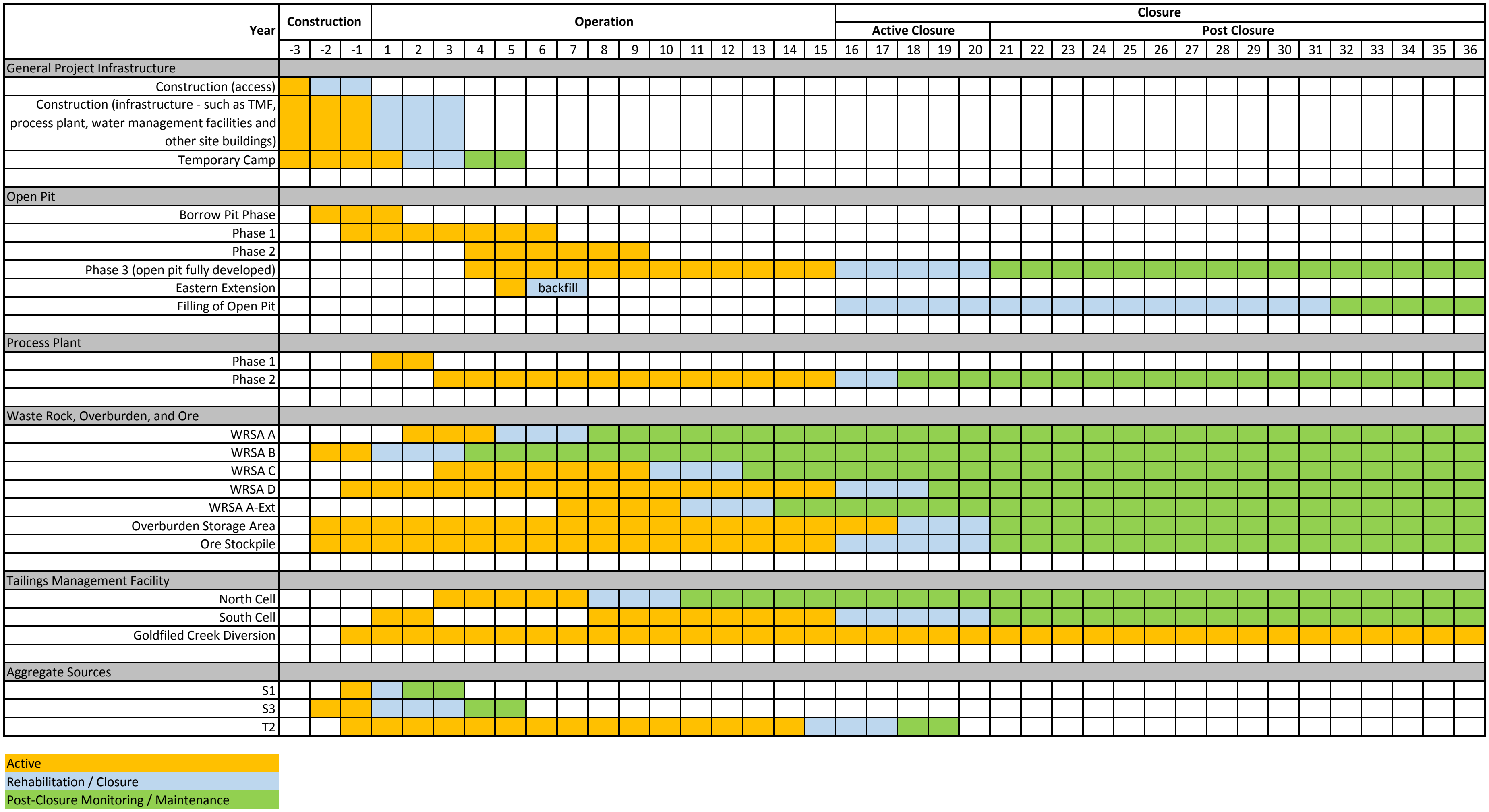


Project Schedule

OVERVIEW OF DEVELOPMENT OF ENVIRONMENTAL MANAGEMENT AND MONITORING PLANS (EMMP) FOR THE HARDROCK PROJECT

Introduction

Chapter 23 of the Final Environmental Impact Statement/Environmental Assessment (EIS/EA) (Stantec 2017) for the Hardrock Project provided a preliminary framework and scope for Environmental Management and Monitoring Plans (EMMPs), including environmental assessment follow-up and monitoring programs developed through the federal EA process for all Project phases as per the Environmental Impact Statement (EIS) Guidelines, and approved provincial EA Terms of Reference.

Greenstone Gold Mines GP Inc. (GGM) is committed to minimizing environmental effects through mitigation measures, monitoring and adaptive management for the Project within EMMPs throughout the construction and operational phases of the project. Through the EMMPs, the Project's environmental risks and opportunities will be addressed in a comprehensive, systematic, planned and documented manner to support the following objectives:

- To carry out the Project in compliance with existing legislation, consistent with federal and provincial guidelines, best practices and GGM corporate policies;
- To document measures to mitigate environmental effects;
- To enhance benefits from the Project; and
- To structure reporting to inform adaptive management and continual improvement.

The EMMPs will guide environmental management for the Project and will be progressively developed as the Project moves through the EIS/EA process, permitting, and construction, and will also be updated based on continual improvement during operation through adaptive management practices. The development of specific EMMPs must anticipate project development activities, such that appropriate procedures are in place to support the training of workers and the development of effective oversight processes for the work before the work commences. The EMMP's will be "*living documents*", continually updated as new environmental permits are issued and other commitments come into effect, and as site development progresses into new phases of activity.

EMMP development was initiated during the EIS/EA process with the preparation of Conceptual EMMPs (Appendix M of the Final EIS/EA) to demonstrate GGM's approach and commitment to environmental protection consistent with the EA. Those 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 preparation and review stage. The level of detail in each EMMP will expand as Project planning and design advance, when detailed follow-up programs are prescribed in the EIS/EA process, and as detailed engineering progresses and specific permit conditions become known. In some cases, an EMMP will be updated as part of the permit application process, but often it will be more appropriate to do this after the monitoring and compliance requirements are confirmed when the permit is issued.

The Project will be subject to a range of monitoring programs, each with its own scope and objective. These include environmental monitoring carried out under specific permit requirements and prescribed EIS/EA follow-up programs, as well as more general regulatory compliance. The objectives of the various EMMP programs will be complementary to reduce duplication, and will be used collectively to inform Project planning and implement the long-term environmental management requirements of the Project. GGM's adaptive management mechanism will be followed to update plans as required.

The following schematic diagram provides a general schedule for when detailed individual EMMP's are expected to be required. The accompanying table outlines the specific activities, environmental permits and regulations that will influence their timing and content. This is intended as a guide and subject to refinement based on permitting discussions with agencies anticipated in 2018.

Reference: Chapter 23 of the Final EIS/EA (Follow-Up and Monitoring Programs and Environmental Management Plans)

Site Preparation

M1 – Water Management and Monitoring Plan
M3 – Emergency Response Plan
M5 - Erosion and Sediment Control Plan
M8 – Spill Prevention and Response Plan
M13 – Biodiversity Management and Management Plan
M14 - Archaeology and Heritage Resource Management Plan

Construction (year 1)

M2 – Waste Rock Management Plan
M4 – Waste Management Plan
M6 - Greenhouse Gas Management and Monitoring Plan
M7 – Air Quality Management and Monitoring Plan
M9 – Soil Management Plan
M10 – Noise and Vibration Management and Monitoring Plan
M11 - Explosives and Blasting Management Plan
M12 – Aquatic Management and Monitoring Plan

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M1 – Water Management and Monitoring Plan (WMMP)	The purpose of the WMMP is to: • provide a reliable water supply for Project operation • use system capacities to maintain a flexible and robust system that allows for the reduction of peak flows requiring treatment and management • where possible, keep contact and non-contact waters separate to reduce the volume of water under management and to reduce the effect of the Project on local waters • manage and treat contact water and sanitary effluent streams to meet regulatory effluent requirements and be protective of the receiving environment.	Preconstruction; (road construction, tree clearing, etc.), potential erosion effects on waterways Construction; (site excavations, aggregate pit dewatering, mine shaft dewatering, camp operation, road crossings of creeks, creek realignment, etc.)	• Following EA approval prior to site activities involving water • Update as site activities and permits evolve	MOECC DFO MNRF ECCC • Ontario Provincial Water Quality Objectives and Interim Guidelines • Canadian MMER Effluent Criteria (DFO 2002) • Effluent Monitoring and Effluent Limits - Metal Mining Sector (O. Reg. 560/94) • MNRF Lakes and Rivers Improvement Act Administrative Guide (MNR 2011) • Canadian Dam Association guidelines • Mining Association of Canada guidelines for Developing an Operations, Maintenance and Surveillance Manual • Ontario *Safe Drinking Water Act* and Regulations • Federal *Fisheries Act*, 1985

Abbreviations:

MOECC	Ontario Ministry of the Environment and Climate Change
MNRF	Ontario Ministry of Natural Resources and Forestry
MNDM	Ontario Ministry of Northern Development and Mines
MTCS	Ontario Ministry of Tourism, Culture and Sport
DFO	Department of Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
NRCAN	Department of Natural Resources Canada
MMER	Metal Mining Effluent Regulations

Overview of Development of Environmental Management and Monitoring Plans (EMMP) for the Hardrock Project

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M2 – Waste Rock Management Plan (WRMP)	The purpose of the WRMP is to provide the geochemical testing and characterization program that will be implemented to guide the use, storage, and management of waste rock for the Project. Specifically, the WRMP identifies: • acid rock drainage (ARD) / metal leaching criteria to guide the management of waste rock, including the identification of waste rock appropriate for construction purposes • procedures to be implemented during operation to classify and manage various waste rock lithologies based on ARD potential • methods to manage ARD from WRSAs based on the geochemical properties of the material.	Construction; (moving old tailings, excavation of foundations, starter pit development, TMF dam construction, etc.)	• Following EA approval, prior to site activities involving movement of historic or newly developed waste rock • Update as site activities evolve	MNDM MOECC • Ontario Provincial Water Quality Objectives and Interim Values • Aquatic Protection Values

Overview of Development of Environmental Management and Monitoring Plans (EMMP) for the Hardrock Project

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M3 – Emergency Response Plan (ERP)	The purpose of the ERP is to: • facilitate prompt, efficient and safe response actions for addressing emergencies or compliance issues • identify the organization, responsibilities and reporting procedures of the emergency response team • define appropriate communications protocols, including procedures to contact relevant regulatory agencies and Aboriginal communities related to an accident or malfunction event and follow-up actions that will be taken • provide site information on the facilities and contingencies in place should an emergency or compliance issue occur • provide support and information on available resources, facilities and trained personnel if an emergency occurs.	Preconstruction (fuel use, tree clearing, road construction, camp operation, etc.)	• Following EA approval, prior to site clearing activities • Update as site activities evolve	MNDM MOECC ECCC • United Nations Environment Programme (UNEP) report titled Awareness and Preparedness for Emergencies on a Local Level for Mining: Guidance for the Mining Industry in Raising Awareness and Preparedness for Emergencies at Local Level (UNEP 2001) • Environmental Code of Practice for Metal Mines (Environment Canada 20) • CAN/CSA-Z731-M91 Emergency Planning for Industry (Canadian Standards Association 2002) • Workplace Hazardous Materials Information System 2015 (WHMIS) (Health Canada 2015) • Implementation Guidelines for Part 8 of the Canadian Environmental Protection Act, 1999 – Environmental Emergency Plans (Environment Canada 2004). • Federal *Transportation of Dangerous Goods Act*, 1992 • Emergency Management Program Standards O.Reg. 380/04 • *Occupational Health and Safety Act* (1990), and associated Ontario Regulation 854: Mines and Mining Plants

Overview of Development of Environmental Management and Monitoring Plans (EMMP) for the Hardrock Project

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M4 – Waste Management Plan (WMP)	The purpose of the WMP is to facilitate the effective management of solid non-hazardous wastes generated from the Project including setting performance objectives, ensuring compliance with regulatory requirements and adhering to the waste management principles of Reduce, Reuse, Recycle, Recover. The WMP outlines: • compliance obligations and methods for managing compliance with these requirements • performance objectives of the WMP • estimates of the quantity and type of solid non-hazardous waste to be generated • methods for characterizing and segregating hazardous waste from the solid waste management stream • appropriate disposal, recycling, or re-use options for wastes generated • tracking environmental performance and evaluating mitigation measures to enable the implementation of adaptive follow-up programs as needed.	Construction; (camp operation, demolition of houses / buildings, receipt of building materials, etc.)	• Following EA approval, prior to construction activities • Update as site activities evolve	MOECC ECCC • Federal *Transportation of Dangerous Goods Act*; • Canadian *Environmental Protection Act* and applicable regulations • Ontario *Environmental Protection Act*, and several associated regulations • Ontario Regulation 347: General – Waste Management

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M5 - Erosion and Sediment Control Plan (ESCP)	The purpose of the ESCP is to provide measures and Management Practices to limit site erosion and protect the watercourses from sedimentation for the protection of the environment.	Preconstruction; (road construction, site clearing) Construction; site preparation	• Following EA approval, prior to site activities • Update as site activities evolve	MNRF MOECC DFO • *Fisheries Act* and MMER (suspended solids a deleterious substance to fish); • *Environmental Protection Act* (MOECC) • *Lakes and Rivers Improvement Act* (MNRF) • *Ontario Water Resources Act* (MOECC) • *Endangered Species Act* (MNRF) • Ontario Provincial Standard Specification for Temporary Erosion and Sediment Control Measures (OPSS 805, November 2006). • Ontario Provincial Standard Specification, 2014. Construction Specification for Seed and Cover Measures (OPSS 804). April 2014.
M6 - Greenhouse Gas Management and Monitoring Plan (GHGMMP)	The purpose of the GHGMMP is to reduce and record the Project GHG emissions to comply with relevant GHG emissions management and reporting legislation.	Construction phase; ordering of key process equipment and vehicles	• Following EA approval • Prior to ordering of key process equipment and vehicles	MOECC ECCC • Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations, SOR/2010–201; 74, aligned with the US, sets progressively stricter GHG emissions standards for 2011-2016 model years • Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations, SOR/2013-24, apply to 2014 and later model years • Ontario Greenhouse Gas Emissions Reporting amendment (O. Reg.452/09) • Climate Change Mitigation and Low Carbon Economy Act, 2016 - O.Reg 143/16 and provincial 'cap and trade' program (O.Reg 144/16)

Overview of Development of Environmental Management and Monitoring Plans (EMMP) for the Hardrock Project

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M7 – Air Quality Management and Monitoring Plan (AQMMP)	The purpose of the AQMMP is to: • describe requirements for the routine management of sources of airborne dust during construction and operation • describe requirements for monitoring ambient air quality and meteorological conditions in and near the PDA as the basis for assessing potential air quality effects that may be attributable to the Project on surrounding areas • track air quality performance and provide feedback to the Environment Manager which may be used to refine the dust suppression program and other potentially significant air quality sources • describe requirements for provincial and federal air quality and emissions reporting.	Construction; haul road traffic, camp operation, burning of brush (if any), etc. Operation; mine operations, process plant operation	• Following EA approval, prior to major construction works; • Update as site activities evolve;	MOECC • MOECC Operations Manual for Air Quality Monitoring in Ontario (MOE 2008) (Operations Manual); • Control of fugitive dust emissions per Appendix B of MOECC Guideline A-10 • National Ambient Air Quality Objectives (NAAQOs) (Canada Gazette 1989), Canada Wide Standards (CWS) and the Canadian Ambient Air Quality Standards (CAAQS) PM2.5, ozone, CO, TSP, SO2 and NO2 • Ontario Regulation 419/05 Ambient Air Quality Criteria (AAQC) Schedule 3 standards • *Toxics Reduction Act* (TRA) - O. Reg. 455/09 Ontario Toxics Reduction Program • Canadian NPRI regulations

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M8 – Spill Prevention and Response Plan (SPRP)	The purpose of the SPRP is to provide the Hardrock Project with guidance in the development of spill prevention, contingency planning and reporting practices for the timely and effective response to spills of pollutants during the Project construction and operation phases for the safety of the environment and Project infrastructure.	Preconstruction; (road construction, site clearing)	• Following EA approval, prior to site activities • Update as site activities evolve	MOECC DFO ECCC • *Fisheries Act* (DFO); • MMER (Environment and Climate Change Canada) • *Transportation of Dangerous Goods Act*, 1992 • CAN/CSA-Z731-M91 Emergency Planning for Industry (Canadian Standards Association 2002) • Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products (CCME 2003) • Workplace Hazardous Materials Information System 2015 (WHMIS) (Health Canada 2015); • Implementation Guidelines for Part 8 of the Canadian *Environmental Protection Act*, 1999 – Environmental Emergency Plans (Environment Canada 2004) • *Environmental Protection Act* – O. Reg 224/07 Spill Prevention and Contingency Plans
M9 – Soil Management Plan (SMP)	The purpose of the SMP is to: • retain and preserve suitable soil for use in Project rehabilitation • identify and manage soil impacted by existing or historical anthropogenic activities that require excavation to allow development of the Project.	Construction; (road construction, soil stripping of quarries or other work sites, excavating historic tailings, etc.)	• Following EA approval, prior major construction works • Update as site activities evolve	MNDM • *Environmental Protection Act*, R.S.O. 1990, c. E.19; • O. Regulation 347: General - Waste Management • MOECC - Management of Excess Soil, A Guide for Best Management Practices (2014) • MOECC Site Condition Standards; Tables 1 - 9 of Ontario Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act* (2011)

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M10 – Noise and Vibration Management and Monitoring Plan (NVMMP)	The purpose of the NVMMP is to: • describe requirements for the routine management/ maintenance of sources of noise and vibration during construction and operation • describe requirements for monitoring noise and vibration during various phases of the Project, as the basis of asserting compliance of Project construction and operation against the predictions described in the Final EIS/EA • describe acoustic assessment and reporting requirements for provincial (and federal) approval/compliance • develop a monitoring program to verify the effectiveness of the mitigation measures implemented for the Project and compliance with the requirements and guidance identified in the "Technical Data Report: Hardrock Project – Noise and Vibration Assessment" (Appendix F2) • Identify: minimum equipment performance requirements, monitoring locations, duration and timing of the monitoring, analysis and reporting requirements and training of field personnel • provide guidance for abatement if exceedances are found during compliance verification.	Construction; (site excavations, aggregate pit operation, blasting in starter pit, etc.)	• Following EA approval, prior to site activities involving blasting or trucking of large volumes of waste rock • Update as site activities evolve	MOECC • For construction and operation noise, in accordance with the NPC-300, sound level and construction vibration limits at points of reception (PoR) • For operation vibration: ISO 2631-2 provides guidance pertaining to upset limits of vibration exposure • For blasting noise and vibration: NPC-119 provides limits to noise and vibration at receptor locations

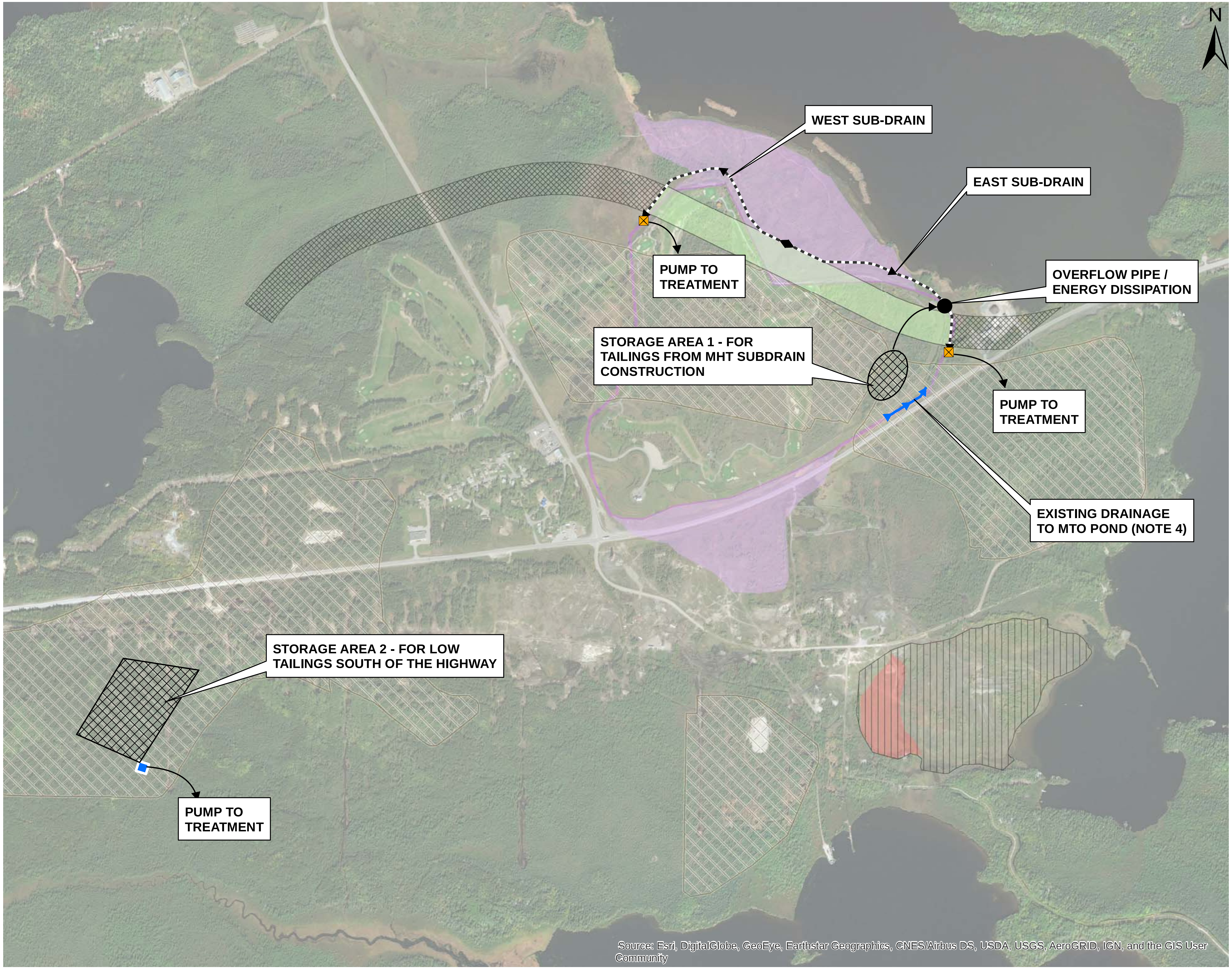
Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M11 - Explosives and Blasting Management Plan (EBMP)	The purpose of the EBMP is to provide direction for the safe storage, handling and use of explosives and explosive components at the Project, for the safety of the public and Project personnel, and protect both the environment and Project components.	Construction; (blasting in starter pit and foundation excavations)	• Prior to use of explosives for excavating the starter pit, building foundations etc. • Update as site activities evolve	NRCAN ECCC DFO MNRF • Canadian Explosives Regulations, 2013 (SOR/2013-211) outline the requirements for an application for a license; • Ammonium Nitrate Storage Facilities Regulations (CRC, c 1145); • Transportation of Dangerous Goods Regulations (SOR/2001-286); • Environmental Emergency Regulations (SOR/2003-307 as amended by SOR/2011-294); and • Natural Resources Canada (2014) Guidelines for Bulk Explosives Facilities • DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat Including Aquatic Species at Risk (DFO 2016)

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M12 – Aquatic Management and Monitoring Plan (AMMP)	The Purpose of the AMMP is to: • describe proposed mitigation to protect fish and fish habitat • describe proposed methods for monitoring potential effects on the aquatic environment to verify the predictions made within the Final EIS/EA • convey the intended management and monitoring plans to stakeholders for consideration in the development of individual, regulatory monitoring requirements (e.g. Fisheries Act Authorization, environmental effects monitoring, Environmental Compliance Approval, Follow-up Program Agreement).	Preconstruction; (only if road construction involves new or upgraded creek crossings) Construction; (construction of creek crossings, creek diversion, discharge of water from excavations near fish habitat, etc.)	• Following EA approval, prior to site activities involving fish habitat • Update as site activities evolve	MOECC DFO MNRF ECCC • Canadian *Fisheries Act* prohibits serious harm to fish, which is defined as the death of fish or a permanent alteration to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats … to carry out their life processes; • *Fisheries Act* Authorizations for the loss or permanent alteration of fish habitat • MMER, under Section 36 of the Fisheries Act, regulate deposit of mine waste into natural waters frequented by fish • *Ontario Lakes and Rivers Improvement Act* • *Ontario Fish and Wildlife Conservation Act*

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M13 – Biodiversity Management and Management Plan (BMMP)	The purpose of the BMMP is to: • Outline mitigation approaches for reducing effects on vegetation and wildlife • Outline vegetation and wildlife monitoring program for construction and operation phases to confirm effectiveness of mitigation measures and verify Final EIS/EA conclusions.	Preconstruction; (site clearing)	• Following EA approval, prior to site activities involving wildlife or plant habitat e.g. tree clearing that might impact Species-at-Risk, raptor nests, active bird nesting sites, etc. • Update as site activities evolve	MNRF DFO ECCC • *Canada Species at Risk Act* (SARA) • Federal Recovery Strategies for boreal caribou (2012), Canada warbler (2016), common nighthawk (2016), and one proposed recovery strategy (little brown myotis and northern myotis (2015) • *Migratory Birds Convention Act* - prohibits the harming, killing, disturbance or destruction of migratory birds, nests and eggs and prohibits depositing oil … or other substances harmful to migratory birds in areas they may inhabit • *Ontario Endangered Species Act*, 2007 (ESA) Ontario Regulation 242/08 provides specific exemptions from the provisions of the ESA under certain conditions; • Ontario Woodland Caribou Conservation Plan (MNR 2009); • *Ontario Fish and Wildlife Conservation Act* • Ontario Policy Statement (MMAH 2014) informs land use planning decisions under the Planning Act; Natural Heritage Reference Manual (MNR, 2010); Significant Wildlife Habitat Technical Guide (MNR 2000); and Eco-Region Criteria Schedules (MNRF 2015) for significant wildlife habitat.

