HARDROCK PROJECT
CONCEPTUAL SOIL MANAGEMENT PLAN

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1.0 Introduction and Environmental Management and Monitoring Plan Overview

Greenstone Gold Mines (GGM) is committed to minimizing environmental effects through the implementation of mitigation measures, monitoring and adaptive management for the Hardrock Project (the Project) within Environment Management and Monitoring Plans (EMMPs) for construction and operation. Through the EMMPs, the Project's environmental risks and opportunities are addressed in a comprehensive, systematic, planned and documented manner to meet the following objectives:

- The Project is carried out in compliance with existing legislation, consistent with Federal and Provincial guidelines, best practices and GGM corporate policies;
- Measures to mitigate environmental effects are documented;
- Benefits from the Project are enhanced; and
- Reporting is structured to inform adaptive management and continual improvement.

The EMMPs guide environmental management for the Project and are progressively developed as the Project moves through the EIS/EA, permitting, and construction, and updated based on continual improvement during operations through adaptive management.

EMMP development begins during the EIS/EA stage with the preparation of Conceptual Environmental Management Plans. These EMMPs are broad in their level of detail, commitment-based and focused on the construction and operation phases of the Project. They include input received from consultation during the Draft EIS/EA stage. The closure phase is addressed in the Conceptual Closure Plan. The level of detail in the EMMPs advance as the Project moves through more detailed engineering and planning and as permit/regulatory requirements are available.

1.1 Environmental Management and Monitoring Plans

The Project's Environmental Management System, includes a comprehensive set of management and monitoring plans collectively referred to as Environmental Management and Monitoring Plans (EMMPs). The EMMPs outline environmental protection measures to mitigate potential environmental effects.

The EMMPs include:

- Water Management and Monitoring Plan;
- Conceptual Waste Rock Management Plan;
- Conceptual Emergency Response Plan;
- Conceptual Waste Management Plan;
- Conceptual Erosion and Sediment Control Plan;
- Conceptual Greenhouse Gas Management and Monitoring Plan;
- Conceptual Air Quality Management and Monitoring Plan;

- Conceptual Spill Prevention and Response Plan;
- Conceptual Soil Management Plan;
- Conceptual Noise and Vibration Management and Monitoring Plan;
- Conceptual Explosives and Blasting Management Plan;
- Conceptual Aquatic Management and Monitoring Plan;
- Conceptual Biodiversity Management and Monitoring Plan; and
- Conceptual Archaeology and Heritage Resource Management Plan.

These Plans are considered "living" documents and will be updated as needed in support of environmental management activities during future permitting, development and operation phases.

2.0 PROJECT SUMMARY

Mining of the Hardrock deposit has been designed as an open pit. The process plant will operate 365 days per year with a Life of Mine (LOM) of approximately 15 years. The mill throughput ranges from 24,000 tonnes per day (tpd) for approximately the first two years of operation (i.e., Mill Phase 1), increasing to 30,000 tpd for the balance of operation (i.e,. Mill Phase 2). The overall Project development schedule will consist of the following main phases, during which various Project activities will be completed:

- Construction: Years -3 to -1 with early ore stockpiling commencing after the first year of construction.
- Operation: Years 1 to 15, with the first year representing a partial year as the Project transitions from construction to operation.
- Closure:
  - Active Closure: Years 16 to 20, corresponding to the period when primary decommissioning and rehabilitation activities are carried out.
  - Post-Closure: Years 21 to 36, corresponding to a semi-passive period when the Project is monitored and the open pit is allowed to fill with water creating a pit lake.

The key components of the Project are as follows:

- open pit
- waste rock storage areas (WRSAs) (designated as WRSA A, WRSA B, WRSA C and WRSA D)
- topsoil and overburden storage areas
- ore stockpile
- crushing plants and mill feed ore storage area
- process plant
- tailings management facility (TMF)
- water management facilities for contact water including collection ditches and ponds

- power plant and associated infrastructure
- liquefied natural gas plant
- explosives facility
- buildings and supporting infrastructure
- water supply and associated infrastructure
- sewage treatment plant
- effluent treatment plant
- lighting and security
- site roads and parking areas
- watercourse crossings and habitat compensation/offsets
- Goldfield Creek diversion
- onsite pipelines
- fuel and hazardous materials
- aggregate sources
- temporary camp

Project activities include the relocation of existing infrastructure currently located within the PDA, including a portion of Highway 11, a Ministry of Transportation (MTO) Patrol Yard, and Hydro One Networks Inc. (Hydro One) facilities.

3.0 MANAGEMENT AND MONITORING PLAN PURPOSE

3.1 Purpose

The purpose of the Conceptual Soil Management Plan (CSMP) is, during the construction and operation phases, to:

- retain and preserve suitable soil for use in Project reclamation/rehabilitation; and
- identify and manage soil impacted by existing or historical anthropogenic activities that require removal to allow development of the Project.

As per the Closure, Rehabilitation and Monitoring section of "*A Practitioner's Guide to Planning For and Permitting a Mineral Development Project in Ontario*" (SENES, 2008) there is a requirement for rehabilitation of a mine development to approximate pre-development conditions. This requirement includes restoration of soil cover materials, vegetation and surface water features to a quality, quantity and appearance that is as close as feasible to pre-development conditions or to the baseline environmental conditions. With this requirement proper soil salvage, soil handling and soil replacement is necessary to facilitate rehabilitation.

