waste rock will require additional management beyond that described in Section 4.1.4.3, an estimate of the maximum percentage of PAG waste rock that could be theoretically managed by blending has been completed. The estimate considered factors that limit neutralization of net potential acidity from PAG rock by an excess of NP from non-PAG rock for the Marathon pit, as follows:

- Non-PAG (NPR>2) waste rock has an average Net Neutralization Potential (NNP=NP-AP) of 65.8 kg CaCO₃/t indicating for excess of NP, while average excess of AP in PAG rock with NPR<1 is 13.9 kg CaCO₃/t. In order to keep NPR of the PAG/Non-PAG mixture above 2, the excess of NP per tonne of Non-PAG rock should be twice that of AP excess in PAG rock. This condition results in 2.4 tonnes of PAG per tonne of Non-PAG waste rock ($65.8 \text{ kg CaCO}_3/\text{t} / (13.9 \text{ kg CaCO}_3/\text{t} \times 2) = 2.37$ or ~ 2.4) based on ABA.
- Kinetic availability of NP was evaluated by comparing the average alkalinity production rate from the last month of humidity cells that contain major rock types from Marathon pit (M QE-POR, M AQPOR and M CG) with the acidity production rate from last month from the carbonate depleted cell (M QPOR-PAG CO3DP, Appendix D in Stantec 2022). The average alkalinity production rate from non-PAG rock (8 mg CaCO₃/kg/week) is 4 times the average acidity production rate (2 mg CaCO₃/kg/week) from PAG rock.
- Static tests provide the lowest ratio of PAG:non-PAG materials (2.4:1) of the two test metrics (ratios) indicating an excess of NP in non-PAG waste rock is a limiting factor for ARD prevention.
- Using the lowest ratio (2.4:1), a conservative estimate is that the mixture/blend of waste rock within the Marathon stockpiles could be up to 70% PAG waste rock while still maintaining neutral conditions.
- The risk that the waste rock production profile will be 70% PAG rock is low based on current estimates for total waste rock volume, with a slightly increased risk in the last years of mining due to mineralized porphyry units at the bottom of Marathon pit.
- Adaptive management will be triggered where estimated/expected PAG volumes exceed the capacity of the waste rock pile to accommodate those materials in any period or if blending and encapsulation requirements for < 55% PAG cannot be met.
- As mining progresses, the ARD block model will be updated and reviewed to further refine the waste rock production profile to adequately plan for waste rock management in the final years of mining.

Similar calculations could be done for Leprechaun waste, but there is only one PAG sample (NPR<1) from Leprechaun waste rock and no data on acidity production rates. As a result, the estimated limit of 70% PAG rock mixture/blend for the Marathon waste rock pile (above) can be conservatively applied to Leprechaun waste rock pile.

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Estimated limits for PAG rock management for both deposits may be refined as more data are accumulated from on-going kinetic testing and operational monitoring. These limits will be considered with the mine plan to determine if additional mitigation is required to manage PAG rock within the waste rock piles. Marathon will also track PAG materials within the stockpiles using detailed surveying and 3D modeling of the piles and the PAG materials placed within the piles to ensure the materials are properly placed and managed, respecting the blending and encapsulation requirements.

The development of the piles will be assessed at least twice annually to consider short term and longer term PAG rock management capacity within the pile relative to the estimate and schedule of PAG materials expected in that period based on the ARD block model for Marathon Pit, or the volumetric estimates for Leprechaun. If waste rock deposition planning indicates that excess PAG materials are generated that cannot be adequately accommodated through encapsulation/blending within the waste rock pile, or in exhausted areas of the pit due to spatial or safety limitations in the final year or two of mining, options to store these materials in temporary locations nearby the pit (waste rock pile or available / expanded stockpile areas) will be evaluated. Noting the quantity of waste rock generated in later years of mining operations is significantly reduced, the preferred closure option for managing excess waste rock is to return the waste to the pit to be permanently submerged. However, alternative closure scenarios may be considered (such as engineered covers) as the closure plan is finalized and reviewed (internally and by regulators) prior to mine closure.

If testing of contact water quality from the waste rock piles exceeds trigger levels identified in Section 4.2, additional sampling, testing and assessment of the source will be required and further mitigation and management measures may be required, such as segregation of problematic rock or water flow, engineered covers, water treatment and other options.

5.1.4 Low Grade Ore

In consideration of the risk that additional test work (pre-development and confirmatory) indicates that the percentage of PAG LGO could create management challenges within the LGO stockpiles, an estimate of the maximum percentage of PAG LGO that could be theoretically managed has been completed.