Environmental Management & Monitoring Plan (EMMP)	Scope / Purpose	Project Activities that will trigger initial plan development	Timing of Plan Development	Links to Regulations, Standards and Regulating Authority
M14 - Archaeology and Heritage Resource Management Plan (AHRMP)	The purpose of the AHRMP is to ensure the protection of archaeological and cultural heritage resources that could potentially be affected by the Project and where necessary, to identify new resources that may warrant appropriate documentation, salvage and commemoration.	Preconstruction; (road construction, site clearing)	• Following EA approval, prior to any site activities involving disturbance of soil or vegetation • Update as site activities evolve	MNDM MTCS • MTCS Ontario Heritage Act and Standards and Guidelines for Consultant Archaeologists (2011) apply to management of archaeological resources; • Ontario Cemeteries Act provides for measures associated with a burial site or artifacts associated with human remains • Mitigation strategies are developed using the MTCS Ontario Heritage Tool Kit (2006)

FIGURE: HISTORIC TAILINGS STORAGE LOCATIONS



LEGEND
- Pump Station for contact water (to WTP)
- Surface Drain
- Storage Facility Excavated Historic Tailings
- Collection Subdrain
- Seepage Collection Pond
- MTO Road Allowance
- MTO Road Allowance - Zone of non-contact water managment by others
- Limit of Future Stockpile
- Hardrock Tailings
- MacLeod High Tailings
- MacLeod Low Tailings
- Reactive TailingsArea

0 125 250 500 Meters

SCALE: 1:12,500
WHEN PLOTTED CORRECTLY AT 11 x 17
NAD 1983 UTM Zone 16N

NOTES
1. This map is for conceptual purposes only and should not be used for navigational purposes.
2. Non-contact stormwater is runoff not affected by seeps, excavation or consolidation
3. Non-contact water treatment is seperaete (TSS Only)
4. To reduce existing surface flow at south side of MHT place surface drainage media and till cover, as required

GREENSTONE GOLD MINES
HARDROCK PROJECT

CONCEPTUAL DESIGN
HARDROCK FEASIBILITY STUDY

HISTORIC TAILINGS STORAGE LOCATIONS

February 7, 2018	Rev	0	Figure No.
Project No.	209.10002.00000		1

SLR
global environmental solutions

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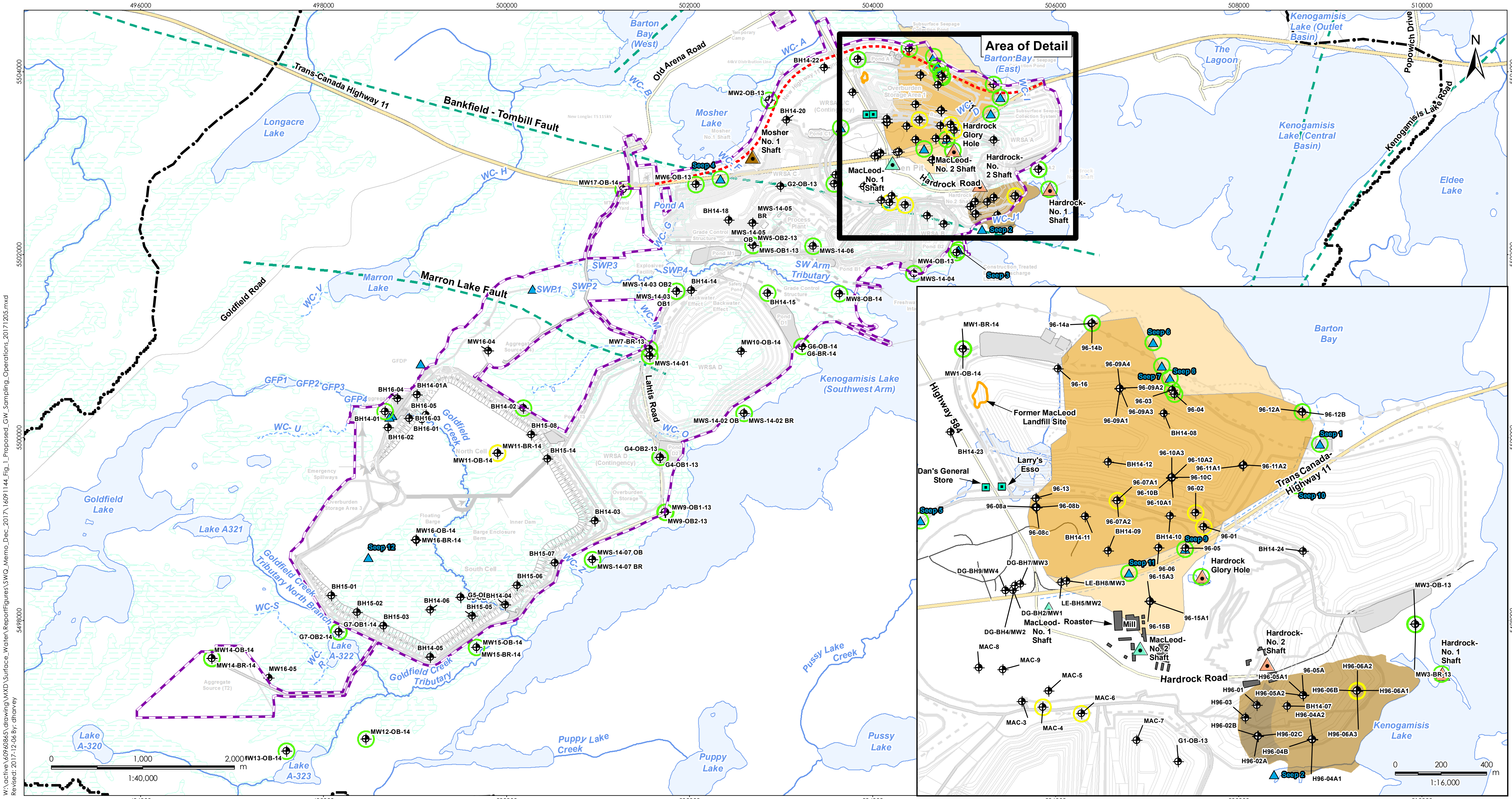

December 2017
160961009

Legend

- Local/ Regional Assessment Area (For Ground Water)
- Project Development Area
- Monitoring Well
- Groundwater Sampling Location (May be reconsidered once construction commences)
- Groundwater Sampling Location
- Seep
- Former Gas Station
- Faults
- New Highway 11 Alignment
- Watercourse- Permanent
- Watercourse- Intermittent
- Former Macleod Landfill Site
- Wetland (Eco-Site Based)

Historic Tailings Areas

- Hardrock Tailings
- Hardrock Reactive Tailings Area
- MacLeod High Tailings
- MacLeod Low Tailings

Historical Tailings Areas Mine Shafts

- Consolidated Mosher Long Lac Shaft
- Hard Rock Gold Mine Shaft
- Little Longlac Mine Shaft
- MacLeod-Cockshutt Mine Shaft

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Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

Client/Project

Greenstone Gold Mines GP Inc (GGM)
Hardrock Project

Figure No.
1

Title
Proposed Groundwater Sampling Locations During Mine Operation

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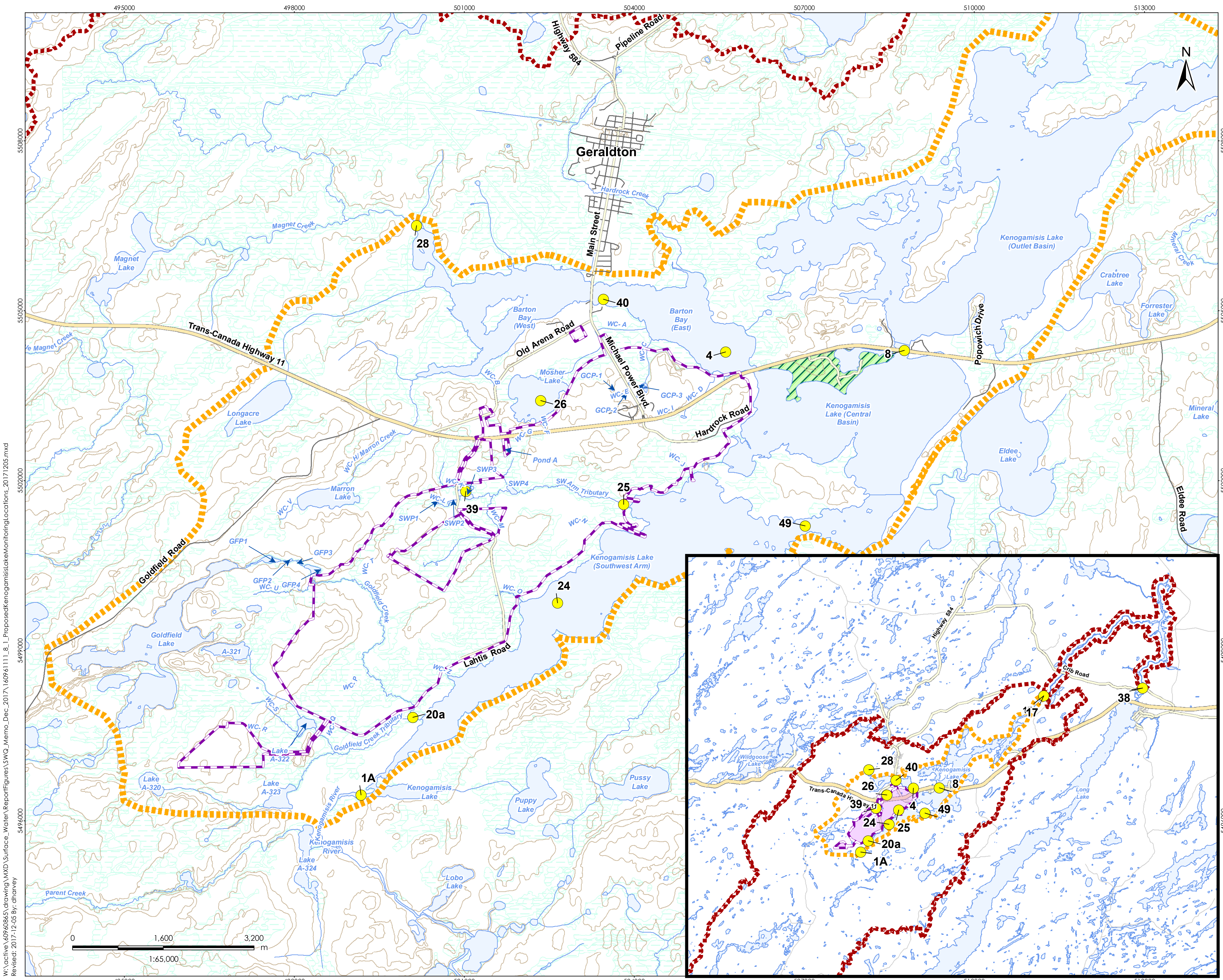
Revised: 2017-12-06 By: dharvey



Stantec

Legend

- Regional Assessment Area
- Local Assessment Area
- Project Development Area
- Proposed Monitoring Location

Existing Features

- Highway
- Major Road
- Local Road
- Watercourse
- Provincial Park
- Wetland (Eco-Site Based)
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

December 2017
160961111

Client/Project

Greenstone Gold Mines GP Inc. (GGM)
Hardrock Project

Figure No.
8-1

Title
Proposed Surface Water Monitoring Stations During Mine Operation

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Revised: 2017-12-05 By: dharvey

“RESPONSE TO KEY INFORMATION REQUESTS REGARDING WATER, HARDROCK PROJECT, GREENSTONE GOLD MINES” MEMO

Stantec

Memo

To:	Stephen Lines, Environmental Assessment and Permitting Manager Greenstone Gold Mines GP Inc.	From:	Michelle Fraser, Nikolay Sidenko, and Sheldon Smith Stantec Consulting Ltd.
File:	160961223	Date:	January 12, 2018

Reference: Response to Key Information Requests regarding Water Hardrock Project, Greenstone Gold Mines

This memo is intended to provide an overview of responses to key surface water, groundwater, and geochemical concerns as well as provide an update to the STELLA arsenic modelling arising from comments received on the Hardrock Project Final Environmental Impact Statement/Environmental Assessment (EIS/EA). Detailed technical responses to comments received are under development and will be submitted to the individual agencies under separate cover.

The following highlights the approach taken by the Project toward the assessment of effects in the EIS/EA:

- Extensive field work was carried out between 2013 and 2016 and used to the extent possible in the development of baseline existing conditions in the prediction of future conditions.
- Conservative assumptions were developed to allow prediction of potential effects and to allow an assessment of the need for mitigation. This approach adds successive levels of conservatism into the analysis and prediction of potential effects to water quality and results in the over-prediction of potential effects. This was a fundamental approach used within the EIS/EA and is discussed further in Section 10.4.1.3 of the Final EIS/EA related to the prediction of effects to groundwater and surface water quality.
- To mitigate potential effects to water quality and meet the intent of Policy 2, a series of mitigation measures have been provided in the Project design, including:
  - An effluent treatment plant (ETP) to treat mine water effluent through the construction and operation period, and into the post-closure phase of the Project if water quality does not meet the required closure criteria. The EIS/EA has proposed effluent criteria for the ETP that are protective of the receiving environment with the overall goal of achieving a higher level of treatment over the long-term operating period. **The benefits of this higher level of treatment have not been included in the assessment to predict the effects to water quality and as a result provide a conservative prediction of potential effects.**
  - A sewage treatment plant (STP) to treat sanitary effluent originating from the mine site, including phosphorus treatment.
  - Reclamation of the historical Hardrock and MacLeod tailings.
  - During closure, if water treatment is required, constructed wetlands or other forms of passive treatment approaches are proposed and a commitment has been made to complete a wetland pilot study during the operation phase to refine the effectiveness and design of these passive systems in the event they are required.
- To confirm future condition estimates and model predictions comply with regulatory conditions, demonstrate environmental stewardship, and to provide potential early detection of

unexpected water quality/quantity conditions, GGM has developed a water management/monitoring and adaptive management plan (Water Management and Monitoring Plan). The Water Management and Monitoring Plan provides critical information to assess the performance the plan and enable adaptive management to both improve performance and intervene in situations where further water quality/quantity mitigation is required.

1.0 SURFACE WATER

1.1 Use of Municipal Wastewater Treatment for Worker Camp Sewage

Minutes from the May 4, 2017 GGM, Municipality of Greenstone (Municipality) and the Ministry of the Environment and Climate Change (MOECC) meeting indicate there are concerns with the municipal sewage treatment plant that must be addressed prior to the addition of the worker camp sewage, including:

- a constriction in the final outfall from the plant
- implications of increased phosphorus.

The minutes list several upgrades and improvements necessary to have the plant operate as designed. The Municipality stated that they are implementing recommendations made in the Pollution Prevention and Control Plan developed several years ago.

The report "Scoping Study for Expansion of Sewage Conveyance Infrastructure" (TBT Engineering March 31, 2017), estimates that while modifications to the existing approval may be required, effluent flows to the plant will remain at or below the current approved levels, including the addition of effluent from the temporary construction camp without capacity expansion. GGM understands that phosphorus treatment is planned by the Municipality to address phosphorus loadings. A confirmation and support letter from the Municipality is included as Attachment C.

1.2 Mercury Concentrations and Predictions in Surface Water

The conservative data handling (e.g., detection limits and non-detected values) and modeling approaches used throughout the development of the EIS/EA have resulted in an overestimation of baseline conditions which is carried forward through to future predictions. This is most evident in the case of mercury where it is generally not detected in surface water yet modelling predictions result in an increasing trend in concentration of mercury over time. Of the 924 surface water samples collected and analyzed for mercury, 911 (99%) were below the detection limit, which was as low as 0.005 µg/L. Geochemical testing indicates no Project sources of mercury, however a slight increasing trend in mercury concentrations is predicted. This increasing trend in mercury concentrations is the result of a modelling artifact and not reflective of the Project. In order to complete the modelling for assessment of affects, a numerical value is required for each modelled parameter. When a parameter was non-detectable, half the detection limit was used in the assessment. The significant amount of non-detectable samples for mercury bias the prediction of effects, indicating that low-level concentrations of mercury are modelled, when in reality, the majority of samples are non-detectable for mercury. The conservative non-detectable data handling method and water quality loading prediction method indicates an increase in mercury when in fact, the increases in mercury predicted are considered to be model artifacts and far over predict future condition expectations. Please refer to the memo "GGM Hardrock Project - Mercury in Surface Water, Fish Tissue and associated Human Health and Ecological Risk Assessment" for further information (January 12, 2018).

The Goldfield Creek diversion to the Southwest Arm Tributary will increase the flow in the Southwest Arm Tributary and result in an increase in the permanently inundated area by approximately 15 ha where the potential exists for subsequent mercury methylation. The generation of methyl-mercury (MeHg) in the Southwest Arm Tributary was evaluated based on 9 years of mercury methylation investigative work by St Louis et al. (2004)[1] at the Experimental Lakes Area of northern Ontario during wetland flooding trials. Mercury methylation due to reservoir development and surface water impoundment is well documented within their work and confirmed by numerous other sources recognizing water impoundment and reservoir development as a potential driver to mercury methylation. Their work showed that the net yield of MeHg in the flooded wetland complex increased in the first year and declined subsequently due to microbial demethylation.

Based on the highest mercury methylation rates observed by St.Louise et al. (2004)[1], the estimated MeHg yield from the increased permanently inundated area around the Southwest Arm Tributary will be approximately 1,050 mg/yr. Based on the mean annual flow estimated for the Southwest Arm Tributary after the diversion, the estimated increase in MeHg concentration in the Southwest Arm Tributary will be approximately 0.0001 µg/L. The CWQG-FAL limit for MeHg is 0.004 µg/L. Refer to the memo "GGM Hardrock Project - Mercury in Surface Water, Fish Tissue and associated Human Health and Ecological Risk Assessment" for further information (January 12, 2018) for discussion of consideration of additional studies in the Experimental Lakes Area Reservoir Project and Flooded Upland Dynamics Experiment.

The following project activities and mitigations are expected to reduce the potential for mercury release and methylation:

- Clearing and grubbing of organic vegetation prior to inundation to reduce potential mercury methylation. This is particularly relevant for the diversion aggregate pit area in the Goldfield Creek Diversion pond and the diversion channel from the pond to Lahtis Road.
- Removal and collection of organic soils, where feasible, for subsequent use in progressive rehabilitation to reduce potential mercury methylation. This is feasible where constructability and access permits in the upper section of the diversion channel and aggregate pit area in the Goldfield Creek Diversion Pond.
- The proposed inundation areas specifically reduce shoreline erosion, which is otherwise known to accelerate potential MeHg release.
- The proposed inundation zones are riverine in the upper diversion channel section and more lacustrine in the Southwest Arm Tributary lowland. The diversion increases the catchment area of Southwest Arm Tributary by more than 200% and will flush more water through the system than

[1]St. Louis, V.L., Rudd J.W.M., Kelly C.A., Bodaly R.A., Paterson M.J., Beaty K.G., Hesslein R.H., Heyes A., and Majewski A.R., 2004. The Rise and Fall of Mercury methylation in an Experimental Reservoirs. Environ Sci Technol 38:1348-1358

under baseline conditions reducing the potential for concentration increase over time under static or low flow conditions.

- Water quality monitoring of the streams and lakes in the local assessment area including the Goldfield Creek Tributary, Goldfield Creek diversion channel, Southwest Arm Tributary inflow to the Southwest Arm of Kenogamisis Lake and Mosher Lake.

1.3 Predicted Effect of Change in Groundwater Quantity on Lake A-322

In the groundwater model, the groundwater table is predicted to change in the area of the northern portion of Lake A-322 due to the presence of the seepage collection ditch located along the southwestern perimeter of the tailings management facility (TMF). The change in groundwater table elevation around the northern shoreline of Lake A-322 is predicted to be approximately 0.5 m or less, which is predicted to result in a 4.59 L/s or 40% decrease in the groundwater discharge to Lake A-322 as discussed in Section 9.4.2.3 of the Final EIS/EA.

Lake A-322 is a flow through system where water levels are primarily governed by flow from Lake A-321, WC-S, GFC tributary, and the upstream sub watershed. The amount of groundwater discharging to Lake A-322 is estimated at 11.5 L/s and represents less than a third of the mean annual flow through the lake. The equivalent decrease in surface water level as a result of the change in groundwater level and decrease in groundwater discharge to Lake A-322 was calculated by considering the dimensions of the lake outlet channel, channel slope and channel roughness and using the Manning's equation to estimate the reduction in water depth necessary to reflect the change in flow from reduced groundwater discharge.

From field measurements, channel dimensions of the outlet of Lake A-322 were estimated to be 3 m wide under mean annual flow conditions, with a channel slope of0.06% and Manning's roughness 0.04. The estimated surface water level change in Lake A-322 as a result of a 40% reduction in groundwater discharge to Lake A-322 was less than 0.01 m which represents less than a 0.05% change in lake surface area. The results are within the natural variability of lake levels.

Potential effects on lake water levels, although not predicted to be significant, would be most noticeable during low water (i.e., summer), not during spring when spawning occurs in Lake A-322. Therefore, there is no anticipated residual effect on water quantity in this lake that would impair existing spawning habitat. Aquatic monitoring is proposed at Lake A-322.

The proposed Environmental Management and Monitoring Plans (EMMPs) are presented in Appendix M of the Final EIS/EA. The EMMPs are commitment based and broad in their level of detail, focused on construction and operation phases of the Project. The level of detail included in the EMMPs will be expanded upon as more Project details are developed and as regulatory input is obtained. The following details related to the proposed EMMPs for surface water and groundwater are provided.

1.4 Water Monitoring Plans

1.4.1 Surface Water Monitoring Plan

During mine operation, surface water quality will be monitored quarterly at 13 locations as shown on Figure 1 (see Attachment A). The monitoring will cover major water features in the LAA and RAA such as:

- Kenogamisis River – Station 1A
- Southwest Arm – Stations 24 and 49
- Southwest Arm Tributary – Station 25
- Goldfield Creek Tributary – Station 20a
- Goldfield Creek Diversion – Station 39
- Mosher Lake – Station 26
- Road – Station 38.
- Magnet Creek – Station 28
- Barton Bay – Stations 40 and 4
- Central Basin – Station 8
- Outlet Basin – Station 17
- Long Lake Inflow at Crib

The following parameters are proposed for surface water monitoring:

- Alkalinity, acidity, hardnessColor, true
- Conductivity
- Dissolved Metals in Water by CRC ICPMS
- Total Metals in Water by CRC ICPMS
- Ammonia by Discrete Analyzer
- Nitrite in Water by IC
- Nitrate in Water by IC
- Phosphorus, Total
- pH
- Cyanide
- Sulfate in Water by IC
- Total Dissolved Solids
- Total Kjeldahl Nitrogen
- Total Organic Carbon (TOC)
- Total Suspended Solids
- Turbidity
- Dissolved and total Mercury in Water by CVAFS
- Methylmercury by CVAFS

Operational monitoring will be complemented by compliance monitoring of the ETP and STP discharge in accordance with the environmental compliance approval (ECA) requirements. The purpose of compliance monitoring is to demonstrate compliance with the proposed effluent criteria and predicted mixing and resultant water quality. Also, water quality monitoring of the Southwest Arm of Kenogamisis Lake will be completed monthly to monitor effluent discharge and the extent of the mixing zone within the receiver.

1.4.2 Groundwater Monitoring Plan

As stated in the Water Management and Monitoring Plan (Appendix M1 of the Final EIS/EA), groundwater levels and groundwater quality within the vicinity of the open pit, TMF, waste rock storage areas (WRSAs), Kenogamisis Lake, Southwest Arm Tributary, and Goldfield Creek will be monitored to confirm results of the groundwater model and effectiveness of mitigation measures. The following additional details of the groundwater monitoring program for construction and operation are provided:

- Monitoring of the dewatering rates form the aggregate source areas, historical underground workings and open pit.
- Monitoring of groundwater levels at approximately 125 monitoring wells on a monthly basis and the deployment of up to 32 data loggers at selected monitoring wells, as presented in Figure 2 (see Attachment A).
- Groundwater quality sampling at 73 monitoring wells on an annual basis, as presented in Figure 3 (see Attachment A), monitoring for general chemistry and dissolved metals.
- Monitoring of water quantity (flow rate and total daily volume) and quality (daily grab sample during dewatering with total of three samples per week) of dewatering water during construction in accordance with permit to take water (PTTW) and ECA requirements.
- Monitoring of water quantity (flow rate and total daily volume) and quality (monthly) pumped from Mosher No. 1 Shaft and Hardrock No. 1 and No. 2 Shafts during dewatering of historical underground workings and open pit in accordance with the requirements of the PTTW.

The monitoring locations and frequency of monitoring will be refined through the permitting process and will consider the addition and/or removal of monitoring wells to account for modifications during the detailed design phase (i.e., actual existing monitoring wells that may be overprinted by Project components and as result new replacement wells are required), for regulatory requirements, and operational monitoring. During construction, additional monitoring may be required temporarily in areas localized around active construction to support permitting requirements and to monitor potential effects. The approach to providing general monitoring locations and the framework were discussed previously with the MOECC and it was agreed that specifying specific monitoring locations at this time was not required and could be advanced as the Project proceeds through the design and permitting phases.

2.0 GROUNDWATER

2.1 Proximity of Tailings Management Facility to Kenogamisis Lake

Groundwater seepage from the TMF does not pose a risk to the environment based on the tailings geochemistry, mitigation measures and conservative water quality predictions, which include:

- Where required, consolidation grouting will be carried out to reduce the permeability of the near surface bedrock.
- Seepage mitigation of the TMF provided through wide tailings beaches abutting the perimeter dams and pushing the pond to the central portion of the TMF away from the perimeter dams; these measures reduce the hydraulic gradient and thus seepage flows and significantly increase the groundwater flow path and travel times as the pond is located approximately 1.5 km from the Southwest Arm of Kenogamisis Lake.

- Seepage collection ditches and ponds have been designed per Metal Mining Effluent Regulations (MMER) requirements to provide hydraulic containment for seepage by maintaining the collection ponds at a lower level than the ambient groundwater, thus creating an inward gradient so that groundwater is drawn into the ponds. With mitigation, the TMF seepage rate represents less than 0.06% of the mean annual flow (8,352 L/s) entering the Southwest Arm of Kenogamisis Lake from the Kenogamisis River just upstream of the TMF. Furthermore, given the setback distance for the TMF Pond from Kenogamisis Lake, groundwater travel times to these points of discharge are estimated at 13 to 16 years, indicating significant travel times over which attenuation within the subsurface can occur.
- The average arsenic concentration (66 µg/L) is well below the MOECC Aquatic Protection Value (APV) of 150 µg/L. This concentration was used in the groundwater model to predict potential effects to surface water quality within Kenogamisis Lake and did not consider any attenuation within the subsurface. Considering the travel times discussed above, it is expected that significant attenuation will result due to both physical flow processes and chemical precipitation reactions towards the point of discharge. This provides a very conservative approach to estimating the effects to surface water quality from the TMF seepage.