3.2 Performance Objectives

Objectives and targets are established to drive continuous improvement in environmental performance and are consistent with the overall strategic goals of the Project. Objectives are measurable (where possible), monitored, communicated, and updated as appropriate.

In support of GGM's overarching environmental objective (to work to prevent or mitigate any environmental impacts, meet or exceed regulatory requirements and strive to continually improve our environmental practices and performance), GGM has established the following performance objectives for the CSMP that considers key Project interactions and compliance obligations:

- to preserve adequate volumes of soil for rehabilitation as specified by the closure plan
- meet closure requirements to allow for successful rehabilitation of Project components
- meet the applicable contaminated site regulations and guidelines when handling, treating and disposing of contaminated soil, overburden, historical tailings and sediment.

4.0 SCOPE

The scope of the CSMP applies to the area of the Project that will undergo changes through construction and/or operation to accommodate the advancement of Project and associated monitoring. The CSMP applies to the construction and operation phases of the Project with closure phase included in the Conceptual Closure Plan.

The CSMP applies to individuals working for or on behalf of GGM, including employees and contractors, which have a role and/or accountability for the development, implementation and maintenance of this EMMP.

GGM will make reasonable efforts that suitably qualified (licenced where applicable) contractors are used for the transport of materials, supplies and waste materials, and that contractors have appropriate controls and management plans in place to reduce the likelihood of incidents during transport. Similarly, Project components under the management and maintenance by third parties are outside the scope of this EMMP. The scope of the CSMP applies to Project infrastructure and management under the care and maintenance of GGM.

5.0 PLANNING

5.1 Organizational Roles and Responsibilities

All persons working for or on behalf of GGM, including employees and contractors, have a role in the successful implementation and maintenance of the CSMP. Table 5-1 outlines roles and responsibilities:

Table 5-1: Conceptual Roles and Responsibilities

Role	Responsibility
Construction Manager (for construction phase) General Manager (for operation phase)	Oversee clearing and grubbing activities during the Construction phase of the Project. Collaborate with the Environment Manager to plan soil handling activities with regards to invasive plant management.
Environment Manager	Collaborate with the Construction Manager to plan and direct soil handling activities. Identify, document, track, and maintain up-to-date compliance obligations related to EMMP goals. Communicate compliance obligations and provide training to employees and contractors related to EMMP. Monitor/document the movement of excavated material and provide guidance on the placement and/or temporary stockpiling of material, if required.
Environment Specialist/Environment Technician	Collaborate with Construction Management to delineate areas of disturbance for construction activities. Supervise clearing and grubbing activities to reduce ground disturbance. Monitor ecosystems to determine effect of construction and operation activities.
Equipment Operator	Complete applicable training in clearing activities, soil salvage, soil handling, and erosion and sediment control. Conduct clearing/grubbing and soil salvage/handling activities according to defined procedures. Implement development and maintenance of Terrestrial ecosystems as instructed. Follow protocols for salvage and handling of topsoils, contaminated soils, tailings, and original condition soils.

5.2 Compliance Obligations

The CSMP is developed and implemented to comply with applicable legislative, regulatory, permit and other relevant obligations, outlined in the following sections.

5.2.1 Environmental Assessment Process Requirements

5.2.1.1 Provincial Terms of Reference

As described in the Approved Terms of Reference, the EA includes a variety of environmental protection and management measures to guide the planning, design, construction, operation and closure of the Project (section 4.1.4) and identification of a monitoring framework related to compliance and effects monitoring (section 8.2).

Under Section 5.1.17 *Historic MacLeod Tailings and Hardrock Tailings* of the TOR there is a commitment to address the removal or alternate disposal locations being considered for areas where the historical tailings will be disturbed by planned mining activities (e.g. the open pit).

5.2.1.2 Federal Environmental Impact Statement Guidelines

The EIS Guidelines for the Hardrock Project include development and implementation of follow-up and monitoring programs (section 8.0). The follow-up program verifies the accuracy of the effects assessment and the effectiveness of the measures implemented to mitigate the adverse effects of the Project. The goal of a monitoring program is to ensure that proper measures and controls are in place in order to decrease the potential for environmental degradation during all phases of the Project and to provide clearly defined action plans and emergency response procedures to account for human and environmental health and safety.

Within the topography and soil section of the Environmental Impact Statement Guidelines (EIS) there are conditions of which are outlined within this CSMP to comply with and they include:

- baseline mapping and description of landforms and soils within the local and regional project area
- maps depicting soil depth by horizon and soil order within the mine site area to support soil salvage and reclamation efforts, and to outline potential for soil erosion
- suitability of topsoil and overburden for use in the rehabilitation of disturbed areas.

5.2.1.3 Draft EIS/EA Report

Section 24 of the Draft EIS/EA includes a listing of proposed Follow-up Monitoring and Environmental Management Plans, which included a commitment to produce a CSMP. This plan is intended to outline soil management within the PDA including topsoil and overburden salvage, and historical impacted soil handling, treatment and storage for backhaul.