The estimate considered factors that limit neutralization of net potential acidity from PAG LGO by an excess of NP from non-PAG LGO that originates from the Marathon pit, as follows:

- Non-PAG (NPR>2) LGO has an average NNP (NNP=NP-AP) of 47.1 kg CaCO₃/t, while average excess of AP in PAG LGO (NPR<1) is -14.8 kg CaCO₃/t. In order to keep NPR of the PAG/Non-PAG mixture above 2, the excess NP (47.1 kg CaCO₃/t) from Non-PAG LGO should be double the excess of AP (14.8 kg CaCO₃/t) from PAG LGO. This translates to a requirement of 1.6 tonnes of PAG LGO per tonne of non-PAG LGO based on static testing.
- The alkalinity production rate from Marathon's LGO humidity cell during the last month of HCT operation (20 mg CaCO₃/kg/week, M-LGO Met) under neutral pH conditions is 5 times greater than the average acidity production rate (4 mg CaCO₃/kg/week) from the carbonate depleted cell during the last month of HCT operation, which simulates acidic conditions in random pockets of the Marathon's LGO stockpile (M-LGO CNP DPL).

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- Static tests provide the lowest ratio of PAG:non-PAG materials (1.6:1) of the two test metrics indicating that the excess of NP in non-PAG LGO is a limiting factor for ARD prevention.
- The ratio (1.6:1) indicates that the mixture/blend in the Marathon LGO stockpile can contain up to 61% PAG material during a rolling 2.8 year period (i.e., the minimum ARD onset time from sensitivity analysis presented in IR 21b in Appendix A, Marathon 2022) to maintain neutral drainage.

Similar analysis is conducted for the LGO stockpile at the Leprechaun site:

- The one PAG sample in LGO from the Leprechaun pit has an average excess of AP in PAG, and the average NNP (NNP=NP-AP) of non-PAG LGO is 69.5 kg CaCO₃/t. In order to keep NPR of the PAG/Non-PAG mixture above 2, the excess NP (69.5 kg CaCO₃/t) from Non-PAG LGO should be twice the excess of AP (17 kg CaCO₃/t). This condition results in 2 tonnes of PAG LGO per tonne of Non-PAG LGO based on static testing.
- No acidity was generated in any kinetic tests of samples from the Leprechaun deposit. Therefore, the estimates are based on static tests only and minimum ARD onset time for the PAG LGO from Leprechaun is assumed to be similar to that calculated for PAG LGO from the Marathon pit.
- The ratio obtained from the static test results (2:1) indicates that the mixture/blend of LGO can contain up to 66.7% PAG material within the Leprechaun LGO stockpile within a rolling 2.8 year (similar to Marathon LGO) period to maintain neutral drainage.

Estimated limits for PAG LGO management for both deposits will be refined as more data is accumulated. The calculated limits will be considered with the mine plans and ARD block model for the Marathon pit to determine if additional mitigation is required to manage PAG LGO rock within the stockpiles. Water quality modeling from the EIS and later sensitivity analyses indicate that the effluents from LGO stockpiles will comply with MDMER limits and water treatment is not expected to be required. In the case that additional pre-construction modeling indicates need for the water treatment, the current mine plan segregates these effluents from other mine component flow streams in the overall mine design to facilitate collection and further water treatment, if required. Also, if excess PAG LGO (above 60% for Marathon and 66.7% for Leprechaun within a rolling 2.8 year period) is generated, the material will be moved to the HGO stockpile or an adjacent area where contingency mitigation for ARD/ML from HGO will be applied (see Section 5.1.5). In the event of early closure or other circumstances that result in unprocessed LGO, material remaining in the stockpiles will be moved back to the pit or covered (engineered cover) to reduce the risk of ARD/ML generation.

5.1.5 High Grade Ore

Water quality modeling from the EIS indicates that the effluents from the HGO stockpile will comply with the MDMER under neutral conditions and specific water treatment is not required. In case there is development of ARD/ML from the HGO stockpile, drainage will be directed to the TMF pond and for management as part of process plant / TMF water cycle as described in section 5.1.6 during 5-6 year lifespan of the stockpile. In the event of circumstances that result in unprocessed HGO, material remaining in the stockpile will be submerged (in the pit or TMF pond) or will be covered (engineered cover) to minimize the risk of ARD/ML generation.

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5.1.6 Tailings

Risk of ARD generation from tailings is low because of short exposure times due to continued tailings deposition in the TMF during Year 1 to Year 9/10 and rapid submergence of tailings deposited in the Leprechaun pit after Year 9/10. The treatment of discharge from the TMF is included in the project design because pond water and seepage are conservatively predicted to exceed the MDMER limits for CN(T), un-ionized ammonia, and Cu (see Section 4.1.4.6). In the unlikely event ARD develops in the TMF during operations, the effluent will be treated prior to discharge until Year 9/10 or discharged to Leprechaun pit afterwards until rehabilitation is complete.