Both the effluent and mass balance surface water model assessments indicate no significant effect in receiving waters from groundwater seepage despite these very conservative assumptions.

2.2 Construction Phase Dewatering and Discharge Assessment

A construction ETP is planned to be used on a temporary basis during construction until the permanent ETP is built. The construction ETP is planned as a mobile unit that will treat construction phase contact water. During construction, total dewatering rate from the open pit and historical underground workings is approximately 109 L/s. This pumping rate was considered in the groundwater flow model and in the assessment of water quality effects on the Southwest Arm of Kenogamisis Lake based on the discharge from the ETP. The exact timing and dewatering requirements for construction is not known until detailed engineering is complete.

The construction ETP will be connected by a pipe to the temporary construction treated effluent discharge location along the shoreline of the Southwest Arm of Kenogamisis Lake as shown on Figure 5-2 of Chapter 5.0 (Project Description) of the Final EIS/EA (see Attachment A). The construction ETP and associated infrastructure will be decommissioned and removed when they are no longer required.

The ETP effluent during construction is expected to be similar to the effluent during operation. Therefore, the Assimilative Capacity study was focused on receiving water assessment under the Project's "worst-case" operation condition as per EIS/EA guidance. The temporary effluent discharge during construction will be further refined during the detailed design for the permitting process.

2.3 Pond M1 and Potential Seepage

Pond M1 will receive contact water from the perimeter contact water collection ditches and ponds (A1, A2, B1, B2, C1, D1, and D2) which service the WRSAs, overburden storage area, ore stockpile, and process plant area. The water quality of pond M1 is predicted to meet the MMER or O.Reg. 560/94 criteria during operation and closure of the Project. Water quality from pond M1 will be treated as required during operation to meet approved discharge criteria for the Project.

Pond M1 serves as a central or final balancing pond to feed the mill or ETP. During the detailed design phase of the Project, the detailed site conditions in the area of Pond M1 will be confirmed to optimize setbacks from the Southwest Arm Tributary and consider the need for a liner or other mitigation to store the required volumes of water and reduce potential seepage.

2.4 Waste Rock Storage Area Seepage Quality and Proximity to Kenogamisis Lake

The seepage quality estimates were completed conservatively, assuming the at-source seepage quality was discharging directly to the receiving waters and did not account for mitigation measures such as:

- Follow-up geochemical field data collected in 2016 and 2017, which indicate a further decline in concentration of parameters of concerns (PoPCs) compared to the 2014 and 2015 data that was used to develop the geochemical inputs (refer to Section 3.0 of this Memo).
- 30 to 45 years for the WRSAs to reach steady state saturation, at which time the WRSAs will be rehabilitated further reducing the potential for seepage from the WRSAs. During operations groundwater recharge from WRSAs C and D are predicted to result in combined discharge representing less than 0.06% of the mean annual flow leaving the Southwest Arm of Kenogamisis Lake and does not results in adverse effects or consider any seepage mitigation, which is predicted to reduce this discharge by 32% during operations. This mitigation was not included in the water quality predictions.
- Natural attenuation of the PoPCs through the WRSAs or the subsurface via physical and chemical processes.

As noted, despite these conservatisms, both the effluent and mass balance surface water model assessments indicate no significant effect in receiving waters from groundwater seepage.

Monitoring will be completed to confirm the results of the effects assessment. In operation, seepage from the WRSAs will be captured by the open pit and the seepage collection system with performance monitoring completed in the immediate vicinity of the WRSAs to characterize actual water quality, and down gradient from the collection systems to confirm that groundwater is below the APVs. This monitoring approach allows the development and implementation of contingency measures if trigger parameters are exceeded. The mean travel times from WRSAs C and D to Kenogamisis Lake is approximately 5 to 40 years, respectively. Therefore, there will be sufficient time to monitor and confirm seepage water quality from the WRSAs and TMF during operations, prior to closure and the potential discharge to Kenogamisis Lake.

2.5 Incorporation of 2016 Groundwater Quality Data

The Draft EIS/EA was submitted in February 2016 and included groundwater quality data at the time of submission, which was to the end of 2015.

The mean concentration groundwater quality parameters presented in the Final EIS/EA were calculated using up to six sampling events completed as part of the baseline monitoring program from 2014 through 2015. This data was in addition to the longer-term data set for the historical tailings that was available since 2012. The baseline monitoring program included 25 monitoring wells completed within the historical MacLeod tailings and 13 monitoring wells completed within the

historical Hardrock tailings.

In 2016, the monitoring program was revised to consider transitioning from baseline monitoring to the long-term monitoring program that would be required as part of the operation and closure phases of the Project. Therefore, monitoring wells that were located within the footprint of the proposed open pit were removed from the monitoring program. For the historical MacLeod tailings, 7 of the 25 monitoring wells were sampled in 2016 and for the historical Hardrock tailings, 4 of the 13 monitoring wells were sampled in 2016.

The 2016 groundwater quality data were reviewed and compared to those presented in the Final EIS/EA. Attachment B presents the 2016 groundwater quality data. Table 2-1 presents the 2014 to 2015 and the 2014 to 2016 mean concentration of arsenic at monitoring wells completed within the historical tailings.

Table 2-1 Comparison of Mean Arsenic Concentration at Monitoring Wells Completed within Historical Tailings

Monitoring Well	2014-2015		2014-2016		Percent Difference
	No. of Samples	Mean Concentration (µg/L)	No. of Samples	Mean Concentration (µg/L)	
Historical MacLeod Tailings					
96-02	4	6,742	7	6,642	-1.5
96-04	7	15,672	10	16,150	3.0
96-07A1	5	9,894	8	9,652	-2.5
96-07A2	5	4,974	8	5,158	3.6
96-12A	6	5,175	9	5,210	0.7
96-12B	6	10,418	9	10,369	-0.5
96-14B	4	102	7	103	1.0
Historical Hardrock Tailings					
H96-06A1	6	7,890	9	8,365	5.8
H96-06A2	5	22,840	8	25,162	9.7
H96-06A3	5	3,141	8	3,397	7.8
H96-06B	5	22,280	8	21,887	-1.8

The 2016 data were consistent with the magnitude and trends presented in the Final EIS/EA. For example, the 2014 to 2016 mean concentration of arsenic were within +/-3.6% and 9.7% compared to the 2014 to 2015 mean concentration of arsenic presented in the Final EIS/EA for monitoring wells completed within the historical MacLeod and Hardrock tailings, respectively. Given the relatively insignificant percent difference between the 2014 to 2015 data presented in the Final EIS/EA and the 2014 to 2016 mean concentration of arsenic, the interpretation of predicted effects on groundwater quality do not change whether the 2016 data are included or not.

2.6 Use of Mean versus 75th Percentile in Groundwater Quality Statistics

To characterize the mass loading from the historical tailings, the mean concentrations were selected for use in the calculation of mass loading to Kenogamisis Lake. The subject of the use of mean versus the median for comparison of groundwater quality data to the PWQO, APV, and Ontario Drinking Water Quality Standards (ODWQS), was discussed with government agency and Aboriginal communities in Fall 2016 and Spring 2017. Groundwater quality was found to vary both horizontally and vertically within the tailings, with higher concentrations for most parameters typically found at depth within the tailings. This variability is evident when comparing the mean and median concentrations for the PoPC within each historical tailings source. A thorough review of the data determined that the mean concentrations of the parameters analyzed were predominantly higher than the median concentrations thus the mean was used as the more conservative value to document existing condition and in the predictive value.

A good fit to the observed mass loading within Kenogamisis Lake based on the mean groundwater concentrations was observed in the mass balance modelling presented in Chapter 10.0 (surface water VC) and in the STELLA mass balance modelling (Appendix F13) of the Final EIS/EA. The results of the statistical analysis requested by MOECC are that the model predictions tend to be slightly conservative through most of the prediction range, which was a specific objective during the model calibration process (i.e., to satisfy requirements of the EIS and Human Health and Ecological Risk Assessment processes, the model predictions should be reasonable, with a tendency to be conservative).

A sensitivity analysis of the total loadings to Kenogamisis Lake on the prediction of total arsenic concentration in water was also completed to address MOECC comments. A conclusion of the sensitivity analysis was that the use of alternative values that result in higher total arsenic concentrations in the water, such as the 75th percentile, tend to be overly-conservative.

The use of the mean concentrations provides a reasonable and reliable estimation of the overall mass loading in groundwater that is actually discharging to the lake.

3.0 GEOCHEMISTRY

3.1 2016-2017 Field Geochemical Testing Trends

Geochemical field data collected in 2016 and 2017 indicate an ongoing declining trend of concentration in composite samples of major waste rock lithologies (Table 3-1). For waste rock lithology WR-S, which represents the majority of the waste rock produced (72%) and has the highest arsenic (As) leaching rates, concentrations decreased from 0.16 mg/L in 2014 to 0.062 mg/L in 2015 (2.6 times reduction) with a further reduction in 2016 to 0.038 mg/L, or an additional 1.6 times below the 2015 data. In 2017 concentrations decreased again to 0.036 mg/L, representing at total reduction of 1.7 times from the 2015 data that were used in the water balance and water quality modelling. Arsenic concentrations for all field bins are below the APVs of 150 ug/L. Similar reductions in PoPCs for other waste rock lithologies are evident in the 2014 to 2017 data.

In the water quality modelling completed as part of the Water Balance and Water Quality Monitoring Report (Appendix F5 of the Final EIS/EA), the quality of leachate and seepage from the

WRSAs was conservatively estimated using the 2014 and 2015 data only. For the model, the 2014 data were used for the first year of deposition, with the 2015 leaching rates used for the second year of deposition on. As the WRSAs were built over time, the leaching rates represent a blend of the 2014 and 2015 rates based on the deposition plan with constant leaching rates being assumed one year after the final deposition of waste rock in the storage area. No further reduction in loading rate was considered. As geochemical reactions are predicted to slow over time due to chemical oxidation reactions and the coating of sulphide minerals with oxidation byproducts, the use of the 2014-2015 data in the water quality modelling provide very conservative estimates of the long-term water quality predicted from the WRSAs, as evident in the data presented in Table 3-1. This is more important for the closure period where mitigation provided by soil cover together with the decline trend in leaching rates will result in better water quality than predicted based on the short term geochemical testing data. This is the reason that the field bin program has been maintained and why an adaptive monitoring approach has been proposed for the Project. As data collection and actual site conditions is confirmed during operations, the ability to improve post-closure water quality predictions will improve significantly.

Table 3-1: Average annual concentrations of selected elements in field tests

Sample ID	Al	Sb	As	Co	U
Units	mg/L	mg/L	mg/L	mg/L	mg/L
PWQG	**-**	**-**	**0.1**	**0.0009**	**-**
Interim PWQG	**0.075**	**0.02**	**0.005**	**-**	**0.005**
WR-S					
Averages 2014-2016	**0.11**	**0.12**	**0.10**	**0.0034**	**0.012**
Year 1 (Apr 2014 - May 2015)	**0.20**	**0.15**	**0.16**	**0.0019**	**0.011**
Year 2 (Jun 2015 - Apr 2016)	0.033	**0.11**	**0.062**	**0.0060**	**0.017**
Year 3 (Jul 2016 - May 2017)	0.031	**0.06**	**0.038**	**0.0030**	**0.008**
Year 4 (Jun 2017 - Oct 2017)	0.027	**0.06**	**0.036**	**0.0027**	**0.007**
WR-I					
Average 2014-2016	**0.076**	**0.049**	**0.11**	0.00039	0.0017
Year 1 (Apr 2014 - May 2015)	**0.078**	**0.054**	**0.10**	0.00044	0.0022
Year 2 (Jun 2015 - Apr 2016)	**0.09**	**0.046**	**0.11**	0.00034	0.0011
Year 3 (Jun 2016 -May 2017)	0.06	**0.041**	**0.10**	0.00036	0.0013
Year 4 (Jun 2017 - Oct 2017)	0.07	**0.026**	**0.07**	0.00023	0.0011
WR-C					
Average 2014-2017	0.059	**0.040**	**0.007**	0.00022	0.0020
Year 1 (Apr 2014 - May 2015)	**0.10**	**0.052**	**0.011**	0.00025	0.0027
Year 2 (Jun 2015 - Apr 2016)	0.033	**0.065**	**0.008**	0.00035	0.0031
Year 3 (Jun 2016 -May 2017)	0.041	**0.023**	0.003	0.00017	0.0011
Year 4 (Jun 2017 - Oct 2017)	0.034	0.016	0.002	0.00009	0.0007
Expected reduction 2015-2017	1.2	2.2	1.9	2.3	2.4

Notes: PWQO exceedances are **bolded** and underlined and Interim PWQO exceedances are **bolded**

For the purposes of the Final EIS/EA, a conservative approach was taken to improve the certainty over the long-term potential effects of the Project, which represents a best practice in EA methodology. This conservative approach starts with the prediction of source water quality, which is

Reference: Response to Key Information Requests regarding Water

the starting point for the groundwater water quality predictions and ultimately the surface water quality model predictions. By carrying this conservative estimate of source water quality for the WRSAs through the groundwater and surface water modelling, and the conservative assumptions that are further included in subsequent model predictions results in very conservative predictions of the potential effects to surface water quality. Even with this very conservative approach, no significant effects to water quality are predicted and in fact water quality improvements are predicted as a result of the Project.

3.2 Historical Tailings Location in TMF

Excavated tailing will include material from the historical MacLeod High, MacLeod Low and Hardrock tailings. The MacLeod High tailings will comprise 81% by volume of relocated tailings with the total volume of relocated tailings representing 1% of the design capacity of the TMF. Most of the tailings will be excavated early on in the Project. Excavated tailings will be hauled with trucks to the new TMF and deposited on top of a layer of fresh tailings that is at least 2 m thick. The tailings from MacLeod High and MacLeod Low sites will be deposited within the northeast corner of the South Cell in first years of mining (Refer to Figure 5-23 in the Final EIS/EA). Tailings from MacLeod High and MacLeod Low sites will be deposited in the southeast corner of the North Cell and covered by several metres of new tailings. The layer of new tailings will consume oxygen preventing metal leaching from oxidation of sulfides minerals including arsenopyrite, which represents 75% of arsenic present in historical tailings. The deposition zone for the historical tailings is constrained by the development of the TMF when the historical tailings are being moved and by feasible depositional methods. The deposition zones were planned to increase the setback of the historical tailings from the TMF boundaries and in turn Kenogamisis Lake.

The groundwater flow modelling confirms that no seepage from the area where the historical tailings are proposed to be deposited in the new TMF reaches a surface water body with all seepage collected within the seepage collection system. This is facilitated by the wide tailings beaches in the area where the historical tailings will be deposited and the distance from this area from the TMF pond, which represents the driving force for the TMF seepage. At closure, the placement of the soil cover will reduce infiltration and further mitigate seepage from the historical tailings placed within the TMF. The seepage collection system would continue to operate during closure until the seepage was of an acceptable quality for discharge to the environment. Additional studies will be conducted prior to relocation of the historical tailings and if required additional deposition design measures can be added in detailed engineering to further segregate the historical tailings in the TMF.

4.0 STELLA MODEL

In response to the MOECCs October 23rd, 2017 memorandum, Stantec is currently completing additional work pertaining to the arsenic concentrations in the water and sediment of Kenogamisis Lake predicted by the STELLA model to address concerns presented regarding model validation/calibration and model sensitivity analysis. The initial results of the additional model validation/calibration and sensitivity analyses will be documented in a new memorandum to be discussed with Dr. Hlevca at a meeting scheduled for December 7, 2017.

5.0 CLOSING

Effects predictions for water quality are not significantly adverse under the highly conservative assessment case presented in the EA. Due to the conservative approach used throughout surface water, groundwater and geochemical modeling, we are confident that future water quality conditions will be better than predicted and protective of the environment. The comprehensive mitigations proposed to address future conditions, including enhanced reclamation of historical tailings and the Project's Effluent Treatment Plant (the latter of which was hardly accounted for in the assessment case), provide for a high level of confidence in the reliability of the assessment. We trust this meets your current requirements, should you have any questions or concerns please do not hesitate to contact the undersigned.

STANTEC CONSULTING LTD.

<Original signed by>

Michelle Fraser, M.Sc., P.Geo.
Hydrogeologist
Phone: (519) 585-7421
michelle.fraser@stantec.com

<Original signed by>

Nikolay Sidenko, Ph.D., P.Geo.
Senior Environmental Geochemist
Phone: (204) 928-8862
nikolay.sidenko@stantec.com

<Original signed by>

Sheldon Smith, MES., P.Geo.
Senior Hydrologist
Phone: (905)415-6405
sheldon.smith@stantec.com

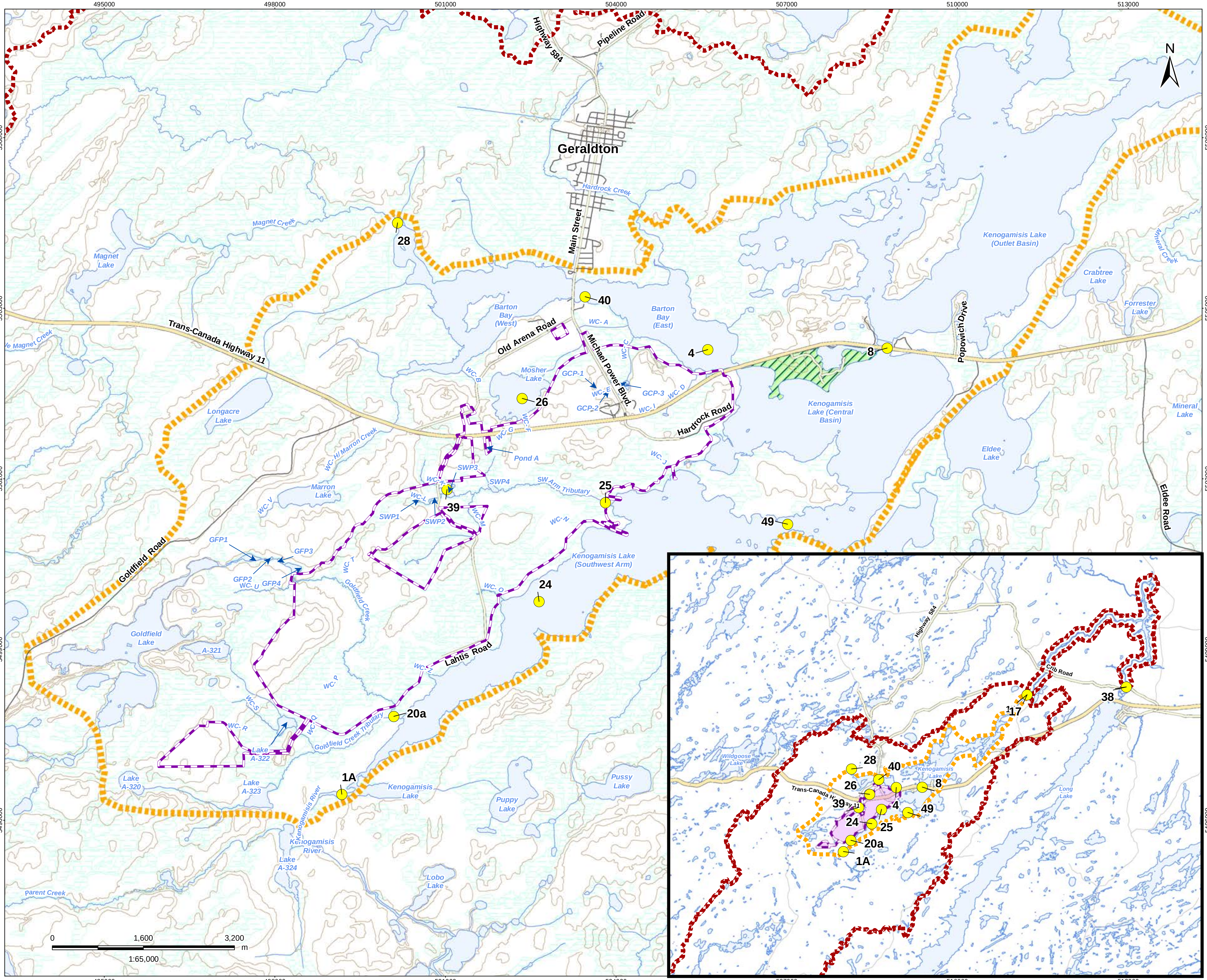
Attachment: Attachment A – Figures
Figure 1 – Proposed Surface Water Monitoring Locations
Figure 2 – Proposed Groundwater Level Monitoring Locations During Mine Operation
Figure 3 – Proposed Groundwater Sampling Locations During Mine Operation
Figure 5-2 from Final EIS/EA

Attachment B – 2016 Groundwater Quality Data
Attachment C – Letter from the Municipality of Greenstone dated January 11, 2018

c. Piero Amodeo, Stantec Consulting Ltd.
Craig Johnston, SLR Consulting

Stantec

ATTACHMENT A
FIGURES



Stantec

N

Legend

- Regional Assessment Area
- Local Assessment Area
- Project Development Area
- Proposed Monitoring Location

Existing Features

- Highway
- Major Road
- Local Road
- Watercourse
- Provincial Park
- Wetland (Eco-Site Based)
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

December 2017
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Client/Project

Greenstone Gold Mines GP Inc. (GGM)
Hardrock Project

Figure No.
1

Title

Proposed Surface Water Monitoring Stations During Mine Operation

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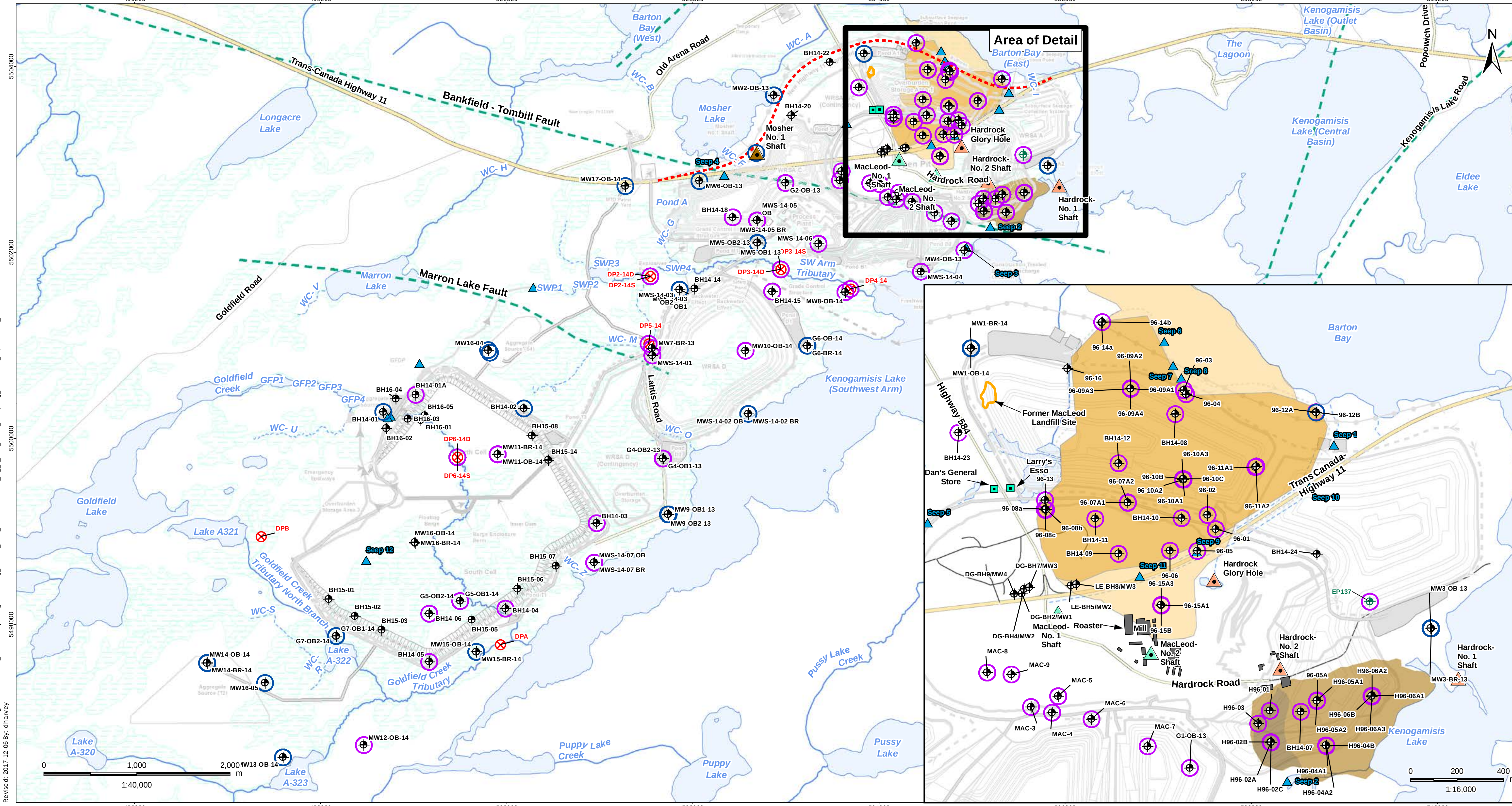
Revised: 2017-12-05 By: dharvey



December 2017
160961144

Legend

- Drive Point
- Exploration Holes
- Monitoring Well
- Manual Groundwater Level Measurement
- Data Logger Installed
- Seep
- Former Gas Station
- Faults
- New Highway 11 Alignment
- Watercourse- Permanent
- Watercourse- Intermittent
- Former Macleod Landfill Site
- Wetland (Eco-Site Based)

Historic Tailings Areas

- Hardrock Tailings
- Hardrock Reactive Tailings Area
- MacLeod High Tailings
- MacLeod Low Tailings

Historical Tailings Areas Mine Shafts

- Consolidated Mosher Long Lac Shaft
- Hard Rock Gold Mine Shaft
- Little Longlac Mine Shaft
- MacLeod-Cockshutt Mine Shaft