Subsequent to the draft EIS/EA submission, comments were raised by several parties requesting additional clarification on the management of topsoil, historical tailings management and sediment from the contact and seepage collection system. Available information has been incorporated to develop this Conceptual Soil Management Plan.

5.2.2 Regulatory Requirements

5.2.2.1 Federal Regulatory Requirements

There are no applicable federal regulatory requirements for soil management.

5.2.2.2 Provincial Regulatory Requirements

This CSMP was prepared following the guidance provided in the Ministry of Environment and Climate Change (MOECC) document Management of Excess Soil - A Guide for Best Managem*ent Practices* (2014).

The determination of soil quality in the CSMP will be conducted in general accordance with the MOECC's 2011 Site Condition Standards, which specifies acceptable values in given settings for a suite of analytical parameters. These values are presented in Table 1 to Table 9 of the Province of Ontario's *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act* (MOE, 2011).

The CSMP includes testing to characterize the sediment quality in accordance with O.Reg. 347/90. R.R.O. 1990, Reg. 347: GENERAL - WASTE MANAGEMENT under Environmental Protection Act, R.S.O. 1990, c. E.19.

Options for the management of historically impacted soil were developed in consideration of Ontario statutes, regulations, and guidance documents, including the following:

- Environmental Protection Act, R.S.O. 1990, c. E.19 (“the EPA”)
- R.R.O. 1990, Regulation 347: General - Waste Management, under Environmental Protection Act, R.S.O. 1990, c. E.19
- MOECC’s “Management of Excess Soil - Management of Excess Soil – A Guide for Best Management Practices, January 2014.

5.2.2.3 Municipal Regulatory Requirements

There are no applicable municipal regulatory requirements for soil management.

5.2.3 Other Agreements, Commitments, Requirements

There are no other agreements, commitments or requirements applicable to soil management.

6.0 SUPPORT

6.1 Identification/Inventory of Resources

As part of the Project development, topsoil (referred to topsoil or soil) and overburden (subsoils) are to be salvaged from the foundation areas of various mine components as follows:

- topsoil, and overburden over the open pit area will be salvaged as required during construction and as the open pit advances through operations
- topsoil will be salvaged from foundation areas of the WRSAs identified during detailed design, from approximately 175 m of the toe of the embankment to outside of the perimeter ditch
- topsoil and unsuitable foundation soils (overburden) will be salvaged from the footprints of the tailings management facility (TMF) dams, perimeter ditches and access roads
- topsoil will be salvaged from the footprint of the planned process plant area
- topsoil will be salvaged from the footprint of borrow source areas
- topsoil will be salvaged from the footprint of water collection ditches

Additional unconsolidated material will be generated throughout the operation phase from the removal of sediment from the WRSA collection ponds and TMF seepage collection ponds considered within this Plan. Other materials includes sludge from the effluent treatment plant and sewage

treatment plant, and potentially contaminated overburden from spills occurring on site. These material are considered waste and will managed as per the Conceptual Waste Management Plan.

Where possible, salvaged soils are to later be used in the rehabilitation works, as described in the Conceptual Closure Plan (Stantec 2017a).

6.1.1 Estimation of Topsoil Material to Salvage

Topsoil volumes were estimated by combining the soil salvage plans and soil quality baseline data with the soil (series) characterization mapping and average topsoil depth per soil series. Volumes were calculated for each mine feature as the sum of the products of the total area of each soil series within that feature's salvage area by the corresponding average depths for each soil series.

In support of the Hardrock Project EIS/EA, baseline soil surveys were conducted to:

- characterize the soils on site and classify them with respect to order and series (for mineral soils and organic muck) (Stantec 2015a)
- evaluate the chemical quality of the soils that are within the vicinity of historical mining activities (Stantec 2015b, 2016a, 2016b).

Seven soil series were identified within the project development area, including: Scotia, Jeannie, Dunbar, Frederick, Shetland and muck (organic). As well, developed land was considered as a separate soil type.

As part of the quality assessment, soils were sampled, analyzed, and compared to Ministry of Environment and Climate Change (MOECC) Tables 6 and 8 Site Conditions Standards (SCS). Using the soil quality data and site mapping (including the limits of the historical tailings), topsoils were differentiated into three conditions encountered on site that will be treated separately and not mixed with one another, including:

Original Condition Soils: soils that were found to meet MOECC Table 6 and 8 SCS, which are assumed to not be impacted by historical mining activities;

Impacted Soils: soils that were found to exceed MOECC Table 6 or 8 SCS, which are assumed to be impacted by historical mining activities, or are naturally elevated in metals.

Soils Overlying Historical Tailings: soils that overly the historical MacLeod or Hardrock mine tailings deposits;

Original condition soils that are naturally mineralized with concentrations of metals and/or inorganic parameters that exceed the MOECC Tables 6 or 8 SCS are considered to be impacted soils within this Plan. However, these soils currently support vegetation and are considered suitable for rehabilitation. With ongoing Project planning and design, site specific criteria will be used to refine the volumes of impacted and naturally mineralized unconsolidated material for use at the Project.

6.1.1.1 Total salvage Areas

The area of each soil series within a topsoil condition was calculated using ArcGIS to measure the area of each soil polygon from the soils classification mapping (Stantec 2015a) of the three topsoil

conditions. The total of each mine feature was calculated by adding the areas of Soil Series within the Topsoil conditions. The total area for each topsoil condition was determined by the sum of the areas of that Series within that mine feature. See the areas in Table 6-1.