If PAG samples are identified during confirmatory sampling of tailings beaches, additional measures will be assessed to reduce the risk of ARD/ML generation at closure. These measures may include, adding NP to areas with PAG tailings (e.g., liming), excavation and relocation of unsaturated PAG tailings to the Leprechaun or Marathon pit and/or (semi-) passive water treatment until TMF effluent(s) comply with MDMER (for further details refer to response to DIET-05 in Appendix A, Marathon 2022).

5.1.7 Open Pits

If testing of contact water quality from the pits exceeds trigger levels identified in Section 4.2, additional sampling, testing and assessment of the source will be completed. Further mitigation and management measures may be required, such as changes in blasting (in case of nitrogen leaching from undetonated explosives), pit water treatment (e.g., liming), and other options will be evaluated.

Figure 2-1 shows the Marathon ARD block model and pit geometry above the estimated pit flood level of 330 m. Based on the most recent ARD block model, PAG gabbro constitutes only 0.2% of total gabbro tonnage within the pit. Maps and cross sections (Figures A-8 to A-11 in the Phase III ARD/ML Assessment Report [Appendix C], Stantec 2022) indicate gabbro primarily intersects the pit wall along the north side, below 330 m elevation except for one small area of intersection on the northwest corner which is the lowest elevation in the pit and where there are also samples of gabbro that tested non-PAG. Most of the gabbro is expected to be below the pit lake elevation. The beige material along the south and southeast boundaries of the pit where the highwall will extend above the flooded water level is primarily conglomerate.

While predictions show that the risk of ARD/ML effects on the pit lake water quality from the exposed PAG materials in the highwall is low, if monitoring determines that sufficient PAG materials are above the flooded elevation of the pit (through geological mapping of the pit walls and updated water quality modelling) adaptive management will be triggered. There are a number of potential management measures that can be applied to address pit lake and discharge water quality if ARD/ML from the highwalls is assessed to be the source. Providing a cover to the exposed PAG in the highwalls, if required, could be achieved, for example, through retreat blasting and benching to lower slope angles to allow placement of the appropriate cover. During closure, natural development of permanently stratified pit lakes is expected with more concentrated contact water entering the pit at the beginning of pit flooding and cleaner water entering the pit near the end of rehabilitation. If natural stratification does not occur and

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discharges from pit lakes are predicted to exceed screening criteria because of ARD/ML, such mitigation measures as directing contaminant flows at depth, induced stratification, and/or in-pit treatment will be evaluated. Successful examples of full scale in-pit treatments of acidity, metals, and cyanide species with or without stratification are shown in Chapman et al. (2008), Fisher and Lawrence (2006), Flite and Duckett (2012), Kalin et al. (2000), Pieters et al. (2014), Poling et al. (2003).

6.0 REPORTING

Reporting procedures and documents associated with the ARD/ML Management Plan will be developed to comply with the conditions of release from the provincial and federal environmental assessment processes and permitting requirements (e.g., annual reports required to be submitted to the NLDIET, Mineral Development Division).

7.0 PLAN REVISION

This ARD/ML Management Plan is a living document and will be reviewed and updated by a Qualified Professional as follows:

- Annually at a minimum
- Following changes in the mine plan that may influence ARD/ML prediction
- As required, based on additional laboratory and/or field data that could potentially change the ARD/ML predictions or management protocols provided in this Plan.
- Results of monitoring programs that require a change or adaptation of the management approach(es) described in this document.

Updates or proposed changes to the ARD/ML Management Plan will be submitted to the applicable regulatory authorities for approval as outlined in Appendix A.

All ARD/ML Management Plan holders may initiate revisions by forwarding proposed revisions to the Environment Manager, Environmental Superintendent and/or Environmental Coordinator. The following information will be provided on the Revision Request Form for all revision requests:

- section to be revised
- nature of the revision
- rationale for the revision (e.g., environment/worker safety)
- name of the revision requestor

Approval for revisions will be required from Marathon. When the Environment Manager approves a revision request, details of the revision will be distributed to all ARD/ML Management Plan holders and will be documented in the Revision History Log as outlined in Appendix B. Each revision will be accompanied by:

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- revision instructions
- list of sections being superseded
- an updated Table of Contents indicating the status of each section in the ARD/ML Management Plan
- When ARD/ML Management Plan holders receive a revision, they will, in a timely manner:
- read the text of the revision
- check the control sheet to confirm that all the listed pages have been received
- remove and destroy the superseded pages from their copy of the ARD/ML Management Plan
- insert the revised pages in the proper place in their copy of the ARD/ML Management Plan
- page check the ARD/ML Management Plan, using the updated table of contents to confirm the ARD/ML Management Plan is complete and current
- enter the revision number and date entered on the Revision History Log
- incorporate the revision into the area of responsibility, as applicable
- confirm that personnel in their purview are informed of and familiar with the revisions

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APPENDIX A

REVISION REQUEST FORM

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APPENDIX B

REVISION HISTORY LOG

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Appendix B REVISION HISTORY LOG

Version	Date Issued	Revision Notes
1	September 15, 2022	