Stantec

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

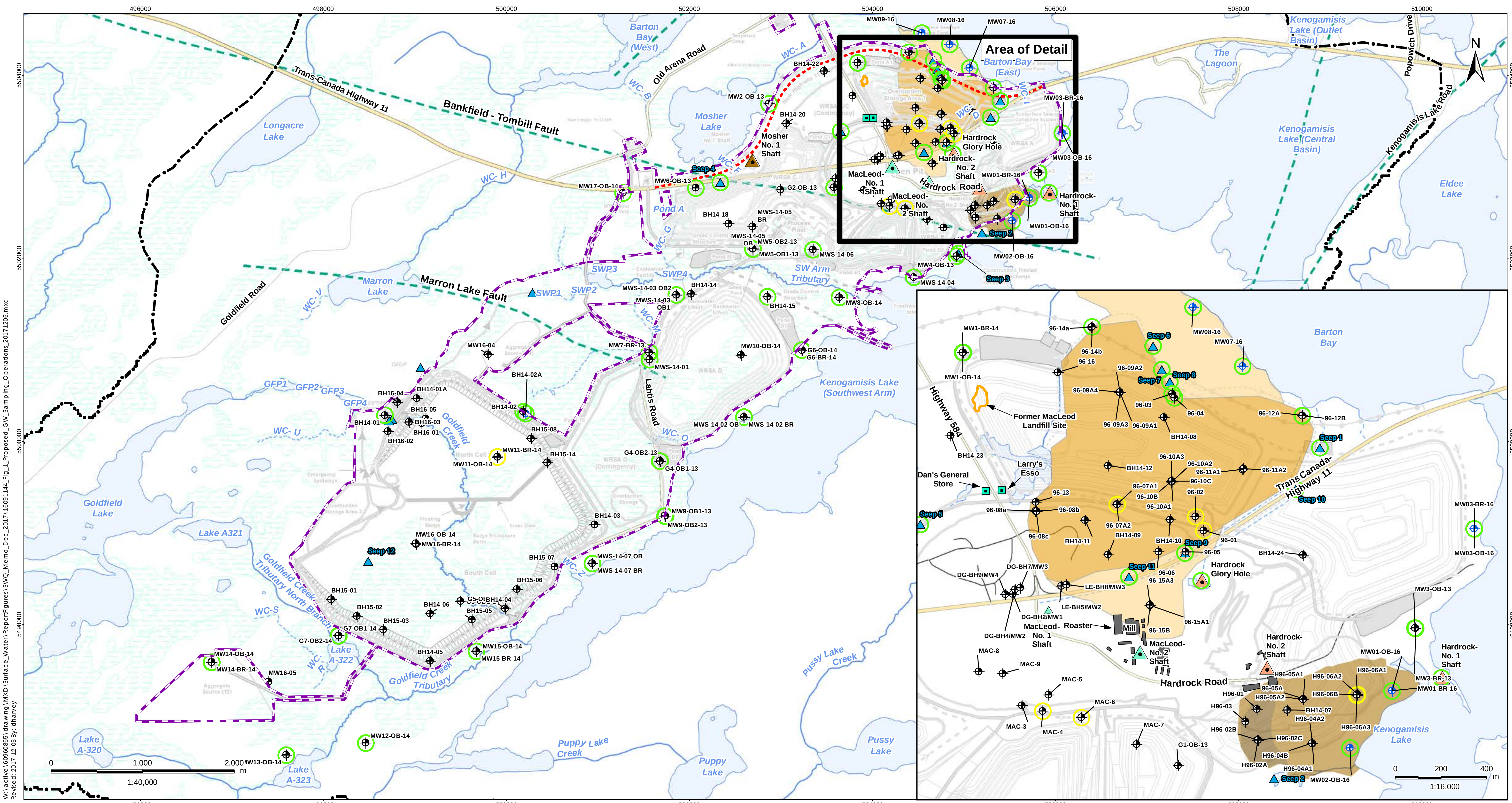
Client/Project

Greenstone Gold Mines GP Inc (GGM)
Hardrock Project

Figure No.
2

Title

Proposed Groundwater Level Monitoring Locations During Mine Operation



December 2017
160961009

Stantec

Legend

- Local/ Regional Assessment Area (For Ground Water)
- Project Development Area
- Monitoring Well
- Proposed Monitoring Well
- Groundwater Sampling Location (May be reconsidered once construction commences)
- Groundwater Sampling Location
- Seep
- Former Gas Station
- Faults
- New Highway 11 Alignment
- Watercourse- Permanent
- Watercourse- Intermittent
- Former Macleod Landfill Site
- Wetland (Eco-Site Based)

Historic Tailings Areas

- Hardrock Tailings
- Hardrock Reactive Tailings Area
- MacLeod High Tailings
- MacLeod Low Tailings

Historical Tailings Areas Mine Shafts

- Consolidated Mosher Long Lac Shaft
- Hard Rock Gold Mine Shaft
- Little Longlac Mine Shaft
- MacLeod-Cockshutt Mine Shaft

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
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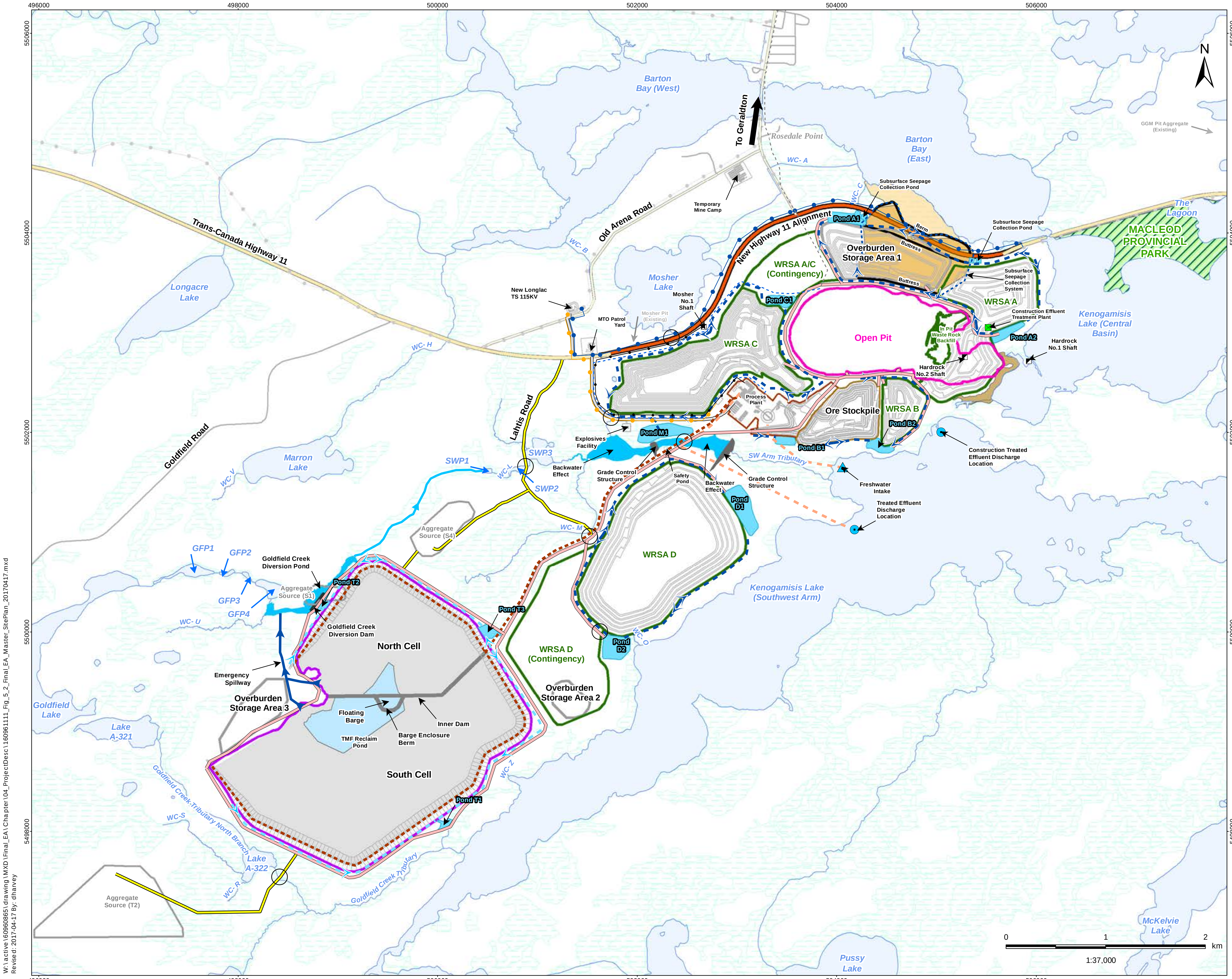
Client/Project

Greenstone Gold Mines GP Inc (GGM)
Hardrock Project

Figure No.
3

Title

Proposed Groundwater Sampling Locations During Mine Operation



Stantec

Legend

Preliminary Site Plan

- Discharge Location
- Existing Mine Shaft
- Freshwater Intake
- Construction Effluent Treatment Plant
- Watercrossing
- Access Road
- Construction Access Road
- Diversion Channel
- Emergency Spillways
- Haul Road
- Potable Water Pipeline
- Pipeline (Intake and Discharge)
- 44 kV Distribution Line
- 12.5 kV Distribution Line
- 115 kV Transmission Line
- Seepage Collection Ditch
- Subsurface Seepage Collection System
- Contact Water Collection Ditch
- Tailings Pipeline and 13.8 kV Distribution Line
- Aggregate Source
- Collection Ponds
- Open Pit- Full Extent
- Ore Stockpile
- Process Plant Area
- Tailings Management Facility
- Waste Rock Storage Area

Highway Realignment

- New Highway 11 Alignment

Existing Features*

- Highway
- Major Road
- Local Road
- Existing Power Line
- Existing Potable Water Pipeline
- Watercourse
- Provincial Park
- Waterbody
- Wetland (Eco-Site Based)

Historical Tailings Areas

- Historical Hardrock Tailings
- Historical MacLeod High Tailings
- Historical MacLeod Low Tailings

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

* Existing Features have been removed in the PDA and do not reflect current conditions.

April 2017
160961111

Client/Project

Greenstone Gold Mines GP Inc. (GGM)
Hardrock Project

Figure No.
5-2

Title

Site Plan Ultimate Footprint

Stantec

ATTACHMENT B:
2016 GROUNDWATER QUALITY DATA

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater													
Sample Location					BH14-01					BH14-02			BH14-15			G4-OB1-13		
Sample Date					15-Jun-16	15-Jun-16	4-Aug-16	4-Aug-16	13-Oct-16	18-Jun-16	2-Aug-16	18-Oct-16	21-Jun-16	4-Aug-16	18-Oct-16	19-Jun-16	3-Aug-16	13-Oct-16
Sample ID					BH14-01	DUP 1	BH14-01	DUPLICATE 5	BH14-01	BH14-02	BH14-02	BH14-02	BH14-15	BH14-15	BH14-15	G4-OB1-13	G4-OB1-13	G4-OB1-13
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1784595	L1809307	L1809307	L1843864	L1786341	L1807778	L1846557	L1787602	L1809307	L1846557	L1786341	L1808958	L1843864
Laboratory Sample ID					L1784595-5	L1784595-6	L1809307-6	L1809307-7	L1843864-11	L1786341-8	L1807778-10	L1846557-7	L1787602-1	L1809307-5	L1846557-4	L1786341-20	L1808958-1	L1843864-10
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**		Field Duplicate		Field Duplicate										
Field Parameters																		
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	0.62	-	3.91	-	2.18	0.42	0.77	0.68	0.21	0.7	0.92	3.07	8.52	5.28
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	387	-	349	-	418	300	0.318	302	1184	1066	1046	457	409	476
pH, Field	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.31	-	7.19	-	7.67	**6.85^{G}**	7.27	7.33	**6.92^{G}**	7	**6.79^{G}**	7.55	7.92	7.77
Temperature, Field	deg C	15^{C}	n/v	≤15^{G}	5.14	-	5.41	-	2.4	5.37	10.5	8.36	3.6	5.56	4.71	4.15	13.09	2.01
General Chemistry																		
Acidity as CaCO3	mg/L	n/v	n/v	n/v	15.1	15.8	7.7	9.5	10.1	10.9	12.3	8.6	53.4	54.7	68.8	10.2	4.1	4.9
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	229	226	220	224	228	166	168	174	708	734	670	310	-	277
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500^{D}	n/v	n/v	229	226	220	224	228	166	168	174	**708^{D}**	**734^{D}**	**670^{D}**	310	262	277
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.169	0.167	0.181	0.141	0.190	0.250	0.26	0.171	0.46	0.47	0.392	0.188	0.368	0.322
Anion Sum	meq/L	n/v	n/v	n/v	4.65	4.57	4.48	4.57	4.62	3.34	3.41	3.59	14.2	14.7	13.4	6.40	5.31	5.62
Cation Sum	meq/L	n/v	n/v	n/v	4.75	4.74	4.79	4.71	4.75	3.95	3.67	3.42	15.1	15.4	13.6	6.84	5.54	5.61
Chloride	mg/L	250^{C}	180^{F}	≤250^{G}	0.77	0.66	0.52	0.63	0.50	0.35	0.32	0.25	1.57	1.36	1.19	0.48	1.50	1.48
Color, True	TCU	5^{C}	n/v	n/v	**6.3^{C}**	**6.1^{C}**	**6.7^{C}**	**5.8^{C}**	4.4	**24.8^{C}**	**18.2^{C}**	-	**6.0^{C}**	**6.1^{C}**	-	<2.0	**5.8^{C}**	4.5
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	**5.8^{C}**	**6.0^{C}**	4.7	4.5	5.0	**12.4^{C}**	**7.7^{C}**	**6.6^{C}**	**181^{C}**	**142^{C}**	**106^{C}**	2.0	**5.1^{C}**	5.0
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	387	388	391	392	393	293	322	315	1220	1310	1150	529	470	463
Fluoride	mg/L	1.5_{b}^{A}	n/v	1.5^{H}	0.039	0.043	0.043	0.044	0.037	0.082	0.073	0.050	0.178	0.169	0.170	0.432	0.364	0.341
Hardness (as CaCO3)	mg/L	80-100^{D}	n/v	n/v	**224^{D}**	**224^{D}**	**225^{D}**	**221^{D}**	**223^{D}**	**175^{D}**	**162^{D}**	**157^{D}**	**643^{D}**	**641^{D}**	**559^{D}**	**289^{D}**	**187^{D}**	**185^{D}**
Ion Balance	%	n/v	n/v	n/v	1.1	1.8	3.3	1.5	1.4	8.3	3.7	<0.000	3.1	2.3	0.6	3.4	2.1	<0.000
Nitrate (as N)	mg/L	10.0_{d}^{A}	n/v	10^{H}	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.040 DM	<0.020	<0.020	0.021
Nitrite (as N)	mg/L	1.0_{d}^{A}	n/v	1^{H}	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.026	0.024	<0.020 DM	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.56	7.55	7.66	7.60	7.79	7.53	7.51	7.38	7.17	7.21	7.16	7.74	7.92	8.06
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.098	0.129	0.0059	0.0051	0.0068	0.0236	0.311	0.630	4.35	3.27	3.12	3.23	0.295	0.176
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0040	<0.0030	<0.0030	<0.0030	0.0036	<0.0030	0.0088	0.0109	0.0150	0.0111	0.0306	0.0194	0.0077	0.0317
Sulfate	mg/L	500_{h}^{C}	n/v	$≤500_{j}^{G}$	2.25	2.11	2.89	3.95	2.05	0.99	1.94	4.45	<0.30	<0.30	<0.60 DM	7.51	0.43	1.51
Total Dissolved Solids	mg/L	500^{C}	n/v	≤500^{G}	243	239	251	265	234	211	152	184	**1040^{CG}**	**923^{CG}**	**760^{CG}**	328	280	294
Total Organic Carbon	mg/L	n/v	n/v	n/v	6.2	6.0	4.7	4.5	4.6	116	36.1	69.9	195	163	110	9.6	6.5	6.8
Total Suspended Solids	mg/L	n/v	n/v	n/v	247	267	4.0	3.1	10.9	820	364	714	9110	17200	10800	4540	454	256

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater													
Sample Location					BH14-01					BH14-02			BH14-15			G4-OB1-13		
Sample Date					15-Jun-16	15-Jun-16	4-Aug-16	4-Aug-16	13-Oct-16	18-Jun-16	2-Aug-16	18-Oct-16	21-Jun-16	4-Aug-16	18-Oct-16	19-Jun-16	3-Aug-16	13-Oct-16
Sample ID					BH14-01	DUP 1	BH14-01	DUPLICATE 5	BH14-01	BH14-02	BH14-02	BH14-02	BH14-15	BH14-15	BH14-15	G4-OB1-13	G4-OB1-13	G4-OB1-13
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1784595	L1809307	L1809307	L1843864	L1786341	L1807778	L1846557	L1787602	L1809307	L1846557	L1786341	L1808958	L1843864
Laboratory Sample ID					L1784595-5	L1784595-6	L1809307-6	L1809307-7	L1843864-11	L1786341-8	L1807778-10	L1846557-7	L1787602-1	L1809307-5	L1846557-4	L1786341-20	L1808958-1	L1843864-10
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**		Field Duplicate		Field Duplicate										
Metals, Dissolved																		
Aluminum	µg/L	100^{D}	n/v	<100/200$_{a}^{G}$	2.7	3.3	3.2	3	3.4	9.2	8.6	6.4	<2	2.8	<2	<2	<2	**712^{DG}**
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<0.1	<0.1	<0.1	<0.1	0.11	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.16	0.13
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	4.67	4.74	4.28	4.17	4.4	**16.1^{H}**	8.08	9	9.43	6.35	6.75	0.83	1	1.22
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	10	10.2	10.4	10.6	10.9	10.4	11.5	10.2	136	140	116	35	40.9	48.5
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<10	<10	<10	<10	<10	<10	<10	<10	148	193	163	24	71	70
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0138	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0083
Calcium	mg/L	n/v	n/v	n/v	69.9	69.9	70.1	68.4	70.8	56.4	51.8	49.8	189	178	153	73.3	40.0	39.7
Cesium	µg/L	n/v	n/v	n/v	0.014	0.016	0.015	0.015	0.014	0.152	0.145	0.149	<0.01	0.013	<0.01	<0.01	<0.01	0.065
Chromium	µg/L	50^{A}	64^{F}	50^{H}	0.4	0.13	0.23	0.16	0.11	0.23	0.19	0.12	<0.1	<0.1	<0.1	<0.1	<0.1	1.45
Cobalt	µg/L	n/v	5.2^{F}	n/v	0.72	0.75	0.37	0.39	0.71	0.3	0.13	0.17	2.07	1.48	1.07	0.22	0.28	0.72
Copper	µg/L	1000^{C}	6.9^{F}	≤1000^{G}	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.49	2.59
Iron	µg/L	300^{C}	n/v	≤300^{G}	**3040^{CG}**	**3100^{CG}**	**3460^{CG}**	**3520^{CG}**	**3480^{CG}**	**2390^{CG}**	**2610^{CG}**	**2020^{CG}**	**7710^{CG}**	**7250^{CG}**	**6450^{CG}**	**387^{CG}**	<10	**710^{CG}**
Lead	µg/L	10$_{c}^{A}$	2^{F}	10^{H}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.579
Lithium	µg/L	n/v	n/v	n/v	<1	<1	1.3	<1	<1	<1	<1	<1	13.5	18.3	14.1	7.8	6.9	6.4
Magnesium	mg/L	n/v	n/v	n/v	12.0	11.9	12.1	12.2	11.2	8.15	7.80	7.90	41.4	47.8	42.9	25.7	21.2	20.8
Manganese	µg/L	50^{C}	n/v	≤50^{G}	**223^{CG}**	**221^{CG}**	**225^{CG}**	**229^{CG}**	**228^{CG}**	**362^{CG}**	**352^{CG}**	**339^{CG}**	**221^{CG}**	**150^{CG}**	**115^{CG}**	**83.7^{CG}**	12.4	28.3
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	0.0066	<0.005	<0.005	<0.005	<0.005	0.0051	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	0.37	0.359	0.347	0.339	0.345	1.97	1.25	0.873	2.32	2.41	2.12	1.32	1.08	0.924
Nickel	µg/L	n/v	39^{F}	n/v	0.81	0.63	<0.5	<0.5	<0.5	0.62	<0.5	<0.5	1.31	0.91	0.78	<0.5	0.87	1.88
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	1.19	1.18	1.21	1.24	1.25	0.680	0.756	0.649	3.84	4.07	3.70	2.75	3.34	3.29
Rubidium	µg/L	n/v	n/v	n/v	3.87	3.74	3.7	3.87	3.79	1.54	1.71	1.3	2.2	2.03	1.5	0.75	0.86	1.88
Selenium	µg/L	10^{A}	5^{F}	50^{H}	0.12	0.084	<0.05	<0.05	<0.05	<0.05	0.243	0.31	<0.05	<0.05	0.098	<0.05	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	5630	5720	5750	5670	5710	5200	6310	6130	11000	12400	12200	8760	6600	8050
Silver	µg/L	n/v	0.12^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L	200$_{g}^{C}$ 20$_{g}^{E}$	180^{F}	≤200^{G}	1.32	1.30	1.32	1.35	1.35	6.50	5.78	3.20	**39.5^{E}**	**48.7^{E}**	**44.9^{E}**	**22.2^{E}**	**38.9^{E}**	**38.9^{E}**
Strontium	µg/L	n/v	n/v	n/v	71.8	73.1	74.4	73.1	70.6	147	145	146	466	470	420	249	293	287
Sulfur	µg/L	n/v	n/v	n/v	680	570	900	820	700	<500	<500	840	<500	<500	<500	2950	<500	<500
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.25
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	<0.1	<0.1	<0.1	0.11
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<0.3	<0.3	0.33	0.31	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	26.7
Tungsten	µg/L	n/v	n/v	n/v	0.51	0.5	1.01	1.02	1.2	0.38	0.49	0.27	1.39	1.14	1	<0.1	15.7	9.89
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.04	0.041	0.048	0.048	0.062	0.241	0.172	0.21	0.182	0.047	0.044	0.547	0.166	0.227
Vanadium	µg/L	n/v	20^{F}	n/v	0.73	0.7	0.7	0.72	0.68	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.64	4.15
Zinc	µg/L	5000^{C}	89^{F}	≤5000^{G}	<1	<1	<1	1.5	2.2	1.2	<1	<1	2.1	<1	<1	<1	<1	4.6
Zirconium	µg/L	n/v	n/v	n/v	0.93	0.95	0.94	0.92	0.89	0.77	0.91	1.14	0.44	0.38	0.4	<0.3	<0.3	1.12