6.1.1.2 Average Topsoil Depths of Soil Series

For each soil series, average topsoil depths were calculated. Topsoil depth information from other subsurface investigations (e.g., geotechnical studies) was collaged and categorized by soil series by cross referencing borehole and test pit locations with the baseline soil characterization mapping. Table 6-2 presents a summary of the average topsoil depths by soil series.

6.1.1.3 Topsoil Available for Salvage

The total volume of topsoil available for salvage by mine feature on the Project was calculated by multiplying the total area of each Soil Series that fell within the topsoil categories in each mine feature by the average topsoil depth of the Soil Series. The grand totals were calculated by adding the volumes of topsoil from each topsoil category available for salvage, as shown in Table.

Table 6-1: Total Salvage Areas by Mine Feature, Soil Condition, and Soil Series (ha)

Mine Feature	Original Condition Soils									Impacted Soils *								Overlying Historical Tailings	Total
	Dunbar	Frederick	Jeannie	Muck	Scotia	Shetland	Water	Developed	**Total**	Dunbar	Frederick	Muck	Scotia	Shetland	Water	Developed	**Total**		
Open Pit	2.1			14.2	16.7		0.1	18.9	**52.1**			5.6	12.7		0.2	29.9	**48.4**	43.8	**144.2**
Open Pit Road	2.7		0.3	5.5	11.3			7.2	**27.0**							1.1	**1.1**	5.0	**33.2**
Ore Stockpile		1.6		11.0					**12.6**	2.7	3.4	17.3	1.7				**25.1**		**37.7**
Overburden Storage Area			0.4	8.5				11.4	**20.2**			0.0				3.5	**3.6**	38.0	**61.7**
Plant Site Area				3.2	6.8				**9.9**	5.5	0.5	8.2	14.8				**29.0**		**38.9**
TMF Ditches, Ponds and Road	8.5	2.4	12.5	22.9	7.1				**53.5**										**53.5**
TMF Inner Berm and Barge enclosure		0.8	8.3	2.2	2.3				**13.6**										**13.6**
TMF Outer Dam	14.3	1.2	33.5	39.6	13.9				**102.6**										**102.6**
Waste Rock A	15.1		1.4		20.1			9.7	**46.3**			0.0	0.2			0.0	**0.3**	4.6	**51.2**
Waste Rock A- Ext	2.0			1.3	2.9				**6.2**	0.0		0.7	4.0			0.1	**4.8**	7.8	**18.8**
Waste Rock B	0.0	4.7		13.8	0.5				**19.0**			5.6	2.5				**8.1**		**27.0**
Waste Rock C	7.9		18.5	23.3	36.8			12.5	**99.0**	0.5	0.0	0.8	28.7				**29.9**		**129.0**
Waste Rock D	31.2			45.9	3.8	3.4			**84.3**	6.9		22.3		0.1			**29.3**		**113.7**
Grand Total	**83.8**	**10.7**	**74.9**	**191.5**	**122.2**	**3.4**	**0.1**	**59.7**	**546.3**	**15.6**	**3.8**	**60.5**	**64.7**	**0.1**	**0.2**	**34.6**	**179.5**	**99.1**	**824.9**

* Totals for impacted soils include soils from naturally mineralized zones.

Table 6-2: Average Topsoil Depth by Soil Series

Soil Series	Average Topsoil Depth (m)
Developed Land	0.03
Dunbar	0.33
Frederick	0.24
Jeannie	0.18
Muck	0.55
Scotia	0.20
Shetland	0.29
Water	0.00

Table 6-3: Estimated Topsoil Volumes (1000s m^3)

Mine Feature	Topsoil Condition			Grand Total
	Original Condition Soils	Impacted Soils *	Overlying Historical Tailings	
Open Pit	124.8	65.6	36.9	227.3
Open Pit Road	64.9	0.3	1.5	66.7
Ore Stockpile	64.5	115.6		180.1
TMF Ditches, Ponds and Road	197.1			197.1
TMF Outer Dam	356.4			356.4
TMF Inner Berm and Barge enclosure	33.6			33.6
Waste Rock A	95.9	0.7	1.8	98.4
Waste Rock A- Ext	19.5	12.2	2.6	34.3
Waste Rock B	88.2	35.7		123.9
Waste Rock C	266.1	64.1		330.2
Waste Rock D	372.4	145.8		518.2
Overburden Storage Area	50.7	1.1	12.9	64.7
Plant Site Area	31.2	94.3		125.5
Grand Total	**1,765**	**535**	**56**	**2,356**

* Totals for impacted soils include soils from naturally mineralized zones.

An estimated 7.24 Mm^3 of overburden from the site will be stockpiled over the LOM, with additional overburden generated as a result of site preparation for other Project components including WRSA and TMF perimeters.

6.2 Competence, Training and Awareness

GGM requires that persons working under its management, including employees and contractors, have the knowledge, understanding, skills and abilities to complete work in a manner that protects the environment. The following actions will be established to provide worker competency, training and awareness:

Applicable field staff will be trained in various soil management procedures as appropriate to their respective work areas.

Personnel who work with heavy equipment will be trained in the appropriate salvage and handling procedures to optimize topsoil salvage and segregation for storage

7.0 Implementation of Mitigation Measures

7.1 General Approach

7.2 Soil Excavation and Salvage

7.2.1 Excavation and Salvage of Original Condition Soils

Once the clearing stage is complete, heavy equipment will salvage the existing topsoil from the areas that are planned for development (typically the dark, upper layer). Based on the average depths of topsoil from the two soil orders and muck, the actual depth of topsoil stripping will be to the depths specified in Table 7-1.

Table 7-1: Estimated Topsoil Stripping Depths

Soil Management Category	Soil Order	Average Topsoil Stripping Depth (cm)	Salvage Notes
1	Brunisolic	20	Medium to coarse textured glacial deposits. May be thin.
2	Gleysolic	30	Fine to coarse textured glacial deposits. Typically poorly drained. May be thin.
3	Muck	55	Organic. High water table. May be thin.

Each of the three soil orders listed in Table 7-1 have distinct characteristics:

- **Brunisolic** soils are the most suitable soils on the Project for rehabilitation efforts. This material provides good moisture retention and nutrient availability qualities. At Hardrock, this soil order includes Jeannie and Scotia soil series.

- **Gleysolic** soils are wet, mineral soils that have the potential for use as topsoil in rehabilitation and to support vegetation. Where the topsoil is thick enough to separate successfully, it will be stripped and stored separately from the underlying overburden. At Hardrock, this soil order includes Dunbar, Frederick, Brunswick, and Shetland soil series.
- Organic **muck** soil covers a large portion of the Project. Although it lacks the stability of a mineral soil, this nutrient rich material is excellent for moisture retention and can provide available nutrients to the rooting zone. Organic soils will be stripped to the total depth of the deposit as practical and retained for rehabilitation in a designated area.

Where the soil order is unclear the topsoil will be stripped, as feasible, to the colour change between the topsoil and the overburden units.

Topsoil and overburden storage will occur within the designated areas of the Project site plan. Within those areas, salvaged material will be stored within designated areas of: a) topsoil, b) overburden or c) a mixture of topsoil and overburden.

Where possible, topsoil and the underlying overburden will be salvaged, handled, and removed separately. Where the soils become too shallow to facilitate separation with heavy equipment, such as areas with shallow bedrock, salvage will be done in a single lift.

Topsoil may be encountered that is thin and has a high content of gravel. This topsoil is not suitable for rehabilitation and will be used where appropriate in other areas of the Project. The topsoil in these areas can be stripped in a single lift and stored separate from the higher quality topsoil storage areas.

7.2.2 Excavation of Impacted Soils

The existing historically impacted soil, or soil impacted by current land uses or mineralization, is not appropriate for use in rehabilitation and removal will be completed using excavation with either front end loaders or excavators. Based on the soil quality data collected, soil within the areas of the historical plant sites contain concentrations of metal parameters, most commonly arsenic, in excess of the MOECC Table 6 or 8 SCS. Concentrations of polychlorinated biphenyls (PCB) and petroleum hydrocarbons (PHC) in soil at a limited number of locations within the historical plant sites were also found in excess of the MOECC Table 6 or 8 SCS, and concentrations of PHCs, benzene, ethylbenzene and xylenes exceeded the MOECC Table 6 or 8 SCS at the two former gasoline service stations.

7.2.3 Standard Excavation Management Practices

Standard management practices for soil excavation include:

- Excessively wet conditions that are unsafe for machinery will be avoided during soil salvage operations or will be done at winter time under frozen conditions when possible.
- Excessive traffic will be avoided during the salvage process to reduce the potential for admixing.
- Traffic will be confined to established routes to avoid unnecessary compaction of soil in undisturbed areas.

- Erosion and sediment control (as per the Conceptual Erosion and Sediment Control Plan) measures will be implemented.

7.3 Excavation of Historical Tailings

Removal of the Hardrock tailings up to the 30 m setback from the high water mark of Kenogamisis Lake has been included to address water quality concerns and loading to Kenogamisis Lake. A total of approximately 77% of historical Hardrock tailings will be removed and relocated. The historical tailings between the 30 m setback and Kenogamisis Lake (approximately 23%) will not be disturbed to protect the riparian zone and reduce potential impacts to fisheries habitat and water quality associated with working in close proximity to the lake.

The MacLeod low tailings on the south side of Highway 11 will be removed and relocated. The Macleod low tailings located to the north of the MacLeod high tailings adjacent to Barton Bay will remain in place with the exception of small areas immediately adjacent to the MacLeod high tailings. These may need to be removed during placement of the buttressing that is proposed for the Highway 11 realignment. The historical MacLeod low tailings between Barton Bay and the Highway 11 realignment will be rehabilitated as required.

An estimated 20% of the MacLeod high tailings will be removed from the open pit footprint and for the construction of the buttressing along the south edge of the tailings in the area of the open pit to address stability design requirements. The remaining portion of the MacLeod high tailings will be covered with an enhanced cover designed to limit infiltration and promote runoff to the sedimentation ponds for clarification and used as an overburden storage area.

Historical tailings removed from the Hardrock, MacLeod high and MacLeod low tailings areas will be deposited in the TMF in a controlled manner to prevent effects to water quality.