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Sample Location					Groundwater														
					BH14-01					BH14-02			BH14-15			G4-OB1-13			
Sample Date					15-Jun-16	15-Jun-16	4-Aug-16	4-Aug-16	13-Oct-16	18-Jun-16	2-Aug-16	18-Oct-16	21-Jun-16	4-Aug-16	18-Oct-16	19-Jun-16	3-Aug-16	13-Oct-16
Sample ID					BH14-01	DUP 1	BH14-01	DUPLICATE 5	BH14-01	BH14-02	BH14-02	BH14-02	BH14-15	BH14-15	BH14-15	G4-OB1-13	G4-OB1-13	G4-OB1-13
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1784595	L1809307	L1809307	L1843864	L1786341	L1807778	L1846557	L1787602	L1809307	L1846557	L1786341	L1808958	L1843864
Laboratory Sample ID					L1784595-5	L1784595-6	L1809307-6	L1809307-7	L1843864-11	L1786341-8	L1807778-10	L1846557-7	L1787602-1	L1809307-5	L1846557-4	L1786341-20	L1808958-1	L1843864-10
Sample Type	Units	ODWS	MOE APV	Health Canada		Field Duplicate		Field Duplicate										
Metals, Total																		
Aluminum	µg/L	100^{D}	n/v	<100/200$_{a}^{G}$	2280^{DG}	2120^{DG}	25.8	25.9	25.5	28400^{DG}	5930^{DG}	20600^{DG}	42500^{DG}	44400^{DG}	28400^{DG}	20800^{DG}	5230^{DG}	8640^{DG}
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	0.16	0.16	<0.1	<0.1	<0.1	<2 DM	<1 DM	<1 DM	<1 DM	<1 DM	<0.5 GT	<1 DM	0.24	0.39
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	8.26	7.74	4.46	4.44	4.33	79.1^{BH}	22^{H}	55.5^{BH}	29.2^{BH}	23.5^{H}	17.3^{H}	7.6	2.11	3.18
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	20.7	18.3	9.62	9.63	10.2	429	91.4	298	430	392	298	183	69.8	104
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<2 DM	<1 DM	<1 DM	1.7	1.7	1.12	<1 DM	0.17	0.24
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<1 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.25 GT	<0.5 DM	<0.05	0.064
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<10	<10	<10	<10	<10	<200 DM	<100 DM	<100 DM	290	250	238	<100 DM	76	68
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	0.0182	0.0136	<0.005	<0.005	<0.005	0.26^{F}	<0.05 DM	0.16	0.483^{F}	0.49^{F}	0.275^{F}	0.226^{F}	0.0581	0.0817
Calcium	mg/L	n/v	n/v	n/v	102	93.5	65.5	68.7	68.4	83.3	59.4	70.2	1200	1210	804	591	92.3	114
Cesium	µg/L	n/v	n/v	n/v	0.193	0.183	0.018	0.018	0.016	2.69	0.68	1.99	3.27	3.64	2.32	1.56	0.457	0.721
Chromium	µg/L	50^{A}	64^{F}	50^{H}	23.2	21.3	0.4	0.41	0.36	166^{AFH}	42	131^{AFH}	112^{AFH}	114^{AFH}	68.9^{AFH}	44.5	11	19.8
Cobalt	µg/L	n/v	5.2^{F}	n/v	6.6^{F}	10.3^{F}	0.6	0.63	0.49	26.9^{F}	5.1	20.1^{F}	32.1^{F}	30.7^{F}	17.9^{F}	11.5^{F}	2.73	4.84
Copper	µg/L	1000^{C}	6.9^{F}	≤1000^{G}	27.1^{F}	45.4^{F}	0.56	0.52	<0.5	123^{F}	24.5^{F}	86.2^{F}	93.2^{F}	89.8^{F}	51.9^{F}	29.5^{F}	16.4^{F}	28.7^{F}
Iron	µg/L	300^{C}	n/v	≤300^{G}	10300^{CG}	10000^{CG}	3700^{CG}	3700^{CG}	3540^{CG}	43500^{CG}	10800^{CG}	31900^{CG}	66000^{CG}	69400^{CG}	43900^{CG}	25500^{CG}	5240^{CG}	9370^{CG}
Lead	µg/L	10$_{c}^{A}$	2^{F}	10^{H}	1.27	1.06	<0.05	<0.05	<0.05	28^{AFH}	4.79^{F}	19.7^{AFH}	26.1^{AFH}	27.8^{AFH}	17.4^{AFH}	13.6^{AFH}	3.13^{F}	5.38^{F}
Lithium	µg/L	n/v	n/v	n/v	4	3.8	<1	<1	<1	<20 DM	<10 DM	18	65	80	58	38	12	14.6
Magnesium	mg/L	n/v	n/v	n/v	17.1	15.6	12.5	12.6	11.2	19.9	10.7	16.7	293	342	212	182	36.3	36.7
Manganese	µg/L	50^{C}	n/v	≤50^{G}	366^{CG}	332^{CG}	232^{CG}	230^{CG}	227^{CG}	987^{CG}	506^{CG}	789^{CG}	2190^{CG}	2070^{CG}	1300^{CG}	966^{CG}	144^{CG}	221^{CG}
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	<0.005	0.0069	<0.005	<0.005	<0.005	0.0255	<0.005	0.023	0.0356	0.032	0.0336	0.0464	0.012	0.015
Molybdenum	µg/L	n/v	730^{F}	n/v	2.68	2.6	0.341	0.358	0.409	29.8	8.18	23.9	5.79	3.76	3.2	1.39	1.09	1.17
Nickel	µg/L	n/v	39^{F}	n/v	9.61	9.79	0.75	0.74	0.56	76^{F}	14.5	56.4^{F}	68.4^{F}	68.5^{F}	39.5^{F}	28.7	6.88	15
Phosphorus	µg/L	n/v	n/v	n/v	166	143	<50	<50	<50	<1000 DM	<500 DM	<500 DM	3810	4050	2320	1990	311	361
Potassium	mg/L	n/v	n/v	n/v	1.64	1.50	1.21	1.20	1.23	4.5	1.55	3.15	12.8	12.4	9.84	7.63	4.48	5.37
Rubidium	µg/L	n/v	n/v	n/v	6.37	5.56	3.75	3.84	3.73	21.1	5.6	14.4	58.5	56.9	36.7	26	7.77	13.3
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.05	0.058	<0.05	<0.05	<0.05	<1 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.25 GT	<0.5 DM	0.055	<0.05
Silicon	µg/L	n/v	n/v	n/v	8800	8720	5660	5730	5690	39500	13900	33500	77000	81800	63200	44500	16600	23300
Silver	µg/L	n/v	0.12^{F}	n/v	0.32^{F}	0.274^{F}	0.014	<0.01	<0.01	8.98^{F}	1.46^{F}	6.15^{F}	1.7^{F}	1.89^{F}	1.07^{F}	0.15^{F}	9.21^{F}	5.9^{F}
Sodium	mg/L	200$_{g}^{C}$ 20$_{g}^{E}$	180^{F}	≤200^{G}	1.51	1.42	1.45	1.47	1.26	9.5	6.65	4.97	49.1^{E}	58.2^{E}	52.6^{E}	23.2^{E}	38.8^{E}	38.6^{E}
Strontium	µg/L	n/v	n/v	n/v	97.5	92.5	72.9	75.1	71.7	385	200	301	1100	1110	859	550	346	356
Sulfur	µg/L	n/v	n/v	n/v	730	660	960	960	720	<10000 DM	<5000 DM	<5000 DM	<5000 DM	<5000 DM	<2500 GT	<5000 DM	<500	<500
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<4 DM	<2 DM	<2 DM	<2 DM	<2 DM	<1 GT	<2 DM	<0.2	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	0.027	0.027	<0.01	<0.01	<0.01	0.27	<0.1 DM	0.25	0.52	0.58	0.361	0.27	0.061	0.097
Thorium	µg/L	n/v	n/v	n/v	0.75	0.82	<0.1	<0.1	<0.1	9.6	1.9	8.1	21.1	23	14.9	10	2.09	3.11
Tin	µg/L	n/v	n/v	n/v	0.66	0.96	<0.1	0.12	<0.1	2.3	<1 DM	1.8	2.8	3.4	2	1.4	1.02	1.73
Titanium	µg/L	n/v	n/v	n/v	204	181	1.74	1.35	1.68	951	215	699	3290	3360	2230	2010	359	528
Tungsten	µg/L	n/v	n/v	n/v	9.89	15.1	1.81	1.34	1.39	49.3	10.3	30.3	11.7	13.2	9.03	<1 DM	15.2	16.3
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.234	0.225	0.047	0.047	0.061	7.47	1.67	5.93	4.66	4.71	3.28	3.87	0.479	0.65
Vanadium	µg/L	n/v	20^{F}	n/v	8.33	7.64	0.82	0.78	0.86	47^{F}	10.2	33^{F}	112^{F}	111^{F}	70.1^{F}	52.8^{F}	14.8	21.5^{F}
Zinc	µg/L	5000^{C}	89^{F}	≤5000^{G}	25.8	41	<3	<3	<3	98^{F}	<30 DM	74	134^{F}	133^{F}	79	59	21	35.8
Zirconium	µg/L	n/v	n/v	n/v	2.25	2.18	0.94	0.97	1.03	6.7	<3 DM	4.9	27.5	17.8	21.5	17	3.81	4.92

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater															
Sample Location					G4-OB2-13			G5-OB1-14				G5-OB2-14			G6-OB-14			G7-OB1-14		
Sample Date					18-Jun-16	2-Aug-16	12-Oct-16	15-Jun-16	9-Aug-16	9-Aug-16	12-Oct-16	15-Jun-16	9-Aug-16	12-Oct-16	15-Jun-16	6-Aug-16	17-Oct-16	15-Jun-16	8-Aug-16	14-Oct-16
Sample ID					G4-OB2-13	G4-0B2-13	G4-OB2-13	G5-OB1-14	G5-OB1-14	DUPLICATE 6	G5-OB1-14	G5-OB2-14	G5-OB2-14	G5-OB2-14	G6-OB-14	G6-OB-14	G6-OB-14	G7-OB1-14	G7-OB1-14	G7-OB1-14
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1807778	L1843856	L1784595	L1811325	L1811325	L1843856	L1784595	L1811325	L1843856	L1784595	L1810001	L1846519	L1784595	L1810700	L1844412
Laboratory Sample ID					L1786341-11	L1807778-7	L1843856-1	L1784595-9	L1811325-5	L1811325-6	L1843856-10	L1784595-10	L1811325-7	L1843856-11	L1784595-1	L1810001-13	L1846519-3	L1784595-7	L1810700-5	L1844412-6
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**						Field Duplicate										
Field Parameters																				
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	4.58	7.58	7.58	0.45	0.51	-	0.55	2.2	1.7	0.26	14.4	6.44	5.45	3.09	1.62	2.18
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	556	484	570	502	441	-	520	531	464	544	158	200	260	264	228	282
pH, Field	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.15	7.34	7.51	7.51	7.54	-	7.48	7.21	7.03	7.2	7.26	7.67	7.79	7.68	7.68	7.56
Temperature, Field	deg C	15^{C}	n/v	≤15^{G}	2.95	5.72	3.21	3.64	3.82	-	3.71	2.89	5.07	5.97	4.79	7.78	5.67	5.13	5.77	4.82
General Chemistry																				
Acidity as CaCO3	mg/L	n/v	n/v	n/v	4.8	16.3	6.5	12.6	4.2	3.1	10.9	18.1	8.8	22.9	2.8	<2.0	<2.0	4.5	2.0	4.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	262	318	320	310	312	321	330	320	332	346	142	141	157	190	159	185
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500^{D}	n/v	n/v	262	318	320	310	312	321	330	320	332	346	142	141	157	190	159	185
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.361	0.31	0.194	0.692	0.577	0.607	0.603	0.527	0.527	0.548	0.031	<0.20 DM	0.022	0.112	0.202	0.081
Anion Sum	meq/L	n/v	n/v	n/v	5.30	6.48	6.57	6.23	6.27	6.46	6.64	6.42	6.70	6.94	2.93	2.91	3.23	3.84	3.19	3.74
Cation Sum	meq/L	n/v	n/v	n/v	5.73	6.49	6.41	6.33	6.05	6.09	6.48	6.71	6.52	6.74	2.79	2.90	2.93	3.26	3.21	3.52
Chloride	mg/L	250^{C}	180^{F}	≤250^{G}	1.62	0.29	0.34	1.00	0.72	0.67	1.02	0.30	0.62	0.25	0.53	0.52	0.18	0.46	0.21	0.25
Color, True	TCU	5^{C}	n/v	n/v	**5.5^{C}**	<2.0	<2.0	3.3	4.3	4.7	**5.8^{C}**	3.4	4.6	4.4	<2.0	<2.0	<2.0	**7.0^{C}**	**9.5^{C}**	**8.7^{C}**
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	4.2	<1.0	3.6	4.1	3.9	5.0	**5.2^{C}**	4.8	**6.1^{C}**	**5.6^{C}**	<1.0	1.3	1.1	**5.1^{C}**	4.5	**6.2^{C}**
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	451	559	550	520	550	554	530	557	577	550	246	254	262	274	291	282
Fluoride	mg/L	1.5$_{b}^{A}$	n/v	1.5^{H}	0.395	0.332	0.430	0.242	0.188	0.185	0.221	0.241	0.229	0.242	0.047	0.049	0.048	0.098	0.083	0.091
Hardness (as CaCO3)	mg/L	80-100^{D}	n/v	n/v	**192^{D}**	**278^{D}**	**273^{D}**	**236^{D}**	**243^{D}**	**245^{D}**	**249^{D}**	**295^{D}**	**289^{D}**	**295^{D}**	**134^{D}**	**139^{D}**	**139^{D}**	**156^{D}**	**154^{D}**	**162^{D}**
Ion Balance	%	n/v	n/v	n/v	3.9	0.1	<0.000	0.8	<0.000	<0.000	<0.000	2.2	<0.000	<0.000	<0.000	0.0	<0.000	<0.000	0.4	<0.000
Nitrate (as N)	mg/L	10.0$_{d}^{A}$	n/v	10^{H}	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	0.021	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	1.0$_{d}^{A}$	n/v	1^{H}	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.89	7.69	7.96	7.80	7.87	7.80	7.86	7.66	7.60	7.57	8.06	7.84	8.20	7.93	7.88	7.78
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.137	1.33	1.05	0.790	0.560	0.595	0.645	1.84	3.26	6.19	2.62	4.09	2.35	0.995	0.245	0.297
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0067	0.0202	0.0237	0.0392	0.0514	0.0543	0.0533	0.0091	0.0052	0.0194	<0.0030	0.0051	0.0076	0.0135	0.0134	0.0394
Sulfate	mg/L	500$_{h}^{C}$	n/v	≤500$_{j}^{G}$	0.48	4.66	6.43	0.37	0.64	0.65	<0.30	0.69	1.12	0.44	3.18	3.28	4.04	1.08	<0.30	1.13
Total Dissolved Solids	mg/L	500^{C}	n/v	≤500^{G}	312	321	330	314	277	284	313	391	344	294	223	185	177	128	191	244
Total Organic Carbon	mg/L	n/v	n/v	n/v	5.5	4.1	5.8	9.3	5.6	6.8	9.9	9.1	12.1	20.3	5.2	15.4	5.4	33.3	6.4	6.2
Total Suspended Solids	mg/L	n/v	n/v	n/v	858	3690	1640	2320	1280	1010	2730	4750	8670	8730	2950	13600	6090	12000	598	2280

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater															
Sample Location					G4-OB2-13			G5-OB1-14				G5-OB2-14			G6-OB-14			G7-OB1-14		
Sample Date					18-Jun-16	2-Aug-16	12-Oct-16	15-Jun-16	9-Aug-16	9-Aug-16	12-Oct-16	15-Jun-16	9-Aug-16	12-Oct-16	15-Jun-16	6-Aug-16	17-Oct-16	15-Jun-16	8-Aug-16	14-Oct-16
Sample ID					G4-OB2-13	G4-0B2-13	G4-OB2-13	G5-OB1-14	G5-OB1-14	DUPLICATE 6	G5-OB1-14	G5-OB2-14	G5-OB2-14	G5-OB2-14	G6-OB-14	G6-OB-14	G6-OB-14	G7-OB1-14	G7-OB1-14	G7-OB1-14
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1807778	L1843856	L1784595	L1811325	L1811325	L1843856	L1784595	L1811325	L1843856	L1784595	L1810001	L1846519	L1784595	L1810700	L1844412
Laboratory Sample ID					L1786341-11	L1807778-7	L1843856-1	L1784595-9	L1811325-5	L1811325-6	L1843856-10	L1784595-10	L1811325-7	L1843856-11	L1784595-1	L1810001-13	L1846519-3	L1784595-7	L1810700-5	L1844412-6
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**						Field Duplicate										
Metals, Dissolved																				
Aluminum	µg/L	100^{D}	n/v	$<100/200_{a}^{G}$	<2	2.2	99	<2	2.9	3.1	**131**^{DG}	<2	<2	**286**^{DG}	2.1	2.9	<2	3.1	3.2	**854**^{DG}
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	0.22	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	1.13	0.62	0.62	1.25	1.48	1.47	1.57	6.38	5.95	7.8	0.53	0.67	0.44	1.33	1	1.41
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	38.9	33.9	32.4	81.4	85.3	83.3	80.4	76.9	76.9	86.5	5.86	10	10.4	17.8	12.3	21.4
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	69	23	26	46	42	43	41	22	23	24	<10	<10	<10	<10	<10	<10
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	0.0116	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0081
Calcium	mg/L	n/v	n/v	n/v	40.8	69.5	68.2	60.3	60.0	60.9	61.9	86.6	84.6	86.2	38.5	39.2	39.7	48.9	47.4	50.9
Cesium	µg/L	n/v	n/v	n/v	<0.01	<0.01	0.011	0.018	0.01	0.011	0.024	<0.01	<0.01	0.028	<0.01	<0.01	<0.01	<0.01	<0.01	0.085
Chromium	µg/L	50^{A}	64^{F}	50^{H}	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.14	<0.1	<0.1	0.35	0.41	0.27	0.31	0.17	0.61	1.49
Cobalt	µg/L	n/v	5.2^{F}	n/v	0.31	0.15	0.34	0.4	0.46	0.48	0.72	1.57	1.5	1.56	<0.1	<0.1	<0.1	<0.1	<0.1	0.93
Copper	µg/L	1000^{C}	6.9^{F}	$\leq1000^{G}$	0.46	0.59	0.22	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.31	0.38	0.74	<0.2	<0.2	<0.2	1.05
Iron	µg/L	300^{C}	n/v	$\leq300^{G}$	<10	**374**^{CG}	**433**^{CG}	**513**^{CG}	**699**^{CG}	**689**^{CG}	**693**^{CG}	**1120**^{CG}	**929**^{CG}	**1490**^{CG}	<10	<10	<10	**411**^{CG}	**518**^{CG}	**1320**^{CG}
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.135	<0.05	<0.05	0.089	<0.05	<0.05	<0.05	<0.05	<0.05	0.504
Lithium	µg/L	n/v	n/v	n/v	4.8	8	9.7	6.1	5.5	5.7	5.6	3.1	3.5	4.4	<1	1.2	1.2	<1	1.1	1.5
Magnesium	mg/L	n/v	n/v	n/v	21.8	25.4	24.9	20.8	22.6	22.6	22.9	19.0	19.0	19.3	9.20	9.91	9.62	8.18	8.54	8.37
Manganese	µg/L	50^{C}	n/v	$\leq50^{G}$	13.1	**69.5**^{CG}	**71**^{CG}	**73.6**^{CG}	**88.4**^{CG}	**89.7**^{CG}	**83.4**^{CG}	**149**^{CG}	**148**^{CG}	**140**^{CG}	3.53	9.97	5.24	**56.9**^{CG}	**60**^{CG}	**83.1**^{CG}
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	1.14	1.15	0.974	2	1.13	1.14	1.39	3.19	3.17	2.56	0.211	0.311	0.355	0.6	0.663	0.36
Nickel	µg/L	n/v	39^{F}	n/v	0.89	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.59	<0.5	<0.5	<0.5	<0.5	<0.5	1.28
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	70	68	69	66	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	3.41	2.77	2.89	2.05	2.64	2.64	2.24	1.97	2.01	2.25	0.390	0.612	0.512	0.784	0.769	1.01
Rubidium	µg/L	n/v	n/v	n/v	0.86	0.86	1.01	1.68	1.87	1.89	1.83	2.37	2.3	2.94	0.5	0.83	0.63	1.08	1.09	2.47
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.05	0.058	0.094	<0.05	<0.05	<0.05	0.087	<0.05	<0.05	<0.05	0.166	0.13	0.222	<0.05	<0.05	0.118
Silicon	µg/L	n/v	n/v	n/v	6220	9180	9780	8400	8490	8600	9420	10300	10400	12300	4810	5690	5890	5210	5210	7220
Silver	µg/L	n/v	0.12^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	$\leq200^{G}$	**41.1**^{E}	18.8	19.3	**33.9**^{E}	**25.0**^{E}	**24.8**^{E}	**31.1**^{E}	15.3	14.6	14.7	2.38	2.67	3.14	2.27	2.19	2.19
Strontium	µg/L	n/v	n/v	n/v	291	233	252	499	496	483	496	253	234	250	35	39.2	41	49.6	49.4	50.7
Sulfur	µg/L	n/v	n/v	n/v	<500	2310	1380	<500	<500	<500	<500	<500	<500	<500	620	710	880	<500	<500	<500
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.39
Tin	µg/L	n/v	n/v	n/v	0.11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	3.87	<0.3	<0.3	<0.3	3.61	<0.3	<0.3	13.5	<0.3	<0.3	<0.3	<0.3	<0.3	42.3
Tungsten	µg/L	n/v	n/v	n/v	20.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.209	0.555	0.409	0.246	0.318	0.327	0.31	0.505	0.533	0.436	0.184	0.318	0.265	0.039	0.023	0.091
Vanadium	µg/L	n/v	20^{F}	n/v	3.37	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.81	0.87	0.89	0.53	<0.5	1.91
Zinc	µg/L	5000^{C}	89^{F}	$\leq5000^{G}$	1.6	4.7	<1	<1	<1	<1	<1	1	<1	<1	2	<1	<1	1.2	2.1	3.5
Zirconium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.55	<0.3	<0.3	<0.3	0.74	0.71	2.53

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater															
Sample Location					**G4-OB2-13**			**G5-OB1-14**				**G5-OB2-14**			**G6-OB-14**			**G7-OB1-14**		
Sample Date					**18-Jun-16**	**2-Aug-16**	**12-Oct-16**	**15-Jun-16**	**9-Aug-16**	**9-Aug-16**	**12-Oct-16**	**15-Jun-16**	**9-Aug-16**	**12-Oct-16**	**15-Jun-16**	**6-Aug-16**	**17-Oct-16**	**15-Jun-16**	**8-Aug-16**	**14-Oct-16**
Sample ID					**G4-OB2-13**	**G4-0B2-13**	**G4-OB2-13**	**G5-OB1-14**	**G5-OB1-14**	**DUPLICATE 6**	**G5-OB1-14**	**G5-OB2-14**	**G5-OB2-14**	**G5-OB2-14**	**G6-OB-14**	**G6-OB-14**	**G6-OB-14**	**G7-OB1-14**	**G7-OB1-14**	**G7-OB1-14**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1786341**	**L1807778**	**L1843856**	**L1784595**	**L1811325**	**L1811325**	**L1843856**	**L1784595**	**L1811325**	**L1843856**	**L1784595**	**L1810001**	**L1846519**	**L1784595**	**L1810700**	**L1844412**
Laboratory Sample ID					**L1786341-11**	**L1807778-7**	**L1843856-1**	**L1784595-9**	**L1811325-5**	**L1811325-6**	**L1843856-10**	**L1784595-10**	**L1811325-7**	**L1843856-11**	**L1784595-1**	**L1810001-13**	**L1846519-3**	**L1784595-7**	**L1810700-5**	**L1844412-6**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**						**Field Duplicate**										
Metals, Total																				
Aluminum	µg/L	100^{D}	n/v	<100/200$_{a}^{G}$	**2150^{DG}**	**13300^{DG}**	**6040^{DG}**	**18000^{DG}**	**8740^{DG}**	**8850^{DG}**	**17000^{DG}**	**18900^{DG}**	**38000^{DG}**	**39300^{DG}**	**23400^{DG}**	**51300^{DG}**	**19400^{DG}**	**13000^{DG}**	**3410^{DG}**	**11800^{DG}**
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	0.24	<1 DM	<0.1	<5 DM	<1 DM	<1	<1 DM	<1 DM	<1	<1 DM	<0.5 DM	<1 DM	<0.5 IF	<0.5 DM	<1 DM	0.14
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	1.74	4.9	2.8	6.7	3.4	3.6	5.3	**13^{H}**	**19.6^{H}**	**21^{H}**	9.1	**20.1^{H}**	6.75	4.83	1.8	4.54
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	54.4	121	80.8	489	198	208	382	201	391	329	173	335	151	98	35.2	95.9
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<1 DM	0.25	<5 DM	<1 DM	<1 DM	1.1	<1 DM	1.5	1.5	0.84	1.8	0.68	<0.5 DM	<1 DM	0.38
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.5 DM	<0.05	<2.5 DM	<0.5 DM	<0.5 DM	0.57	<0.5 DM	<0.5 DM	0.53	<0.25 DM	<0.5 DM	<0.25 GT	<0.25 DM	<0.5 DM	0.107
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	62	<100 DM	44	<500 DM	<100 DM	<100 DM	<100 DM	<100 DM	<100 DM	<100 DM	67	<100 DM	<50 GT	<50 DM	<100 DM	16
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	0.0179	0.125	0.1	***<0.25 DM***	0.065	0.088	0.106	**0.246^{F}**	**0.427^{F}**	**0.549^{F}**	**0.234^{F}**	**0.542^{F}**	**0.219^{F}**	0.119	<0.05 DM	0.117
Calcium	mg/L	n/v	n/v	n/v	58.4	374	283	219	164	174	217	564	1040	1300	489	1270	495	250	107	222
Cesium	µg/L	n/v	n/v	n/v	0.179	0.95	0.436	1.25	0.66	0.67	1.22	1.54	2.83	2.8	2.1	4.19	1.65	1.26	0.3	1.14
Chromium	µg/L	50^{A}	64^{F}	50^{H}	4.77	29.1	12.8	34.3	20.3	22.3	33.6	42.8	**95.4^{AFH}**	**102^{AFH}**	**54.1^{AH}**	**136^{AFH}**	44.4	33	7.7	30.1
Cobalt	µg/L	n/v	5.2^{F}	n/v	1.27	**7^{F}**	3.36	**7.2^{F}**	4.5	4.5	**6.9^{F}**	**13.6^{F}**	**26.8^{F}**	**30.5^{F}**	**15^{F}**	**35.7^{F}**	**11.5^{F}**	**8.21^{F}**	2.1	**7.43^{F}**
Copper	µg/L	1000^{C}	6.9^{F}	≤1000^{G}	**7.06^{F}**	**19.4^{F}**	**9.31^{F}**	***<25 DM***	**9.5^{F}**	**9.1^{F}**	**15.1^{F}**	**26^{F}**	**63.3^{F}**	**70.8^{F}**	**36.1^{F}**	**91.3^{F}**	**31.2^{F}**	**21.5^{F}**	<5 DM	**20.7^{F}**
Iron	µg/L	300^{C}	n/v	≤300^{G}	**2220^{CG}**	**15400^{CG}**	**7240^{CG}**	**17800^{CG}**	**9470^{CG}**	**10100^{CG}**	**17000^{CG}**	**24800^{CG}**	**50400^{CG}**	**54300^{CG}**	**27500^{CG}**	**70700^{CG}**	**23500^{CG}**	**16900^{CG}**	**4690^{CG}**	**15000^{CG}**
Lead	µg/L	10$_{c}^{A}$	2^{F}	10^{H}	1.36	**8.14^{F}**	**4.13^{F}**	**23^{AFH}**	**7.09^{F}**	**7.46^{F}**	**20.7^{AFH}**	**11.5^{AFH}**	**25.4^{AFH}**	**28.2^{AFH}**	**12.6^{AFH}**	**31.6^{AFH}**	**10.8^{AFH}**	**7.98^{F}**	**2.05^{F}**	**7.33^{F}**
Lithium	µg/L	n/v	n/v	n/v	7.8	24	16.6	<50 DM	10	11	19	29	55	58	27.6	67	25.4	17.7	<10 DM	15.8
Magnesium	mg/L	n/v	n/v	n/v	26.0	125	79.6	63.9	55.3	55.1	59.2	146	302	340	105	344	113	55.8	23.7	34.8
Manganese	µg/L	50^{C}	n/v	≤50^{G}	**67.3^{CG}**	**613^{CG}**	**382^{CG}**	**551^{CG}**	**348^{CG}**	**358^{CG}**	**524^{CG}**	**1050^{CG}**	**2030^{CG}**	**2280^{CG}**	**966^{CG}**	**2470^{CG}**	**812^{CG}**	**540^{CG}**	**178^{CG}**	**516^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	0.0111	0.0165	0.0114	0.0122	0.0051	<0.005	0.0063	0.0239	0.0139	0.0261	0.0403	0.041	0.0146	0.0114	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	1.19	1.16	1.05	<2.5 DM	1.43	1.46	1.42	3.35	4.19	3.71	0.51	0.71	0.56	0.72	0.72	0.589
Nickel	µg/L	n/v	39^{F}	n/v	3.56	16.9	7.84	<25 DM	9.5	9.8	15.8	26.1	**57^{F}**	**62.9^{F}**	34.6	**85.6^{F}**	28.7	20.9	5.2	18.6
Phosphorus	µg/L	n/v	n/v	n/v	141	1490	806	<2500 DM	570	560	850	1860	3330	4380	1820	4290	1470	760	<500 DM	384
Potassium	mg/L	n/v	n/v	n/v	3.95	6.23	4.35	7.6	5.19	5.31	6.55	6.58	10.1	9.79	5.28	8.80	4.59	4.04	1.68	3.65
Rubidium	µg/L	n/v	n/v	n/v	3.59	17.3	8.43	26	13.4	13.9	24.2	25.4	47.9	50.1	28.3	59.6	25.1	18.8	5.9	18.8
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.05	<0.5 DM	0.052	<2.5 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.25 DM	<0.5 DM	<0.25 GT	<0.25 DM	<0.5 DM	0.068
Silicon	µg/L	n/v	n/v	n/v	10300	33400	20900	42600	24000	24800	40300	43300	67600	70700	43400	79000	40400	27800	11600	27600
Silver	µg/L	n/v	0.12^{F}	n/v	**2.32^{F}**	<0.1 DM	0.039	***<0.5 DM***	<0.1 DM	<0.1 DM	<0.1 DM	0.11	**0.22^{F}**	**0.28^{F}**	0.12	**0.31^{F}**	0.108	0.078	<0.1 DM	0.071
Sodium	mg/L	200$_{g}^{C}$ 20$_{g}^{E}$	180^{F}	≤200^{G}	**39.2^{E}**	**22.7^{E}**	19.7	**34.0^{E}**	**29.3^{E}**	**29.2^{E}**	**32.9^{E}**	17.6	**21.8^{E}**	19.4	5.04	6.91	5.42	3.78	2.63	3.75
Strontium	µg/L	n/v	n/v	n/v	318	420	365	786	631	662	689	546	878	934	340	773	339	192	87.8	182
Sulfur	µg/L	n/v	n/v	n/v	<500	<5000 DM	1960	<25000 DM	<5000 DM	<5000 DM	<5000 DM	<5000 DM	<5000 DM	<5000 DM	<2500 DM	<5000 DM	<2500 GT	<2500 DM	<5000 DM	<500
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<2 DM	<0.2	<10 DM	<2 DM	<2 DM	<2 DM	<2 DM	<2 DM	<2 DM	<1 DM	<2 DM	<1 GT	<1 DM	<2 DM	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	0.027	0.17	0.086	<0.5 DM	<0.1 DM	<0.1 DM	0.19	0.25	0.51	0.65	0.296	0.7	0.261	0.175	<0.1 DM	0.158
Thorium	µg/L	n/v	n/v	n/v	0.85	7.2	3.6	25.6	8.5	8.4	23.7	10.6	23	23.4	11.1	28	9.54	6.2	1.5	5.39
Tin	µg/L	n/v	n/v	n/v	0.48	<1 DM	0.63	<5 DM	<1 DM	<1 DM	1.2	1	1.6	1.4	1.66	3.4	1.8	0.77	<1 DM	1.63
Titanium	µg/L	n/v	n/v	n/v	148	1290	538	533	490	502	537	1820	3350	3330	1940	3760	1530	1060	253	787
Tungsten	µg/L	n/v	n/v	n/v	18.2	<1 DM	<0.1	<5 DM	<1 DM	<1	<1 DM	<1 DM	<1 DM	<1 DM	<0.5 DM	<1 DM	<0.5 GT	<0.5 DM	<1 DM	<0.1
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.364	2.22	1.31	8.4	2.62	2.64	7.21	2.9	5.22	5.72	1.78	4.1	1.69	1.17	0.3	0.947
Vanadium	µg/L	n/v	20^{F}	n/v	8.05	**32.4^{F}**	14.9	**28^{F}**	16.2	16.4	**25.4^{F}**	**49.5^{F}**	**99.8^{F}**	**103^{F}**	**59.2^{F}**	**138^{F}**	**48.4^{F}**	**32.7^{F}**	8	**27.9^{F}**
Zinc	µg/L	5000^{C}	89^{F}	≤5000^{G}	9.8	39	17.2	***<150 DM***	<30 DM	<30 DM	40	49	**104^{F}**	**116^{F}**	66	**171^{F}**	55	36	<30 DM	34.4
Zirconium	µg/L	n/v	n/v	n/v	1.6	9.4	6.16	<15 DM	<3 DM	<3 DM	<3 DM	11.8	16.3	17	8.1	16.7	11.8	6.3	<3 DM	7.3