The removal of the MacLeod and Hardrock tailings will be completed using a combination of dozer pushing and excavation with either front end loaders or excavators. For the MacLeod low and Hardrock tailings within the footprint of the open pit, the tailing thicknesses range from 1 to 5 m; as a result, tailings will be removed with conventional excavation and loading methods with water collected and managed in sumps and pumped to the temporary or permanent ETP for treatment prior to discharge.

Excavation of the historical tailings will be completed in a series of benches with stabilization of each bench prior to the advancing to the next bench. Following completion of the excavation, an access road will be constructed next to the rock buttress that will be placed at the toe of the remaining MacLeod high tailings. A similar plan will be developed for the Hardrock tailings prior to their removal.

As the excavation will be advanced below the water table, water management will be required during construction and is anticipated to include a series of collection ditches and sumps, and potentially the use of well point systems to lower the water table in advance of the excavation works. Water collected during excavation works will be directed to a temporary collection pond located on the eastern side of the MacLeod high tailings for sediment removal and then pumped to the temporary or permanent ETP for treatment prior to discharge to the environment. The quantity of water and the need for a well point system during construction will be confirmed during

the detailed design stage. Once the excavation is completed and the final berm/ buttresses and seepage collection system are installed, final water management will include the french drain collection system at the base of the MacLeod high tailings and the runoff collection ditches located around the perimeter of the overburden stockpile.

7.4 Handling and Storage of Soils

7.4.1 Handling and Storage of Original Condition Soils

Soil handling and storage is an important stage of topsoil management since inappropriate handling and storage can result in accelerated decomposition of organic matter or loss of soil resources due to erosion.

There are two soil storage scenarios that may be implemented at the Project:

- **Windrowed soils:** for linear features such as channels, roads, and retention ponds, soil will be excavated and placed in linear piles or berms along the features. Where overburden is to be removed, it will be stripped, piled, and stored separate from the topsoil. Linear features will have soil windrowed unless they are at risk of dust deposition which may impact soil quality. Soils at risk will be moved to a more appropriate stockpile area.
- **Stockpiled soils:** this is the removal of soil after vegetation has been cleared and transporting of soil by haul trucks to designated storage areas within the Project site plan. Sites proposed for this type of soil handling include areas that will be covered by mine features such as the processing plant site, portions of the WRSAs, ore stockpile areas, aggregate source areas, creek diversion, and the open pit. Where overburden/subsoil is to be removed, it will be stripped, piled, and stored separate from the topsoil.

The organic/muck soils will be moved and stockpiled separately, as possible, from the topsoils and overburden. These soils can be mixed with lower quality topsoil to improve the water holding capacity.

7.4.2 Handling and Storage of Impacted Soils and Soils Overlying Historical Tailings

Impacted and/or contaminated soil encountered during the construction and operation of the Project include known areas of existing development and/or contamination and locations found during construction activities (referred to as a ‘chance find’).

The Project currently hosts a variety of commercial and residential buildings, and infrastructure (e.g., highway) that will need to be managed to allow Project construction and operation. The underlying soils of this existing current and historical development may or may not be affected by these activities; however, it is anticipated that various construction materials may be located within the footprint of these facilities.

The initial step will involve environmental personnel outlining the area of developed/impacted soil prior to excavation and sampling to assess the quality of the material for reuse within the Project. Soils intended for reuse as backfill or for structural purposes will also be reviewed and assessed by a qualified geotechnical engineer to determine if they are suitable for the intended reuse.

Impacted soil will be considered a waste stream and managed under the Conceptual Waste Management Plan and disposed in either the TMF in conjunction with tailings generated by the Project, or WRSA, or in an approved facility offsite

7.4.3 Standard Management Practices for Soil Storage Areas

The following is a list of the standard management practices for soil salvage, handling and storage:

- Soil will be stockpiled in the identified locations where it will not be moved or subject to further disturbance to address admixing and physical deterioration concerns.
- Erosion will be managed by limiting the height and slope of stockpiles. Where possible, slopes will be 3:1 and bench heights will not exceed 20 m.
- Whenever possible, stockpiles will be oriented to reduce wind erosion and stockpiles will not be stored at heights of land to reduce wind exposure.
- Where required, erosion control measures will be implemented.
- Soil stockpile locations will be identified by signage to prevent removal of material from the site or contamination with other materials.
- Covers may be used or vegetation will be established on stockpiles to reduce exposure to wind and water erosion and establishment of invasive plants.

7.5 Soil Treatment / Land-Farming

The operation of an on-site land-farm will be considered to treat soils that are impacted only by PHCs. Based on the soil quality information obtained for the Project to date, these soils were identified in the areas of the former MacLeod and Hardrock plant areas and at the two gasoline service station locations. In addition, it is possible that spills during the construction, operation and closure of the Project site could result in additional soils becoming impacted by PHCs.

Land-farming is an *ex situ* bioremediation technique that involves excavating and spreading of impacted soil either in beds consisting of a thin uniform layer, or in windrows. Remediation occurs by manipulating the soil conditions to stimulate microbial activity. Nutrients and water may be applied to the soil to stimulate microbial activity. Land-farms are an effective method to remediate soils impacted by PHCs, particularly in remote regions of Canada, due to the simplicity of the operational requirements. Once PHC concentrations in the soil have been remediated to an acceptable level, the soil can potentially be used for grading and the land-farm area can be rehabilitated.