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater													
Sample Location					G7-OB2-14			MAC-1				MAC-4			MAC-6			
Sample Date					15-Jun-16	8-Aug-16	14-Oct-16	21-Jun-16	5-Aug-16	15-Oct-16	15-Oct-16	21-Jun-16	7-Aug-16	15-Oct-16	21-Jun-16	21-Jun-16	5-Aug-16	15-Oct-16
Sample ID					G7-OB2-14	G7-OB2-14	G7-OB2-14	MAC-1	MAC 1	MAC-1	DUPLICATE 5	MAC-4	MAC 4	MAC-4	MAC-6	DUP 7	MAC 6	MAC-6
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1810700	L1844412	L1787602	L1810001	L1844417	L1844417	L1787602	L1810001	L1844417	L1787602	L1787602	L1810001	L1844417
Laboratory Sample ID					L1784595-8	L1810700-4	L1844412-5	L1787602-3	L1810001-4	L1844417-1	L1844417-9	L1787602-4	L1810001-20	L1844417-2	L1787602-5	L1787602-6	L1810001-5	L1844417-5
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**							Field Duplicate					Field Duplicate		
Field Parameters																		
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	0.42	0.44	2.05	0.33	0.38	1.63	-	6.84	7.12	5.04	2.63	-	1.09	2.55
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	340	798	375	484	320	544	-	731	626	811	512	-	430	594
pH, Field	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.35	7.3	7.3	**6.85^{G}**	**6.64^{G}**	**6.75^{G}**	-	**6.97^{G}**	7.12	7.29	7.17	-	7.3	7.41
Temperature, Field	deg C	15^{C}	n/v	≤15^{G}	4.18	6.17	6.43	5.37	9.76	8.45	-	5.13	8.14	7.97	3.37	-	6.59	5.73
General Chemistry																		
Acidity as CaCO3	mg/L	n/v	n/v	n/v	12.0	6.0	11.5	20.0	25.1	55.9	60.0	15.4	11.8	23.9	9.2	6.4	9.2	20.1
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	218	231	246	208	155	261	263	279	274	298	244	244	233	311
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500^{D}	n/v	n/v	218	231	246	208	155	261	263	279	274	298	244	244	233	311
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.187	0.249	<0.10 DM	<0.020	0.20	0.036	0.033	0.042	<0.020	0.026	0.106	0.060	0.073	0.044
Anion Sum	meq/L	n/v	n/v	n/v	4.51	4.67	5.02	5.45	4.22	6.38	6.39	8.79	8.60	9.40	5.85	5.88	5.65	6.94
Cation Sum	meq/L	n/v	n/v	n/v	4.67	4.06	4.82	5.39	4.43	5.82	6.08	8.28	8.88	8.91	5.82	5.80	5.86	6.54
Chloride	mg/L	250^{C}	180^{F}	≤250^{G}	0.34	0.20	0.22	2.38	0.97	1.86	1.85	14.6	14.7	14.1	4.76	5.03	4.65	3.22
Color, True	TCU	5^{C}	n/v	n/v	**16.8^{C}**	**19.8^{C}**	**11.5^{C}**	**20.3^{C}**	**20.8^{C}**	**19.6^{C}**	**18.3^{C}**	2.1	<2.0	<2.0	<2.0	<2.0	2.2	2.1
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	4.6	**6.6^{C}**	**6.4^{C}**	**9.1^{C}**	**8.5^{C}**	**10.5^{C}**	**9.6^{C}**	2.7	1.9	3.0	3.0	2.9	2.4	4.9
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	367	377	395	496	394	527	531	752	780	796	521	515	530	573
Fluoride	mg/L	1.5_{b}^{A}	n/v	1.5^{H}	0.148	0.131	0.154	0.039	0.041	0.039	0.039	0.072	0.079	0.067	0.091	0.095	0.081	0.089
Hardness (as CaCO3)	mg/L	80-100^{D}	n/v	n/v	**223^{D}**	**195^{D}**	**224^{D}**	**257^{D}**	**209^{D}**	**278^{D}**	**291^{D}**	**403^{D}**	**432^{D}**	**433^{D}**	**271^{D}**	**270^{D}**	**273^{D}**	**307^{D}**
Ion Balance	%	n/v	n/v	n/v	1.8	<0.000	<0.000	<0.000	2.5	<0.000	<0.000	<0.000	1.6	<0.000	<0.000	<0.000	1.7	<0.000
Nitrate (as N)	mg/L	10.0_{d}^{A}	n/v	10^{H}	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	1.60	1.59	1.63	<0.020	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	1.0_{d}^{A}	n/v	1^{H}	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010 RW	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.67	7.59	7.72	7.20	**6.94^{G}**	**6.97^{G}**	**6.93^{G}**	7.54	7.47	7.51	7.70	7.85	7.58	7.60
Phosphorus, Total	mg/L	n/v	n/v	n/v	27.0	6.15	4.81	0.020	3.20	0.024	0.021	0.370	0.277	1.56	0.145	0.161	0.184	0.070
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0168	0.0107	0.0346	<0.0030	<0.0030	0.0052	0.0076	<0.0030	<0.0030	0.0056	0.0036	0.0030	0.0055	0.0101
Sulfate	mg/L	500_{h}^{C}	n/v	$\leq 500_{j}^{G}$	6.30	2.41	3.79	58.9	52.3	53.0	52.6	129	125	141	40.2	41.4	41.3	30.6
Total Dissolved Solids	mg/L	500^{C}	n/v	≤500^{G}	268	320	270	335	259	338	343	**521^{CG}**	**513^{CG}**	**590^{CG}**	323	330	324	344
Total Organic Carbon	mg/L	n/v	n/v	n/v	40.2	41	6.1	9.6	33.7	11.3	9.9	4.1	2.6	10.9	4.3	4.5	4.6	4.2
Total Suspended Solids	mg/L	n/v	n/v	n/v	33900	58400	31200	47.5	1930	84.4	80.9	1090	584	5220	230	221	273	58.9

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater													
Sample Location					G7-OB2-14			MAC-1				MAC-4			MAC-6			
Sample Date					15-Jun-16	8-Aug-16	14-Oct-16	21-Jun-16	5-Aug-16	15-Oct-16	15-Oct-16	21-Jun-16	7-Aug-16	15-Oct-16	21-Jun-16	21-Jun-16	5-Aug-16	15-Oct-16
Sample ID					G7-OB2-14	G7-OB2-14	G7-OB2-14	MAC-1	MAC 1	MAC-1	DUPLICATE 5	MAC-4	MAC 4	MAC-4	MAC-6	DUP 7	MAC 6	MAC-6
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1810700	L1844412	L1787602	L1810001	L1844417	L1844417	L1787602	L1810001	L1844417	L1787602	L1787602	L1810001	L1844417
Laboratory Sample ID					L1784595-8	L1810700-4	L1844412-5	L1787602-3	L1810001-4	L1844417-1	L1844417-9	L1787602-4	L1810001-20	L1844417-2	L1787602-5	L1787602-6	L1810001-5	L1844417-5
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**							Field Duplicate					Field Duplicate		
Metals, Dissolved																		
Aluminum	µg/L	100[D]	n/v	<100/200$_a$[G]	5.3	9	**1030[DG]**	23.8	38.9	33.3	34.7	<2	<2	**121[DG]**	<2	<2	<2	17.4
Antimony	µg/L	6[B]	1600[F]	6[H]	<0.1	<0.1	<0.1	0.1	0.15	0.13	0.15	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1
Arsenic	µg/L	25[B]	150[F]	10[H]	0.8	1.44	1.45	2.71	3.63	7.02	4.57	0.38	0.47	<1	**158[BFH]**	**152[BFH]**	**190[BFH]**	**139[BH]**
Barium	µg/L	1000[A]	2300[F]	1000[H]	19.7	18.7	29.1	20.9	18.8	24.2	25.2	49.4	49.5	49.8	93.9	93.9	98.4	96.2
Beryllium	µg/L	n/v	5.3[F]	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 GT	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000[B]	3550[F]	5000[H]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<100 GT	11	11	13	14
Cadmium	µg/L	5[A]	0.21[F]	5[H]	<0.005	<0.005	0.0134	0.0588	0.0222	0.052	0.0535	0.0357	0.0366	<0.05 GT	<0.005	<0.005	<0.005	<0.005
Calcium	mg/L	n/v	n/v	n/v	68.1	58.2	69.1	77.8	62.8	83.9	88.1	120	129	128	84.2	83.5	85.7	92.7
Cesium	µg/L	n/v	n/v	n/v	<0.01	0.011	0.108	0.018	0.017	0.032	0.032	0.062	0.12	<0.1 GT	0.239	0.225	0.26	0.246
Chromium	µg/L	50[A]	64[F]	50[H]	0.14	0.23	1.7	<0.1	0.24	0.16	0.2	0.58	0.65	<1 GT	<0.1	<0.1	<0.1	<0.1
Cobalt	µg/L	n/v	5.2[F]	n/v	<0.1	<0.1	0.74	0.67	0.84	0.86	0.98	0.22	0.56	<1 GT	2.59	2.49	2.94	2.67
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	0.35	<0.2	2.55	1.21	1.35	0.75	0.77	2.51	2.65	3.6	<0.2	0.31	<0.2	0.41
Iron	µg/L	300[C]	n/v	≤300[G]	**782[CG]**	**803[CG]**	**1500[CG]**	**370[CG]**	**1480[CG]**	**561[CG]**	**565[CG]**	<10	<10	140	**357[CG]**	**340[CG]**	**350[CG]**	159
Lead	µg/L	10$_c$[A]	2[F]	10[H]	<0.05	<0.05	1.42	<0.05	0.072	0.067	0.067	<0.05	<0.05	<0.5 GT	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	n/v	n/v	n/v	1.4	1.1	2	<1	<1	<1	<1	5.9	6.9	<10 GT	2.9	2.8	2.6	3.2
Magnesium	mg/L	n/v	n/v	n/v	12.9	12.0	12.5	15.2	12.7	16.8	17.2	25.3	27.0	27.7	14.7	15.0	14.4	18.4
Manganese	µg/L	50[C]	n/v	≤50[G]	46.1	**51[CG]**	**63.2[CG]**	**287[CG]**	**259[CG]**	**323[CG]**	**336[CG]**	<0.1	0.11	2.5	**292[CG]**	**295[CG]**	**306[CG]**	**240[CG]**
Mercury	µg/L	1[A]	0.77[F]	1[H]	0.0064	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	0.229	0.182	0.191	0.144	0.126	0.144	0.15	0.506	0.65	0.56	1.29	1.43	0.635	1.08
Nickel	µg/L	n/v	39[F]	n/v	<0.5	<0.5	1.3	2.98	2.91	3.6	3.63	<0.5	<0.5	<5 GT	0.82	0.82	1.04	1.13
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<50	<50	<50	<500 GT	<50	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	1.10	0.912	1.33	0.839	0.992	1.00	1.05	3.89	4.22	4.11	1.95	2.01	1.82	2.33
Rubidium	µg/L	n/v	n/v	n/v	2.13	2.27	3.91	0.38	0.52	0.62	0.62	2.22	2.51	2.4	1.55	1.55	1.63	1.58
Selenium	µg/L	10[A]	5[F]	50[H]	<0.05	<0.05	0.136	0.07	0.096	0.077	0.068	0.223	0.231	<0.5 GT	<0.05	<0.05	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	5940	5230	8100	3130	3660	4360	4430	5760	6640	6680	6010	6060	6240	7190
Silver	µg/L	n/v	0.12[F]	n/v	<0.01	<0.01	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 GT	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L	200$_g$[C] 20$_g$[E]	180[F]	≤200[G]	2.85	2.27	2.55	4.66	2.71	4.14	4.41	2.79	3.14	3.13	7.27	7.33	7.25	7.42
Strontium	µg/L	n/v	n/v	n/v	75.8	61.3	74.3	565	475	660	688	148	146	153	302	302	316	278
Sulfur	µg/L	n/v	n/v	n/v	720	520	1040	22400	18700	18100	19000	43400	44600	47600	13500	13600	15400	10300
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2 GT	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40[F]	n/v	<0.01	<0.01	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 GT	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	0.42	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	0.68	1.39	46.1	<0.3	<0.3	0.34	0.31	<0.3	<0.3	4.6	<0.3	<0.3	<0.3	0.74
Tungsten	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	0.98	0.53	0.74	0.73	1.43	2.96	2.5	7.8	9.02	2.82	7.43
Uranium	µg/L	20[A]	33[F]	20[H]	0.022	0.045	0.256	0.228	0.115	0.241	0.247	4.24	4.9	5.44	0.619	0.65	0.614	0.999
Vanadium	µg/L	n/v	20[F]	n/v	0.8	1.66	2.73	<0.5	<0.5	<0.5	<0.5	1.26	1.49	<5 GT	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	2	<1	3.5	1.1	3.1	<1	1.4	2.5	2.4	<10 GT	<1	1.5	<1	<1
Zirconium	µg/L	n/v	n/v	n/v	0.93	1.65	3.07	0.32	1.42	0.38	0.39	<0.3	<0.3	<3 GT	<0.3	<0.3	<0.3	<0.3

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater													
Sample Location					**G7-OB2-14**			**MAC-1**				**MAC-4**			**MAC-6**			
Sample Date					**15-Jun-16**	**8-Aug-16**	**14-Oct-16**	**21-Jun-16**	**5-Aug-16**	**15-Oct-16**	**15-Oct-16**	**21-Jun-16**	**7-Aug-16**	**15-Oct-16**	**21-Jun-16**	**21-Jun-16**	**5-Aug-16**	**15-Oct-16**
Sample ID					**G7-OB2-14**	**G7-OB2-14**	**G7-OB2-14**	**MAC-1**	**MAC 1**	**MAC-1**	**DUPLICATE 5**	**MAC-4**	**MAC 4**	**MAC-4**	**MAC-6**	**DUP 7**	**MAC 6**	**MAC-6**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1784595**	**L1810700**	**L1844412**	**L1787602**	**L1810001**	**L1844417**	**L1844417**	**L1787602**	**L1810001**	**L1844417**	**L1787602**	**L1787602**	**L1810001**	**L1844417**
Laboratory Sample ID					**L1784595-8**	**L1810700-4**	**L1844412-5**	**L1787602-3**	**L1810001-4**	**L1844417-1**	**L1844417-9**	**L1787602-4**	**L1810001-20**	**L1844417-2**	**L1787602-5**	**L1787602-6**	**L1810001-5**	**L1844417-5**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**							**Field Duplicate**					**Field Duplicate**		
Metals, Total																		
Aluminum	µg/L	100^{D}	n/v	<100/200$_a$^{G}	**64300^{DG}**	**57100^{DG}**	**43400^{DG}**	**1620^{DG}**	**39100^{DG}**	**922^{DG}**	**901^{DG}**	**10600^{DG}**	**4730^{DG}**	**9150^{DG}**	**2970^{DG}**	**2980^{DG}**	**4390^{DG}**	**645^{DG}**
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<1 DM	<1 DM	<1 IF	<1 DM	<5 DM	0.15	0.15	<0.5 DM	0.13	<1 GT	0.12	0.12	<0.1	<0.1
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	**39.8^{BH}**	**36^{BH}**	**22.8^{H}**	7.5	**115^{BH}**	6.46	6.51	6.1	3.31	6.3	**186^{BFH}**	**178^{BFH}**	**233^{BFH}**	**160^{BFH}**
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	447	435	283	28.3	164	26.1	26.3	119	79.2	130	130	120	137	96.8
Beryllium	µg/L	n/v	5.3^{F}	n/v	2.8	2.5	1.9	<1 DM	<5 DM	<0.1	<0.1	<0.5 DM	0.13	<1 GT	<0.1	<0.1	0.14	<0.1
Bismuth	µg/L	n/v	n/v	n/v	0.78	1.06	0.59	<0.5 DM	<2.5 DM	<0.05	<0.05	<0.25 DM	<0.05	<0.5 GT	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	180	180	130	<100 DM	<500 DM	<10	<10	<50 DM	11	<100 GT	18	18	16	17
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	**1.26^{F}**	**1.32^{F}**	**0.698^{F}**	0.112	**0.68^{F}**	0.0696	0.0651	0.155	0.0923	0.196	0.0284	0.0249	0.033	0.0085
Calcium	mg/L	n/v	n/v	n/v	3260	3530	1830	90.1	102	89.7	88.8	279	186	370	130	130	117	97.4
Cesium	µg/L	n/v	n/v	n/v	5.26	4.7	3.21	0.1	1.83	0.068	0.069	1.12	0.729	1.04	0.638	0.642	0.879	0.35
Chromium	µg/L	50^{A}	64^{F}	50^{H}	**216^{AFH}**	**188^{AFH}**	**123^{AFH}**	3.2	32.6	0.79	0.78	22.5	10.5	18.9	7.79	7.05	10.4	1.54
Cobalt	µg/L	n/v	5.2^{F}	n/v	**77.2^{F}**	**73.6^{F}**	**43^{F}**	2.2	**15.6^{F}**	1.08	1.08	**6.49^{F}**	4.08	**6.8^{F}**	**6.51^{F}**	**6.17^{F}**	**7^{F}**	3.38
Copper	µg/L	1000^{C}	6.9^{F}	≤1000^{G}	**170^{F}**	**179^{F}**	**93.4^{F}**	**11.4^{F}**	**144^{F}**	2.72	2.61	**36.4^{F}**	**20^{F}**	**38.8^{F}**	**8.19^{F}**	**7.9^{F}**	**9.5^{F}**	2.39
Iron	µg/L	300^{C}	n/v	≤300^{G}	**116000^{CG}**	**102000^{CG}**	**66100^{CG}**	**3180^{CG}**	**78400^{CG}**	**1680^{CG}**	**1630^{CG}**	**11500^{CG}**	**5580^{CG}**	**10600^{CG}**	**3820^{CG}**	**4000^{CG}**	**5900^{CG}**	**989^{CG}**
Lead	µg/L	10$_c$^{A}	2^{F}	10^{H}	**62^{AFH}**	**68.4^{AFH}**	**35^{AFH}**	**6.77^{F}**	**93.4^{AFH}**	1.69	1.57	**6.18^{F}**	**4.6^{F}**	**6.42^{F}**	**2.36^{F}**	**2.21^{F}**	**2.52^{F}**	0.444
Lithium	µg/L	n/v	n/v	n/v	115	99	64	<10 DM	<50 DM	1.1	1.2	18.1	11.7	19	6.1	6.1	7.4	4.2
Magnesium	mg/L	n/v	n/v	n/v	733	939	454	18.9	29.3	17.2	17.4	69.3	48.1	63.3	26.8	24.9	25.1	20.0
Manganese	µg/L	50^{C}	n/v	≤50^{G}	**5470^{CG}**	**5370^{CG}**	**2990^{CG}**	**360^{CG}**	**696^{CG}**	**330^{CG}**	**348^{CG}**	**305^{CG}**	**145^{CG}**	**372^{CG}**	**444^{CG}**	**430^{CG}**	**445^{CG}**	**268^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	0.09	0.153	0.0499	0.005	0.041	<0.005	<0.005	0.0103	<0.005	0.0189	0.0108	0.0074	0.0087	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	1.69	1.44	1.22	0.72	<2.5 DM	0.198	0.198	0.86	0.694	0.8	2.01	1.87	0.835	1.14
Nickel	µg/L	n/v	39^{F}	n/v	**157^{F}**	**144^{F}**	**87^{F}**	6.8	**40^{F}**	4.14	4.21	15.6	7.27	14.9	5.43	5.36	7.94	2.13
Phosphorus	µg/L	n/v	n/v	n/v	20300	17300	10200	<500 DM	<2500 DM	<50	<50	630	302	<500 GT	223	205	164	<50
Potassium	mg/L	n/v	n/v	n/v	9.88	9.26	7.38	1.07	3.1	1.06	1.05	6.70	5.19	6.23	3.22	3.08	2.83	2.39
Rubidium	µg/L	n/v	n/v	n/v	68.3	66.7	45.5	<2 DM	14	0.88	0.93	15.1	7.62	12.8	5.75	5.55	7.08	2.5
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.5 DM	0.51	<0.5 GT	<0.5 DM	<2.5 DM	0.1	0.1	0.28	0.237	<0.5 GT	<0.05	<0.05	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	77100	76000	63200	6230	83300	6730	6610	25900	15400	23100	12700	13100	14200	8510
Silver	µg/L	n/v	0.12^{F}	n/v	**0.48^{F}**	**29^{F}**	**0.33^{F}**	**0.39^{F}**	**4.03^{F}**	0.097	0.084	**4^{F}**	**2.75^{F}**	**6.48^{F}**	**0.713^{F}**	**1.29^{F}**	**0.628^{F}**	0.067
Sodium	mg/L	200$_g$^{C} 20$_g$^{E}	180^{F}	≤200^{G}	6.80	6.48	6.33	5.19	4.1	4.46	4.46	4.28	3.84	4.47	8.58	7.86	8.47	7.63
Strontium	µg/L	n/v	n/v	n/v	1890	1820	1080	623	823	717	709	248	181	323	352	342	335	301
Sulfur	µg/L	n/v	n/v	n/v	6600	8100	<5000	26300	<25000 DM	18600	17800	50600	46600	50300	16300	16200	16000	10800
Tellurium	µg/L	n/v	n/v	n/v	<2 DM	<2 DM	<2 GT	<2 DM	<10 DM	<0.2	<0.2	<1 DM	<0.2	<2 GT	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	1.48	1.64	0.99	<0.1 DM	<0.5 DM	<0.01	<0.01	0.098	0.049	<0.1 GT	0.032	0.032	0.053	0.011
Thorium	µg/L	n/v	n/v	n/v	41.8	40.3	23.9	<1 DM	48.7	1.02	1	3.14	1.55	2.5	0.9	0.93	1.34	0.22
Tin	µg/L	n/v	n/v	n/v	<1 DM	<1 DM	1.1	<1 DM	<5 DM	0.13	0.15	0.59	0.34	<1 GT	0.99	0.57	0.61	0.4
Titanium	µg/L	n/v	n/v	n/v	3140	2310	3380	15.4	109	12.1	12.9	792	355	623	186	195	220	38.1
Tungsten	µg/L	n/v	n/v	n/v	<1 DM	<1 DM	<1 GT	12	41.9	3.24	2.66	16.6	10	23.6	16	14.4	5.66	7.12
Uranium	µg/L	20^{A}	33^{F}	20^{H}	**24^{AH}**	**23.2^{AH}**	14.8	0.4	9.25	0.478	0.445	5.26	5.25	5.73	0.934	0.912	0.812	1.18
Vanadium	µg/L	n/v	20^{F}	n/v	**214^{F}**	**183^{F}**	**134^{F}**	<5 DM	**35^{F}**	0.9	0.94	**25.8^{F}**	13.1	**22.7^{F}**	7.28	7.33	10.1	1.9
Zinc	µg/L	5000^{C}	89^{F}	≤5000^{G}	**244^{F}**	**216^{F}**	**131^{F}**	<30 DM	***<150 DM***	3.6	3.6	33	16.5	35	10.3	10	15.8	3
Zirconium	µg/L	n/v	n/v	n/v	5.8	5.9	11.9	<3 DM	<15 DM	0.84	0.83	5.3	2.73	3.7	1.78	1.91	2.09	0.69

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater												
Sample Location					**MW11-BR-14**			**MW11-OB-14**			**MW12-OB-14**				**MW13-OB-14**		
Sample Date					17-Jun-16	10-Aug-16	14-Oct-16	17-Jun-16	10-Aug-16	14-Oct-16	17-Jun-16	17-Jun-16	10-Aug-16	14-Oct-16	19-Jun-16	8-Aug-16	15-Oct-16
Sample ID					MW11-BR-14	MW11-BR-14	MW11-BR-14	MW11-OB-14	MW11-OB-14	MW11-OB-14	MW12-OB-14	DUP 3	MW12-OB-14	MW12-OB-14	MW13-OB-14	MW13-OB-14	MW13-OB-14
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1812825	L1844412	L1786341	L1812825	L1844412	L1786341	L1786341	L1812825	L1844412	L1786341	L1810700	L1844417
Laboratory Sample ID					L1786341-3	L1812825-2	L1844412-1	L1786341-4	L1812825-3	L1844412-2	L1786341-1	L1786341-2	L1812825-1	L1844412-8	L1786341-15	L1810700-3	L1844417-6
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**								Field Duplicate					
Field Parameters																	
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	6.72	8.88	8.33	5.87	3.87	9.37	1.96	-	6.88	4.5	7.24	7.64	9.18
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	443	367	518	510	0.559	573	344	-	270	347	304	290	291
pH, Field	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	**6.78^{G}**	7.1	7.51	7.63	7.6	7.85	7.26	-	7.51	7.57	7.43	7.54	7.53
Temperature, Field	deg C	15^{C}	n/v	≤15^{G}	3.89	6.24	3.67	8.4	11.48	5.24	2.18	-	5.28	6.11	3.08	6.77	5.14
General Chemistry																	
Acidity as CaCO3	mg/L	n/v	n/v	n/v	7.3	9.5	21.4	4.9	<2.0	11.4	3.7	4.1	6.0	5.4	4.3	2.2	5.1
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	253	-	298	286	-	306	200	187	-	234	185	200	209
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500^{D}	n/v	n/v	253	247	298	286	371	306	200	187	194	234	185	200	209
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.073	0.020	<0.020	0.053	0.121	0.033	0.046	0.050	0.034	0.026	0.27	0.88	0.042
Anion Sum	meq/L	n/v	n/v	n/v	5.24	5.13	6.18	6.10	7.86	7.24	4.28	3.99	4.13	4.96	3.81	4.08	4.29
Cation Sum	meq/L	n/v	n/v	n/v	5.51	4.77	5.77	6.35	7.49	5.89	4.52	4.39	3.89	4.04	3.49	3.24	3.23
Chloride	mg/L	250^{C}	180^{F}	≤250^{G}	0.69	0.44	0.86	0.78	0.91	0.70	0.38	0.34	0.31	0.32	0.34	0.29	0.31
Color, True	TCU	5^{C}	n/v	n/v	3.0	<2.0	2.2	**103^{C}**	**123^{C}**	**206^{C}**	3.3	<2.0	<2.0	<2.0	2.5	2.5	<2.0
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	3.0	1.9	3.5	**20.8^{C}**	**27.0^{C}**	**30.2^{C}**	1.2	1.1	1.5	1.8	1.8	2.4	1.9
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	444	446	509	517	659	630	351	349	358	357	294	300	293
Fluoride	mg/L	1.5$_{b}^{A}$	n/v	1.5^{H}	0.095	0.108	0.096	0.136	0.122	0.137	0.091	0.084	0.068	0.071	0.042	0.041	0.039
Hardness (as CaCO3)	mg/L	80-100^{D}	n/v	n/v	**258^{D}**	**227^{D}**	**270^{D}**	95.6	92.2	**73.1^{D}**	**219^{D}**	**213^{D}**	**189^{D}**	**194^{D}**	**159^{D}**	**147^{D}**	**154^{D}**
Ion Balance	%	n/v	n/v	n/v	2.6	<0.000	<0.000	2.0	<0.000	<0.000 BR	2.7	4.8	<0.000	<0.000 BR	<0.000	<0.000	<0.000 BR
Nitrate (as N)	mg/L	10.0$_{d}^{A}$	n/v	10^{H}	<0.020	0.022	<0.020	<0.020	0.027	2.13	<0.020	<0.020	<0.020	<0.020	0.066	0.057	0.032
Nitrite (as N)	mg/L	1.0$_{d}^{A}$	n/v	1^{H}	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.78	7.74	7.55	7.94	8.19	7.78	7.78	7.86	7.81	7.75	7.83	7.75	7.91
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.020	0.025	0.0069	2.32	1.12	2.04	3.69	3.49	3.75	1.58	26.5	18.3	5.74
Phosphorus, Total	mg/L	n/v	n/v	n/v	<0.0030	<0.0030	<0.0030	0.0057	<0.0030	0.0124	<0.0030	<0.0030	<0.0030	0.0130	<0.0030	0.0543	0.0053
Sulfate	mg/L	500$_{h}^{C}$	n/v	≤500$_{j}^{G}$	7.19	8.42	9.16	17.3	20.3	45.0	13.1	11.7	11.5	12.8	4.37	3.82	5.16
Total Dissolved Solids	mg/L	500^{C}	n/v	≤500^{G}	278	255	292	430	**551^{CG}**	496	279	266	212	226	330	242	166
Total Organic Carbon	mg/L	n/v	n/v	n/v	2.7	1.8	2.3	32	43	55	7.1	6.6	11.6	3.6	N/R	235	2.1
Total Suspended Solids	mg/L	n/v	n/v	n/v	21.2	22.6	7.8	1610	4620	5130	7880	8450	9570	3720	79100	20900	18600

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater												
Sample Location					MW11-BR-14			MW11-OB-14			MW12-OB-14				MW13-OB-14		
Sample Date					17-Jun-16	10-Aug-16	14-Oct-16	17-Jun-16	10-Aug-16	14-Oct-16	17-Jun-16	17-Jun-16	10-Aug-16	14-Oct-16	19-Jun-16	8-Aug-16	15-Oct-16
Sample ID					MW11-BR-14	MW11-BR-14	MW11-BR-14	MW11-OB-14	MW11-OB-14	MW11-OB-14	MW12-OB-14	DUP 3	MW12-OB-14	MW12-OB-14	MW13-OB-14	MW13-OB-14	MW13-OB-14
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1812825	L1844412	L1786341	L1812825	L1844412	L1786341	L1786341	L1812825	L1844412	L1786341	L1810700	L1844417
Laboratory Sample ID					L1786341-3	L1812825-2	L1844412-1	L1786341-4	L1812825-3	L1844412-2	L1786341-1	L1786341-2	L1812825-1	L1844412-8	L1786341-15	L1810700-3	L1844417-6
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**								**Field Duplicate**					
Metals, Dissolved																	
Aluminum	µg/L	100^{D}	n/v	$<100/200_{a}^{G}$	4.3	5.3	9.5	51	58.5	**1400^{DG}**	<2	<2	<2	**211^{DG}**	2.1	2.6	**108^{DG}**
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	0.54	0.64	0.65	<1 GT	0.75	1.28	<0.1	<0.1	<0.1	<1 DM	<0.1	<0.1	<1 GT
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	1.65	1.25	1.79	3.9	6.67	6.94	0.42	0.41	0.44	<1 DM	0.41	0.39	2.1
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	29.6	30.5	34.4	23.9	34.3	26.5	20.5	19.8	21.2	25.8	7.47	7.64	10.3
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<1 DM	<0.1	<0.1	<1 GT
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.5 GT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 DM	<0.05	<0.05	<0.5 GT
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<10	<10	10	<100 GT	22	13	<10	<10	<10	<100 DM	<10	<10	<100 GT
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	0.0254	0.0151	0.0142	<0.05 GT	0.0261	0.0151	<0.005	0.0163	<0.005	<0.05 DM	<0.005	<0.005	<0.05 GT
Calcium	mg/L	n/v	n/v	n/v	77.8	67.2	80.7	32.1	30.2	24.5	63.0	61.5	53.2	54.3	48.6	43.5	45.5
Cesium	µg/L	n/v	n/v	n/v	0.02	0.017	0.023	<0.1 GT	<0.01	0.036	<0.01	<0.01	<0.01	<0.1 DM	<0.01	<0.01	<0.1 GT
Chromium	µg/L	50^{A}	64^{F}	50^{H}	0.1	<0.1	<0.1	<1 GT	2.66	1.69	<0.1	<0.1	<0.1	<1 DM	0.36	0.45	<1 GT
Cobalt	µg/L	n/v	5.2^{F}	n/v	1.37	0.53	0.58	<1 GT	0.93	2.82	<0.1	0.1	<0.1	<1 DM	<0.1	<0.1	<1 GT
Copper	µg/L	1000^{C}	6.9^{F}	$\leq1000^{G}$	1.17	1.22	1.45	**12.3^{F}**	**10.2^{F}**	**13.2^{F}**	<0.2	0.48	<0.2	<2 DM	3.07	0.5	<2 GT
Iron	µg/L	300^{C}	n/v	$\leq300^{G}$	<10	<10	<10	<100 GT	107	**674^{CG}**	<10	<10	<10	180	<10	<10	<100 GT
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	0.079	<0.05	<0.05	0.58	0.215	0.561	<0.05	<0.05	<0.05	<0.5 DM	0.096	<0.05	<0.5 GT
Lithium	µg/L	n/v	n/v	n/v	<1	<1	<1	<10 GT	<1	<1	1.8	1.7	1.9	<10 DM	<1	<1	<10 GT
Magnesium	mg/L	n/v	n/v	n/v	15.5	14.4	16.7	3.76	4.07	2.87	15.1	14.5	13.5	14.1	9.08	9.24	9.76
Manganese	µg/L	50^{C}	n/v	$\leq50^{G}$	**206^{CG}**	**56^{CG}**	**65.5^{CG}**	**209^{CG}**	**352^{CG}**	34.6	17.2	17.1	12.4	13	6.59	5.03	1.9
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	0.006	<0.005	<0.005	0.0136	0.0063	0.0149	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	3.22	2.48	3.16	18.5	18.8	7.72	0.968	0.995	0.86	0.65	0.498	0.349	0.69
Nickel	µg/L	n/v	39^{F}	n/v	3.03	1.83	2	<5 GT	4.81	3.15	<0.5	<0.5	<0.5	<5 DM	<0.5	<0.5	<5 GT
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<500 GT	<50	<50	<50	<50	<50	<500 DM	<50	<50	<500 GT
Potassium	mg/L	n/v	n/v	n/v	1.49	1.42	1.78	1.98	1.94	1.82	1.65	1.64	1.72	2.04	0.189	0.314	<0.50 GT
Rubidium	µg/L	n/v	n/v	n/v	2.93	3.05	3.67	<2 GT	1.4	1.15	2.07	2.04	2.18	2.6	0.64	1.05	<2 GT
Selenium	µg/L	10^{A}	5^{F}	50^{H}	0.098	0.134	0.084	<0.5 GT	0.305	<0.5 DM	<0.05	<0.05	0.064	<0.5 DM	0.064	0.071	<0.5 GT
Silicon	µg/L	n/v	n/v	n/v	5100	5340	6070	3290	4890	6970	4070	3940	4110	4620	4020	3960	4240
Silver	µg/L	n/v	0.12^{F}	n/v	<0.01	<0.01	<0.01	<0.1 GT	0.037	0.023	<0.01	<0.01	<0.01	<0.1 DM	<0.01	<0.01	<0.1
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	$\leq200^{G}$	7.03	4.51	7.31	**101^{E}**	**128^{E}**	**96.4^{E}**	2.02	1.95	1.86	1.87	6.77	5.46	3.18
Strontium	µg/L	n/v	n/v	n/v	144	119	148	54.5	54.6	49.2	51.3	48.9	43.5	46.3	70.6	46.2	39.5
Sulfur	µg/L	n/v	n/v	n/v	2380	2100	2280	<5000 GT	7480	12200	4620	4450	4190	<5000 DM	1310	980	<5000 GT
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<2 GT	<0.2	<0.2	<0.2	<0.2	<0.2	<2 DM	<0.2	<0.2	<2 GT
Thallium	µg/L	n/v	40^{F}	n/v	<0.01	<0.01	0.011	<0.1 GT	0.033	0.017	0.013	0.013	0.014	<0.1 DM	<0.01	<0.01	<0.1 GT
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<1 GT	0.44	0.97	<0.1	<0.1	<0.1	<1 DM	<0.1	<0.1	<1 GT
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<1 DM	0.23	0.32	<0.1	<0.1	<0.1	<1 DM	<0.1	<0.1	<1 GT
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<3 GT	2.49	21.6	<0.3	<0.3	<0.3	8.8	<0.3	<0.3	<3 GT
Tungsten	µg/L	n/v	n/v	n/v	0.39	0.35	0.44	<1 GT	0.43	0.46	<0.1	<0.1	<0.1	<1 DM	<0.1	<0.1	<1 GT
Uranium	µg/L	20^{A}	33^{F}	20^{H}	1.8	1.77	1.87	12.2	13.7	8.57	2.34	2.37	2.85	3.3	1.07	0.865	0.57
Vanadium	µg/L	n/v	20^{F}	n/v	<0.5	<0.5	<0.5	<5 GT	3.29	1.53	<0.5	<0.5	<0.5	<5 DM	<0.5	0.51	<5 GT
Zinc	µg/L	5000^{C}	89^{F}	$\leq5000^{G}$	1.8	4.8	1.1	<10 GT	12.2	4.2	<1	2.7	<1	<10 DM	2.7	1	<10 GT
Zirconium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<3 GT	4.9	3.39	<0.3	<0.3	<0.3	<3 DM	<0.3	<0.3	<3 GT

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater												
Sample Location					MW11-BR-14			MW11-OB-14			MW12-OB-14				MW13-OB-14		
Sample Date					17-Jun-16	10-Aug-16	14-Oct-16	17-Jun-16	10-Aug-16	14-Oct-16	17-Jun-16	17-Jun-16	10-Aug-16	14-Oct-16	19-Jun-16	8-Aug-16	15-Oct-16
Sample ID					MW11-BR-14	MW11-BR-14	MW11-BR-14	MW11-OB-14	MW11-OB-14	MW11-OB-14	MW12-OB-14	DUP 3	MW12-OB-14	MW12-OB-14	MW13-OB-14	MW13-OB-14	MW13-OB-14
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1812825	L1844412	L1786341	L1812825	L1844412	L1786341	L1786341	L1812825	L1844412	L1786341	L1810700	L1844417
Laboratory Sample ID					L1786341-3	L1812825-2	L1844412-1	L1786341-4	L1812825-3	L1844412-2	L1786341-1	L1786341-2	L1812825-1	L1844412-8	L1786341-15	L1810700-3	L1844417-6
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**								Field Duplicate					
Metals, Total																	
Aluminum	µg/L	100[D]	n/v	<100/200$_a$[G]	**475[DG]**	**526[DG]**	**149[DG]**	**14300[DG]**	**13700[DG]**	**39800[DG]**	**6630[DG]**	**27000[DG]**	**33300[DG]**	**6870[DG]**	**<300 GT**	**140[DG]**	**59800[DG]**
Antimony	µg/L	6[B]	1600[F]	6[H]	0.75	0.75	0.63	<1 DM	<1 DM	<2 GT	<1 GT	<1 DM	<1 DM	<1 DM	**<10 GT**	<2 IF	<1 GT
Arsenic	µg/L	25[B]	150[F]	10[H]	2.55	1.75	1.83	**14.9[H]**	**16.4[H]**	**32.2[BH]**	3.9	**11.6[H]**	**14.5[H]**	2.8	<10 GT	4.1	**19.6[H]**
Barium	µg/L	1000[A]	2300[F]	1000[H]	41.7	40	34.2	121	255	405	125	234	294	95.3	961	805	576
Beryllium	µg/L	n/v	5.3[F]	n/v	<0.1	<0.1	<0.1	<1 DM	<1 DM	<2 GT	<1 GT	1	1.2	<1	**<10 GT**	<2 IF	3.2
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.5 DM	0.56	<1 GT	<0.5 GT	<0.5 DM	<0.5 DM	<0.5 DM	<5 GT	<1 IF	0.88
Boron	µg/L	5000[B]	3550[F]	5000[H]	<10	11	14	<100 DM	<100 DM	<200 GT	<100 GT	<100 DM	<100 DM	<100 DM	<1000 GT	380	110
Cadmium	µg/L	5[A]	0.21[F]	5[H]	0.0317	0.0181	0.0203	0.111	0.135	**0.33[F]**	**0.216[F]**	**0.314[F]**	**0.421[F]**	0.121	**2.12[F]**	**1.72[F]**	**0.704[F]**
Calcium	mg/L	n/v	n/v	n/v	77.0	77.8	79.9	268	44.9	407	563	816	1000	253	6310	6620	1810
Cesium	µg/L	n/v	n/v	n/v	0.103	0.091	0.048	1.42	1.61	4.06	0.48	1.97	2.67	0.46	<1 GT	0.76	4.59
Chromium	µg/L	50[A]	64[F]	50[H]	1.39	1.68	0.6	41.1	30	**114[AFH]**	15.1	**64.3[AFH]**	**83.4[AFH]**	14.4	<10 GT	<2 IF	**155[AFH]**
Cobalt	µg/L	n/v	5.2[F]	n/v	2.76	1.64	0.74	**14.5[F]**	**10.5[F]**	**35.5[F]**	**6[F]**	**17.6[F]**	**22.6[F]**	3.8	**44[F]**	**6.4[F]**	**35.8[F]**
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	3.56	2.73	2.35	**50.8[F]**	**75[F]**	**118[F]**	**13.8[F]**	**47.7[F]**	**62.3[F]**	**9.9[F]**	**<50 GT**	**<10 IF**	**103[F]**
Iron	µg/L	300[C]	n/v	≤300[G]	**623[CG]**	**801[CG]**	211	**18700[CG]**	**13200[CG]**	**50300[CG]**	**7780[CG]**	**31800[CG]**	**42700[CG]**	**7140[CG]**	**<1000 GT**	<200 IF	**78800[CG]**
Lead	µg/L	10$_c$[A]	2[F]	10[H]	0.709	1.07	0.226	**11.8[AFH]**	**15.3[AFH]**	**37[AFH]**	**3.8[F]**	**17.1[AFH]**	**20.3[AFH]**	**3.74[F]**	**10.1[AFH]**	<1 IF	**45.3[AFH]**
Lithium	µg/L	n/v	n/v	n/v	1.3	1	1.1	16	11	48	11	36	42	<10 DM	<100 GT	55	73
Magnesium	mg/L	n/v	n/v	n/v	15.1	15.1	17.0	74.7	8.39	131	92.5	229	276	50.5	1630	1730	375
Manganese	µg/L	50[C]	n/v	≤50[G]	**274[CG]**	**93.9[CG]**	**88.6[CG]**	**692[CG]**	**497[CG]**	**1100[CG]**	**666[CG]**	**1210[CG]**	**1460[CG]**	**333[CG]**	**8640[CG]**	**6250[CG]**	**2480[CG]**
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	0.0499	0.0928	0.0809	0.0467	0.0544	0.0674	0.0221	0.356	0.265	0.0459
Molybdenum	µg/L	n/v	730[F]	n/v	3.73	3.06	3.52	16.8	16.7	7.2	1.02	1.25	1.16	1.12	<5 GT	1.9	0.73
Nickel	µg/L	n/v	39[F]	n/v	4.86	3.09	2.62	31.6	30.7	**83[F]**	11	**43.3[F]**	**56.5[F]**	9.6	**79[F]**	10	**93.7[F]**
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	1790	<500 DM	2200	680	2620	3480	<500 DM	<5000 GT	<1000 IF	5050
Potassium	mg/L	n/v	n/v	n/v	1.72	1.65	1.69	4.26	3.63	7.0	3.76	7.77	8.75	3.88	13.4	16.2	10.1
Rubidium	µg/L	n/v	n/v	n/v	3.83	4.03	3.8	16	18.3	44.7	12.5	36.7	46.8	11.1	54	68.4	73.8
Selenium	µg/L	10[A]	5[F]	50[H]	0.098	0.151	0.078	<0.5 DM	<0.5 DM	<1 GT	<0.5 DM	<0.5 DM	<0.5 DM	<0.5 DM	<5 GT	<1 IF	<0.5 GT
Silicon	µg/L	n/v	n/v	n/v	6090	6690	6320	25500	28000	65300	16300	48900	62800	17600	31600	24300	91200
Silver	µg/L	n/v	0.12[F]	n/v	**0.135[F]**	**0.311[F]**	0.064	**0.24[F]**	**0.45[F]**	**0.7[F]**	<0.1 DM	**0.18[F]**	**0.24[F]**	<0.1 DM	**<1 GT**	**<0.2**	**0.37[F]**
Sodium	mg/L	200$_g$[C] 20$_g$[E]	180[F]	≤200[G]	6.83	4.90	8.33	**99.6[E]**	**134[E]**	**121[E]**	3.04	5.10	5.46	2.92	19.0	**20.3[E]**	8.24
Strontium	µg/L	n/v	n/v	n/v	153	151	158	218	104	337	366	514	612	183	3610	3640	1130
Sulfur	µg/L	n/v	n/v	n/v	2760	2580	2380	<5000 DM	5600	11000	<5000 DM	<5000 DM	5200	<5000 DM	<50000 GT	11000	<5000 GT
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<2 DM	<2 DM	<4 GT	<2 DM	<2 DM	<2 DM	<2 DM	<20 GT	<4 IF	<2 GT
Thallium	µg/L	n/v	40[F]	n/v	0.016	0.014	0.012	0.23	0.26	0.75	0.11	0.41	0.52	0.12	1	0.67	0.73
Thorium	µg/L	n/v	n/v	n/v	0.32	0.24	<0.1	5.6	6.8	17.8	3.6	14.1	17.4	3.1	<10 GT	<2 IF	44.1
Tin	µg/L	n/v	n/v	n/v	0.29	0.14	<0.1	1.4	1.3	2	<1 DM	1.6	1.6	<1 DM	<10 GT	<2 IF	1.6
Titanium	µg/L	n/v	n/v	n/v	38.1	50.5	11.7	1160	302	1980	486	2300	3080	544	<30 GT	<6 IF	3090
Tungsten	µg/L	n/v	n/v	n/v	1.15	0.79	0.56	1.3	<1 DM	<2 GT	<1 DM	<1 DM	<1 DM	<1 DM	<10 GT	<2 IF	<1 GT
Uranium	µg/L	20[A]	33[F]	20[H]	2.1	2.04	2.25	14.9	19.4	18.2	8.35	11.3	8.25	5.07	<1 GT	0.21	10.5
Vanadium	µg/L	n/v	20[F]	n/v	1.29	1.59	0.66	**36[F]**	**22.2[F]**	**86[F]**	15.8	**66.9[F]**	**86.3[F]**	14.8	**<50 GT**	17	**142[F]**
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	3.6	4.6	<3	40	46	**119[F]**	<30 DM	79	**105[F]**	<30	**<300 GT**	<60 IF	**167[F]**
Zirconium	µg/L	n/v	n/v	n/v	0.58	0.41	<0.3	5.9	3.9	6.8	4.6	13.5	15.6	4.9	<30 GT	<6 IF	7.3