The design of an on-site land-farm is outside the scope of this CSMP. A Land-farm Management Plan will be developed for the Project if on site soil bioremediation is optioned during construction or operations. It is also noted that the construction and operation of a land-farm will require an Environmental Compliance Approval (ECA) under Part V of the EPA.

7.6 Handling and Storage of Historical tailings

Excavated tailings will be placed in haul trucks in a controlled manner to prevent spillage losses to the environment during hauling to the new TMF. The excavated tailings will be deposited on top of the fresh tailings in the area between the TMF Inner Dam and Southeast Dam. Excavated tailings will only be deposited when a sufficiently thick layer of 2 m of fresh tailings has been deposited, with deposition cycling between the south and north cells to avoid interference with the ongoing deposition of fresh tailings. As deposition of historical tailings continues the base layer of new tailings will undergo compaction and result in reduced permeability.

Deposition will commence in the South Cell after the completion of tailings deposition in Year 2 of operation. The remaining historical tailings will be deposited in the North Cell over a blanket of fresh tailings in Year 4 of operations. The historical tailings will be completely covered with new tailings in subsequent years of operation. A buffer of 200m is provided to prevent the direct deposition of historical tailings on natural ground as the new tailings will typically thins out towards the margins. The buffer space will need to be confirmed during operations when the actual thickness, extent and surface gradient of the deposited tailings can be confirmed in the field.

The locations selected for historical tailings deposition in the new TMF are based on groundwater modelling and provide for the collection of seepage as a backstop to mitigate potential effects on groundwater and receiving environment. GGM will carry out additional testing of historical tailings including laboratory work to simulate storage conditions in the new TMF to confirm geochemical behavior prior to relocating material in Year 2.

7.7 Contact and Seepage Collection System Sediment

The ore milling and processing plant area, mill feed storage area, TMF and WRSAs will be drained via a series of seepage collection ditches collecting runoff and seepage to a series of collection ponds. The collection system provide runoff control, primary sedimentation of suspended solids within the ponds, and seepage collection.

Sediment clean out may be required for the collection ponds to maintain the storage capacity. Following standard excavation management measures (section 7.2.3), the collected sediment would be mechanically excavated using onsite equipment. It would be tested and if material are classified as non-hazardous waste and meets acceptable criteria for reuse it will be stored within the topsoil/overburden storage area for reuse during rehabilitation. If material cannot be used for rehabilitation it will be transferred to the TMF for disposal and if it is not possible to manage the material onsite, it will be transported offsite and disposed of at an appropriately licensed waste management facility.

7.8 Closure

The topsoil stockpiled on site will be used in the rehabilitation works. It is anticipated that the volume of stockpiled overburden will be in excess of the volume required for rehabilitation works. Further discussion of the topsoil and overburden uses for rehabilitation is discussed in the Conceptual Closure Plan (Stantec 2017a).

Mitigation and monitoring activities associated with decommissioning, reclamation and rehabilitation during the closure phase is presented in the Conceptual Closure Plan.

8.0 MONITORING, EVALUATION AND REPORTING

8.1 Monitoring, Measurement, Analysis and Evaluation

The purpose of the soil monitoring program is to evaluate and document performance objectives of the CSMP. Table 8-1 outlines the conceptual monitoring program.

Table 8-1: Summary of Conceptual Soil Management Plan Monitoring

Monitoring Activity	Project Phase	Frequency	Season
Soil Quality Sampling and Analyses for identifying Contaminated areas	Construction	On-going - to identify soil condition for planning of stockpile locations	Non-frozen ground days during drier periods
Soil Quality Sampling and Analyses of Soils for Rehabilitation	Operation	On-going - to identify future uses of soil stockpiles	Non-frozen ground days during drier periods

Early in the construction phase, sampling and analyses of the topsoil and overburden planned to be excavated will be conducted based on design planning and carried out by a qualified person to determine verify acceptable soil quality criteria.

Environmental personnel will also monitor/document the movement of excavated material and provide guidance on the placement and/or temporary stockpiling of material, if required.

During the operation phase, soil stockpiles and storage areas will be identified as to their suitability for rehabilitation as a revegetation root zone medium or other uses during rehabilitation. A qualified person will sample and analyze the stockpiles for grain-size distribution and available nutrients. Additional testing of the soils may be completed as part of the vegetation test plotting study, further described in the Conceptual Biodiversity Management and Monitoring Plan

8.2 Reporting

The form and frequency of follow-up reporting will be determined as the Project progresses through EA and permitting, however, it is anticipated that those elements relevant to the CSMP will be assembled into a formal summary report and provided to interested parties on an annual basis during construction and operation and during closure in years when monitoring is carried out. The reporting will be used to inform adaptive management reviews. Receiving, documenting and responding to communication from external interested parties, including complaints, will also form part of reporting under this Plan.

8.3 Continual Improvement

Adaptive management is a planned and systematic process for continuously improving environmental management practices by learning from their outcomes. Adaptive management provides the flexibility to address/accommodate new circumstances, to adjust monitoring, implement new mitigation measures or modify existing measures.

GGM will identify and correct incidents with appropriate and lasting measures aimed to prevent reoccurrence and/or similar occurrences. The Adaptive Management Framework (Figure 8-1), provides a formalized approach to:

- formally track and monitor activities;
- report and as needed investigate incidents, including non-conformance and non-compliance events;
- develop and implement corrective and preventive actions; and
- continue monitoring and update relevant EMMPs.

Corrective actions will be assigned as appropriate, including actions to prevent their reoccurrence. Corrective actions will vary according to the results of incident investigation and in consideration of other incidents related to soil management.

GGM is committed to the continual improvement of its environmental management and performance. As part of the GGM Adaptive Management Framework, the CSMP will be assessed annually to verify implementation and the continued suitability, adequacy and effectiveness of the Plan. The review will identify elements of this EMMP in need of revision, and evaluate performance against established performance objectives.

Figure 8-2 presents the overall approach to developing and advancing the EMMPs from the final EIS/EA to the construction Phase of the Project. The first stage of EMMP development begins with preparation of Conceptual Environmental Management Plans as part of the final EA/EIS. These Conceptual EMMPs are commitment-based and broad in their level of detail. The EMMPs guide environmental management for the Project and are progressively developed as the Project moves through the EA/EIS, permitting, and construction, and updated based on continual improvement during operations through adaptive management.

9.0 REFERENCES

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10.0 FIGURES

Figure 8-1: Hardrock Project Adaptive Management Framework

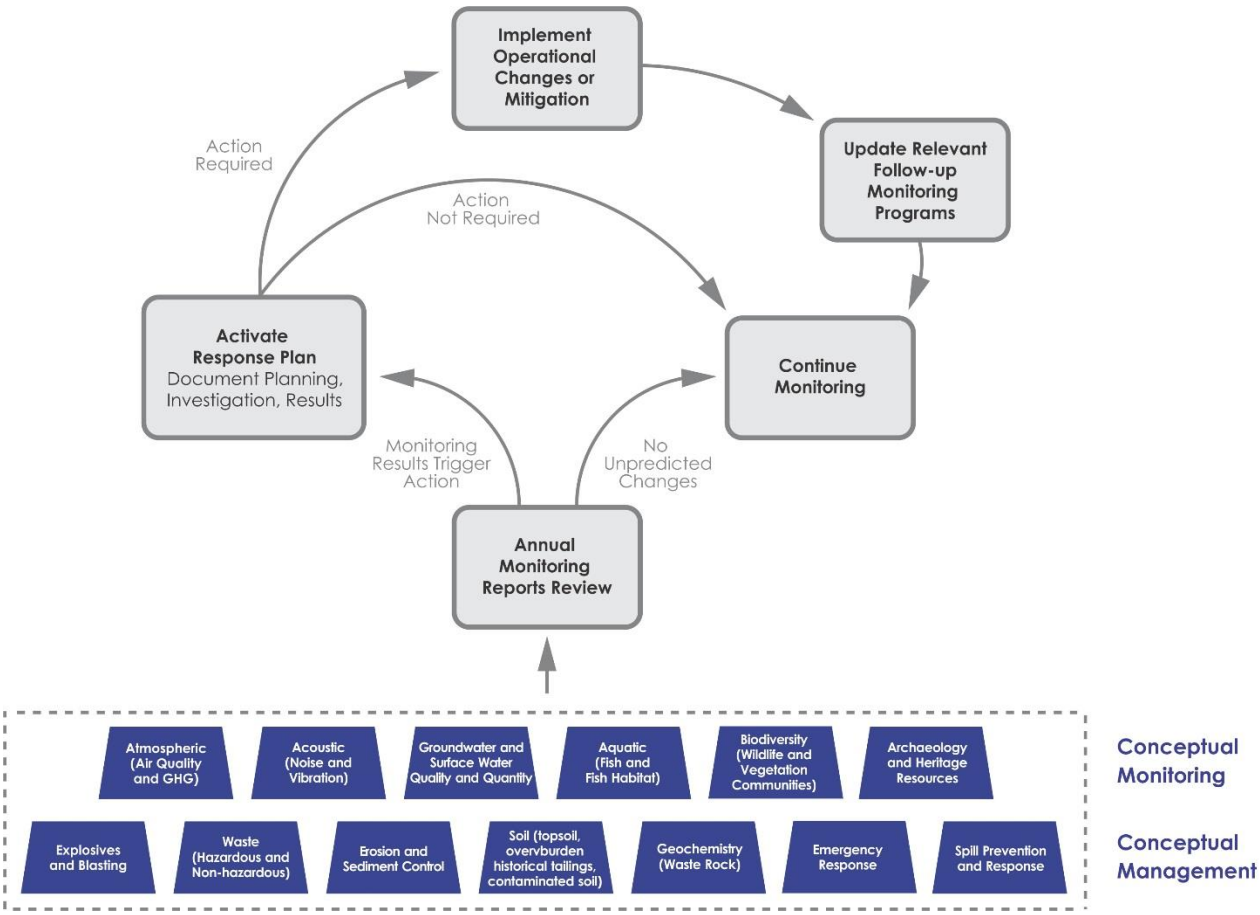

Figure 8-2: Environmental Management and Monitoring Plan Development EA to Construction