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater												
Sample Location					MW14-BR-14				MW14-OB-14			MW15-BR-14			MW15-OB-14		
Sample Date					19-Jun-16	7-Aug-16	15-Oct-16	14-Oct-16	18-Jun-16	7-Aug-16	15-Oct-16	16-Jun-16	9-Aug-16	18-Oct-16	16-Jun-16	9-Aug-16	14-Oct-16
Sample ID					MW14-BR-14	MW14-BR-14	MW14-BR-14	DUPLICATE 3	MW14-OB-14	MW14-OB-14	MW14-OB-14	MW15-BR-14	MW15-BR-14	MW15 BR-14	MW15-OB-14	MW15-OB-14	MW15-OB-14
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1810001	L1844417	L1844412	L1786341	L1810001	L1844417	L1785355	L1811325	L1846557	L1785355	L1811325	L1844412
Laboratory Sample ID					L1786341-14	L1810001-22	L1844417-4	L1844412-13	L1786341-7	L1810001-21	L1844417-3	L1785355-2	L1811325-3	L1846557-6	L1785355-1	L1811325-4	L1844412-11
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**				Field Duplicate									
Field Parameters																	
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	2.09	2.49	0.16	-	2.51	4.72	4.09	8.63	3.63	5.91	7.34	7.57	6.41
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	426	350	425	-	591	483	594	202	284	327	192	278	334
pH, Field	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	7.29	7.7	7.72	-	7.09	7.11	7.2	**6.98[G]**	7.41	7.46	7.05	7.28	7.55
Temperature, Field	deg C	15[C]	n/v	≤15[G]	5.02	5.28	6.47	-	3.21	7.44	8.01	4.72	5.3	5.52	5.4	5.42	5.69
General Chemistry																	
Acidity as CaCO3	mg/L	n/v	n/v	n/v	2.6	<2.0	4.4	49.0	14.8	11.3	19.6	5.7	<2.0	3.1	5.8	<2.0	2.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	246	240	258	386	333	332	363	180	181	197	185	207	191
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500[D]	n/v	n/v	246	240	258	386	333	332	363	180	181	197	185	207	191
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.402	0.489	0.398	1.72	<0.020	<0.20 DM	0.050	0.103	0.185	0.021	0.059	0.083	0.037
Anion Sum	meq/L	n/v	n/v	n/v	4.97	4.85	5.20	46.5	6.89	6.88	7.49	3.90	3.92	4.03	3.80	4.26	3.95
Cation Sum	meq/L	n/v	n/v	n/v	5.18	5.02	4.91	41.2	7.57	7.10	6.76	3.74	3.69	3.80	3.77	3.64	3.87
Chloride	mg/L	250[C]	180[F]	≤250[G]	0.80	0.66	0.68	7.22	0.50	0.45	0.45	0.24	0.24	0.19	0.25	0.28	0.32
Color, True	TCU	5[C]	n/v	n/v	**7.8[C]**	**6.9[C]**	**7.0[C]**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	**5.2[C]**	<2.0
Cyanide	mg/L	n/v	0.0052[F]	0.2[H]	<0.0020	<0.0020	<0.0020	**0.150[F]**	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2[A]	n/v	0.2[H]	<0.0050	<0.0050	<0.0050	<0.0050 BL	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020 BL	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5[C]	n/v	n/v	4.1	3.2	4.2	3.2	1.8	1.1	2.0	<1.0	<1.0	1.7	<1.0	1.3	1.2
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	416	440	425	2910	573	615	592	342	352	348	335	349	337
Fluoride	mg/L	1.5$_{b}$[A]	n/v	1.5[H]	0.378	0.369	0.359	0.15	0.400	0.386	0.382	0.135	0.114	0.033	0.046	0.042	0.039
Hardness (as CaCO3)	mg/L	80-100[D]	n/v	n/v	**153[D]**	**143[D]**	**138[D]**	**1880[D]**	**348[D]**	**326[D]**	**309[D]**	**177[D]**	**174[D]**	**184[D]**	**183[D]**	**176[D]**	**183[D]**
Ion Balance	%	n/v	n/v	n/v	2.0	1.7	<0.000	<0.000	4.8	1.6	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000
Nitrate (as N)	mg/L	10.0$_{d}$[A]	n/v	10[H]	<0.020	<0.020	<0.020	<0.10 GT	0.173	0.216	0.215	<0.020	<0.020	<0.020	<0.020	<0.020	0.025
Nitrite (as N)	mg/L	1.0$_{d}$[A]	n/v	1[H]	<0.010	<0.010	<0.010	<0.050 GT	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	7.86	7.99	8.06	**6.84[G]**	7.72	7.57	7.67	7.89	7.83	7.74	7.88	7.83	7.78
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.074	0.116	0.229	87.2	0.600	0.792	0.725	0.0084	0.0219	8.31	8.05	13.7	6.70
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0147	0.0251	0.0242	0.0875	<0.0030	<0.0030	0.0034	<0.0030	<0.0030	0.0052	<0.0030	<0.0030	0.0083
Sulfate	mg/L	500$_{h}$[C]	n/v	≤500$_{j}$[G]	0.39	0.54	1.01	**1850[CG]**	8.57	8.86	9.24	13.7	14.2	4.29	3.98	5.21	5.88
Total Dissolved Solids	mg/L	500[C]	n/v	≤500[G]	264	258	247	**2940[CG]**	344	322	336	197	188	215	407	211	211
Total Organic Carbon	mg/L	n/v	n/v	n/v	3.8	3.2	4.9	8.4	3.3	4.1	5.2	<1.0	<1.0	4.0	N/R	<25	1.6
Total Suspended Solids	mg/L	n/v	n/v	n/v	2550	192	351	92600	1040	1690	2580	33.5	41.4	10800	21800	21900	14800

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater												
Sample Location					MW14-BR-14				MW14-OB-14			MW15-BR-14			MW15-OB-14		
Sample Date					19-Jun-16	7-Aug-16	15-Oct-16	14-Oct-16	18-Jun-16	7-Aug-16	15-Oct-16	16-Jun-16	9-Aug-16	18-Oct-16	16-Jun-16	9-Aug-16	14-Oct-16
Sample ID					MW14-BR-14	MW14-BR-14	MW14-BR-14	DUPLICATE 3	MW14-OB-14	MW14-OB-14	MW14-OB-14	MW15-BR-14	MW15-BR-14	MW15 BR-14	MW15-OB-14	MW15-OB-14	MW15-OB-14
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1810001	L1844417	L1844412	L1786341	L1810001	L1844417	L1785355	L1811325	L1846557	L1785355	L1811325	L1844412
Laboratory Sample ID					L1786341-14	L1810001-22	L1844417-4	L1844412-13	L1786341-7	L1810001-21	L1844417-3	L1785355-2	L1811325-3	L1846557-6	L1785355-1	L1811325-4	L1844412-11
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**				Field Duplicate									
Metals, Dissolved																	
Aluminum	µg/L	100^{D}	n/v	$<100/200_{a}^{G}$	7.5	7.9	7.6	51	4.6	6.9	<20 GT	3.8	4.5	2.5	2.4	4.7	**564^{DG}**
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<0.1	<0.1	<0.1	2.26	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	4.85	6.55	6.62	**6830^{BFH}**	0.16	0.19	<1	0.71	0.62	0.59	0.61	0.48	1.5
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	41.9	42	40.3	20.8	61.1	58.8	60	12.7	12.9	41.2	41.1	53.2	51.5
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 GT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 GT
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	61	59	58	63	17	18	<100 GT	11	<10	<10	<10	<10	<100 GT
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	<0.005	<0.005	<0.005	<0.005	0.0104	0.0098	<0.05 GT	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05 GT
Calcium	mg/L	n/v	n/v	n/v	35.8	31.4	29.8	465	98.7	89.2	82.1	53.3	51.3	55.0	55.9	52.0	54.5
Cesium	µg/L	n/v	n/v	n/v	0.035	0.035	0.037	0.036	<0.01	<0.01	<0.1 GT	0.088	0.091	<0.01	<0.01	<0.01	<0.1 GT
Chromium	µg/L	50^{A}	64^{F}	50^{H}	<0.1	<0.1	<0.1	<0.1	0.33	0.47	<1 GT	<0.1	<0.1	0.37	0.27	0.35	<1 GT
Cobalt	µg/L	n/v	5.2^{F}	n/v	0.54	0.42	0.49	1.98	0.12	<0.1	<1 GT	0.12	0.1	<0.1	<0.1	<0.1	<1 GT
Copper	µg/L	1000^{C}	6.9^{F}	$\leq1000^{G}$	<0.2	<0.2	<0.2	<0.2	0.57	0.95	<2 GT	<0.2	<0.2	0.41	0.33	0.5	<2 GT
Iron	µg/L	300^{C}	n/v	$\leq300^{G}$	210	178	64	**44600^{CG}**	<10	<10	<100 GT	187	193	<10	<10	<10	**480^{CG}**
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 GT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 GT
Lithium	µg/L	n/v	n/v	n/v	2.4	2.8	2.4	10.1	<1	2.3	<10 GT	1.4	1.9	<1	<1	<1	<10 GT
Magnesium	mg/L	n/v	n/v	n/v	15.3	15.8	15.5	175	24.6	24.9	25.2	10.7	11.3	11.3	10.5	11.2	11.3
Manganese	µg/L	50^{C}	n/v	$\leq50^{G}$	**110^{CG}**	**115^{CG}**	**89.1^{CG}**	**452^{CG}**	13.5	12.9	9.7	**67.9^{CG}**	**65.2^{CG}**	1.96	3.29	2.85	12.7
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	2.13	2.21	1.88	3.47	3.7	3.22	2.75	0.497	0.555	0.633	0.63	0.615	0.53
Nickel	µg/L	n/v	39^{F}	n/v	<0.5	<0.5	<0.5	1.81	<0.5	<0.5	<5 GT	<0.5	<0.5	<0.5	<0.5	<0.5	<5 GT
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<500 GT	<50	<50	<50	<50	<50	<500 GT
Potassium	mg/L	n/v	n/v	n/v	3.03	3.24	3.19	35.1	3.78	3.93	3.73	1.70	1.72	1.90	1.75	1.88	1.90
Rubidium	µg/L	n/v	n/v	n/v	2.76	2.88	2.62	4.9	3.59	3.67	3.2	3.17	2.99	3.29	3.13	3.22	3.9
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.05	0.056	0.052	<0.05	0.186	0.225	<0.5 GT	0.117	<0.05	0.116	0.13	0.103	<0.5 GT
Silicon	µg/L	n/v	n/v	n/v	6320	6440	6470	11700	6600	7000	7120	6910	7140	4660	4410	4420	5950
Silver	µg/L	n/v	0.12^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 GT	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 GT
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	$\leq200^{G}$	**46.1^{E}**	**46.5^{E}**	**46.5^{E}**	5.34	12.1	11.4	11.4	3.31	3.31	1.82	1.75	1.64	1.70
Strontium	µg/L	n/v	n/v	n/v	210	188	187	2490	230	218	219	157	148	53.2	53.8	50	54.7
Sulfur	µg/L	n/v	n/v	n/v	<500	<500	<500	557000	2890	2870	<5000 GT	4740	4150	1320	1570	1360	<5000 GT
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2 GT	<0.2	<0.2	<0.2	<0.2	<0.2	<2 GT
Thallium	µg/L	n/v	40^{F}	n/v	<0.01	<0.01	<0.01	<0.01	0.014	0.012	<0.1 GT	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 GT
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<2.8 DM	<0.3	<0.3	<3 GT	<0.3	<0.3	<0.3	<0.3	<0.3	22.4
Tungsten	µg/L	n/v	n/v	n/v	4.8	2.99	2.98	1.47	0.28	0.37	<1 GT	0.63	0.65	0.59	0.49	0.58	<1 GT
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.243	0.181	0.173	0.089	2.17	1.94	1.91	0.362	0.325	0.619	0.686	0.695	0.72
Vanadium	µg/L	n/v	20^{F}	n/v	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5 GT	<0.5	<0.5	<0.5	<0.5	<0.5	<5 GT
Zinc	µg/L	5000^{C}	89^{F}	$\leq5000^{G}$	1	1.5	<1	2.2	<1	3.2	<10 GT	<1	1.1	3	3.1	2.4	11
Zirconium	µg/L	n/v	n/v	n/v	0.39	0.59	0.5	<0.3	<0.3	<0.3	<3 GT	0.33	0.32	<0.3	<0.3	<0.3	<3 GT

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Sample Location					Groundwater												
					MW14-BR-14				MW14-OB-14			MW15-BR-14			MW15-OB-14		
Sample Date					19-Jun-16	7-Aug-16	15-Oct-16	14-Oct-16	18-Jun-16	7-Aug-16	15-Oct-16	16-Jun-16	9-Aug-16	18-Oct-16	16-Jun-16	9-Aug-16	14-Oct-16
Sample ID					MW14-BR-14	MW14-BR-14	MW14-BR-14	DUPLICATE 3	MW14-OB-14	MW14-OB-14	MW14-OB-14	MW15-BR-14	MW15-BR-14	MW15 BR-14	MW15-OB-14	MW15-OB-14	MW15-OB-14
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1810001	L1844417	L1844412	L1786341	L1810001	L1844417	L1785355	L1811325	L1846557	L1785355	L1811325	L1844412
Laboratory Sample ID					L1786341-14	L1810001-22	L1844417-4	L1844412-13	L1786341-7	L1810001-21	L1844417-3	L1785355-2	L1811325-3	L1846557-6	L1785355-1	L1811325-4	L1844412-11
Sample Type	Units	ODWS	MOE APV	Health Canada				Field Duplicate									
Metals, Total																	
Aluminum	µg/L	100^{D}	n/v	$<100/200_{a}^{G}$	**737^{DG}**	**1310^{DG}**	**2230^{DG}**	**102000^{DG}**	**10800^{DG}**	**11700^{DG}**	**17600^{DG}**	**395^{DG}**	**673^{DG}**	**74700^{DG}**	**76200^{DG}**	**114000^{DG}**	**23400^{DG}**
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	0.1	0.11	0.15	**8.6^{BH}**	<1 DM	<1 DM	<1 GT	<0.1	<0.1	<1 GT	<1 DM	<1 DM	<1 GT
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	5.78	7.16	7.75	**18200^{BFH}**	6	5.2	8.2	0.81	1.05	**36.5^{BH}**	**41.9^{BH}**	**52.8^{BH}**	9.5
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	51.8	57.1	65.4	812	182	171	258	15.9	26.7	669	794	**1140^{AH}**	381
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	0.1	4	<1 DM	<1 DM	<1 GT	<0.1	<0.1	2.9	3	4.6	<1 GT
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	4.9	<0.5 DM	<0.5 DM	<0.5 GT	<0.05	<0.05	0.73	0.81	1.1	<0.5 GT
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	62	55	69	<200	<100 DM	<100 DM	<100 GT	10	11	150	140	200	<100 GT
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	0.0102	0.0162	0.0354	**2.04^{F}**	0.096	0.126	**0.241^{F}**	0.0077	0.0063	**1.07^{F}**	**1.21^{F}**	**1.72^{F}**	**0.466^{F}**
Calcium	mg/L	n/v	n/v	n/v	39.5	44.5	71.4	1190	228	244	401	58.5	50.9	2360	2820	3310	1060
Cesium	µg/L	n/v	n/v	n/v	0.158	0.243	0.386	21.3	0.78	0.82	1.3	0.16	0.161	6.97	6.88	9.18	2.02
Chromium	µg/L	50^{A}	64^{F}	50^{H}	3.82	7.02	10.6	**396^{AFH}**	25.9	35.7	46.2	1.47	2.64	**209^{AFH}**	**228^{AFH}**	**314^{AFH}**	**55.9^{AH}**
Cobalt	µg/L	n/v	5.2^{F}	n/v	0.97	1.5	2.08	**73.7^{F}**	**9.2^{F}**	**8.3^{F}**	**12.9^{F}**	0.35	0.59	**58.5^{F}**	**67.1^{F}**	**93^{F}**	**15.7^{F}**
Copper	µg/L	1000^{C}	6.9^{F}	$\leq 1000^{G}$	1.56	3.05	4.89	**320^{F}**	**26.1^{F}**	**22.6^{F}**	**36.5^{F}**	0.9	1.83	**160^{F}**	**173^{F}**	**261^{F}**	**39.9^{F}**
Iron	µg/L	300^{C}	n/v	$\leq 300^{G}$	**1340^{CG}**	**2230^{CG}**	**3140^{CG}**	**488000^{CG}**	**12900^{CG}**	**14100^{CG}**	**20700^{CG}**	**682^{CG}**	**930^{CG}**	**107000^{CG}**	**111000^{CG}**	**153000^{CG}**	**28300^{CG}**
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	0.676	1.08	1.65	**145^{AFH}**	**7.8^{F}**	**7.76^{F}**	**11.7^{AFH}**	0.094	0.23	**51.8^{AFH}**	**58^{AFH}**	**81.4^{AFH}**	**12.2^{AFH}**
Lithium	µg/L	n/v	n/v	n/v	3.5	4.1	5.5	89	11	11	20	2.2	<1	118	124	164	28
Magnesium	mg/L	n/v	n/v	n/v	17.7	20.2	27.1	369	59.7	73.0	94.0	11.9	12.0	577	617	834	132
Manganese	µg/L	50^{C}	n/v	$\leq 50^{G}$	**138^{CG}**	**168^{CG}**	**189^{CG}**	**6780^{CG}**	**429^{CG}**	**453^{CG}**	**746^{CG}**	**77.6^{CG}**	**85.2^{CG}**	**3560^{CG}**	**4250^{CG}**	**5220^{CG}**	**1250^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	<0.005	<0.005	<0.005	<0.005	0.0327	0.0146	0.0054	<0.005	<0.005	0.161	0.092	0.0788	0.192
Molybdenum	µg/L	n/v	730^{F}	n/v	2	2.29	2.34	18.4	3.75	3.23	3.12	0.541	0.935	0.96	1.35	1.62	0.93
Nickel	µg/L	n/v	39^{F}	n/v	2	3.32	4.72	**230^{F}**	14.7	17.2	23.4	0.75	1.45	**162^{F}**	**177^{F}**	**242^{F}**	**42.3^{F}**
Phosphorus	µg/L	n/v	n/v	n/v	78	98	234	7600	680	610	1030	<50	<50	7770	8150	11600	1630
Potassium	mg/L	n/v	n/v	n/v	3.40	3.52	3.78	61.1	6.56	6.55	8.28	1.85	2.03	14.0	14.4	19.4	6.89
Rubidium	µg/L	n/v	n/v	n/v	3.8	4.36	5.72	177	18.2	17.6	26.8	3.85	4.21	111	123	159	36.1
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.05	<0.05	<0.05	1	<0.5 DM	<0.5 DM	<0.5 GT	<0.05	<0.05	<0.5 GT	<0.5 DM	0.86	<0.5 GT
Silicon	µg/L	n/v	n/v	n/v	7620	9100	10900	135000	25100	27700	37600	8150	7870	110000	104000	140000	44900
Silver	µg/L	n/v	0.12^{F}	n/v	**0.138^{F}**	**0.375^{F}**	**0.388^{F}**	**1.53^{F}**	**0.15^{F}**	<0.1 DM	**0.14^{F}**	0.029	0.11	**0.51^{F}**	**0.54^{F}**	**0.68^{F}**	**0.14^{F}**
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	$\leq 200^{G}$	**45.4^{E}**	**46.2^{E}**	**47.3^{E}**	7.6	13.3	13.8	15.6	3.22	3.60	7.18	6.40	9.20	4.71
Strontium	µg/L	n/v	n/v	n/v	194	191	221	3770	350	332	476	178	154	1400	1660	1980	692
Sulfur	µg/L	n/v	n/v	n/v	<500	<500	<500	624000	<5000 DM	<5000 DM	<5000 GT	4620	4330	<5000 GT	<5000 DM	<5000 DM	<5000 GT
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<4	<2 DM	<2 DM	<2 GT	<0.2	<0.2	<2 GT	<2 DM	<2 DM	<2 GT
Thallium	µg/L	n/v	40^{F}	n/v	0.012	0.022	0.043	2.31	0.18	0.19	0.27	<0.01	0.011	1.13	1.25	1.65	0.33
Thorium	µg/L	n/v	n/v	n/v	0.33	0.6	1.13	26.3	8.7	9.7	12.6	0.11	0.32	37.6	45.3	62.3	10.5
Tin	µg/L	n/v	n/v	n/v	0.19	0.22	0.25	3.8	<1 DM	<1 DM	1.1	<0.1	0.11	<1 GT	1	<1 DM	<1 GT
Titanium	µg/L	n/v	n/v	n/v	61.9	102	208	4370	762	766	1170	28.7	47.1	3730	4300	4480	1880
Tungsten	µg/L	n/v	n/v	n/v	4.83	5.43	5.36	47.7	<1 DM	<1 DM	<1 GT	0.67	1.25	<1 GT	<1 DM	<1 DM	<1 GT
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.3	0.356	0.5	3.75	3.77	3.85	4.23	0.352	0.781	7.21	8.23	11.1	2.97
Vanadium	µg/L	n/v	20^{F}	n/v	2.44	3.91	6.56	**219^{F}**	**22^{F}**	**25.2^{F}**	**36.6^{F}**	1.14	1.95	**186^{F}**	**201^{F}**	**266^{F}**	**56.1^{F}**
Zinc	µg/L	5000^{C}	89^{F}	$\leq 5000^{G}$	6.7	6.2	8.3	**585^{F}**	35	40	57	3	<3	**288^{F}**	**304^{F}**	**472^{F}**	**108^{F}**
Zirconium	µg/L	n/v	n/v	n/v	2.25	2.68	8.07	20.2	34.6	3.3	4.1	0.68	0.5	3.5	8.6	6.4	10

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater															
Sample Location					MW16-BR-14			MW16-OB-14			MW17-OB-14					MW1-BR-14				
Sample Date					15-Jun-16	9-Aug-16	12-Oct-16	15-Jun-16	9-Aug-16	12-Oct-16	18-Jun-16	2-Aug-16	2-Aug-16	12-Oct-16	12-Oct-16	16-Jun-16	3-Aug-16	3-Aug-16	13-Oct-16	13-Oct-16
Sample ID					MW16-BR-14	MW16-BR-14	MW16-BR-14	MW16-OB-14	MW16-OB-14	MW16-OB-14	MW17-OB-14	MW17-OB-14	DUP 2	MW17-OB-14	DUPLICATE 1	MW1-BR-14	MW1-BR-14	DUPLICATE 1	MW1-BR-14	DUPLICATE 3
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1811325	L1843856	L1784595	L1811325	L1843856	L1786341	L1807778	L1807778	L1843856	L1843856	L1785355	L1808958	L1808958	L1843864	L1843864
Laboratory Sample ID					L1784595-13	L1811325-2	L1843856-12	L1784595-12	L1811325-1	L1843856-9	L1786341-13	L1807778-5	L1807778-6	L1843856-5	L1843856-6	L1785355-6	L1808958-6	L1808958-7	L1843864-1	L1843864-9
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**									Field Duplicate		Field Duplicate			Field Duplicate		Field Duplicate
Field Parameters																				
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	5.43	0.95	1.5	0.41	1.14	5	0.25	1.27	-	0.85	-	0.24	0.57	-	0.87	-
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	433	380	446	324	343	405	3466	3520	-	3739	-	1287	1147	-	1291	-
pH, Field	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	7.26	7.17	7.33	7.12	7.06	7.23	**6.89[G]**	**6.98[G]**	-	7.17	-	7.1	7.04	-	7.11	-
Temperature, Field	deg C	15[C]	n/v	≤15[G]	4.21	5.13	4.32	3.84	7.26	8.11	3.64	8.97	-	6.24	-	5.63	5.99	-	5.85	-
General Chemistry																				
Acidity as CaCO3	mg/L	n/v	n/v	n/v	11.1	3.3	14.6	16.1	10.5	20.6	30.9	48.5	49.0	44.2	47.9	20.7	29.8	35.1	22.2	20.5
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	259	256	267	244	257	261	414	418	399	404	404	309	-	-	318	321
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	-	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	-	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500[D]	n/v	n/v	259	256	267	244	257	261	414	418	399	404	404	309	303	303	318	321
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.134	0.064	0.031	0.230	0.281	0.396	0.142	0.21	0.20	0.062	0.062	<0.020	0.044	0.066	<0.020	<0.020
Anion Sum	meq/L	n/v	n/v	n/v	5.33	5.27	5.47	4.90	5.16	5.23	32.8	37.6	41.4	37.6	34.4	14.4	15.0	15.0	15.8	15.8
Cation Sum	meq/L	n/v	n/v	n/v	5.06	5.21	5.28	5.04	4.93	5.15	39.5	40.1	40.0	38.8	40.8	14.8	15.4	15.2	15.3	15.0
Chloride	mg/L	250[C]	180[F]	≤250[G]	0.71	0.39	0.40	0.66	0.25	0.28	**851[CFG]**	**1020[CFG]**	**1160[CFG]**	**1030[CFG]**	**918[CFG]**	82.3	86.4	87.2	87.7	88.8
Color, True	TCU	5[C]	n/v	n/v	<2.0	3.2	<2.0	**19.8[C]**	**26.6[C]**	**24.5[C]**	**6.8[C]**	**9.9[C]**	**9.5[C]**	5.0	4.1	<2.0	<2.0	<2.0	<2.0	<2.0
Cyanide	mg/L	n/v	0.0052[F]	0.2[H]	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0021	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2[A]	n/v	0.2[H]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5[C]	n/v	n/v	4.3	3.0	4.1	**8.1[C]**	**9.0[C]**	**9.3[C]**	**6.3[C]**	**6.4[C]**	**6.0[C]**	**5.5[C]**	**5.6[C]**	1.7	1.4	1.3	2.5	1.4
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	449	478	452	425	449	422	3340	4020	4020	3640	3350	1270	1300	1310	1310	1300
Fluoride	mg/L	1.5_{b}[A]	n/v	1.5[H]	0.127	0.109	0.116	0.076	0.058	0.063	0.038	<0.10 DM	<0.20 DM	<0.20 GT	<0.20 DM	0.039	<0.040 GT	<0.040 GT	<0.10 DM	<0.10 DM
Hardness (as CaCO3)	mg/L	80-100[D]	n/v	n/v	**241[D]**	**249[D]**	**249[D]**	**241[D]**	**237[D]**	**244[D]**	**431[D]**	**421[D]**	**413[D]**	**556[D]**	**563[D]**	**655[D]**	**687[D]**	**680[D]**	**685[D]**	**673[D]**
Ion Balance	%	n/v	n/v	n/v	<0.000	<0.000	<0.000	1.4	<0.000	<0.000	9.3	3.2	<0.000	1.6	8.5	1.3	1.2	0.5	<0.000	<0.000
Nitrate (as N)	mg/L	10.0_{d}[A]	n/v	10[H]	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.052	<0.10 DM	<0.20 DM	<0.10 GT	<0.20 DM	<0.020	<0.040 GT	<0.040 GT	<0.10 DM	<0.10 DM
Nitrite (as N)	mg/L	1.0_{d}[A]	n/v	1[H]	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.050 DM	<0.10 DM	<0.10	<0.10	<0.010	<0.020 GT	<0.020 GT	<0.050 DM	<0.050 DM
pH	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	7.80	7.73	7.68	7.59	7.53	7.51	7.29	7.17	7.17	7.30	7.26	7.54	7.41	7.38	7.63	7.69
Phosphorus, Total	mg/L	n/v	n/v	n/v	3.18	0.097	0.102	7.45	8.27	14.6	2.28	1.48	1.26	1.25	1.31	0.025	0.182	0.182	0.0086	0.0146
Phosphorus, Total	mg/L	n/v	n/v	n/v	<0.0030	0.0039	0.0063	0.0034	0.0143	0.0209	<0.0030	<0.0060 DM	<0.0030	<0.0030	0.0043	<0.0030	<0.0030	<0.0030	0.0055	0.0035
Sulfate	mg/L	500_{h}[C]	n/v	$≤500_{j}$[G]	5.91	6.30	5.47	0.66	1.13	0.53	23.1	24.4	25.7	23.8	19.7	284	315	314	337	330
Total Dissolved Solids	mg/L	500[C]	n/v	≤500[G]	287	247	268	264	262	277	**1940[CG]**	**2280[CG]**	**2180[CG]**	**2150[CG]**	**2030[CG]**	**919[CG]**	**896[CG]**	**893[CG]**	**933[CG]**	**924[CG]**
Total Organic Carbon	mg/L	n/v	n/v	n/v	11.3	3.6	4.7	97.5	37.7	NR	13.5	10.3	11.3	10.9	9.7	1.1	1.4	1.5	1.9	<1.0 XH
Total Suspended Solids	mg/L	n/v	n/v	n/v	6540	112	96.3	10700	16300	13700	6030	3000	3720	3990	3600	49.5	185	199	7.8	9.0

See notes on last page

Table 1
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Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Sample Location					MW16-BR-14			MW16-OB-14			MW17-OB-14					MW1-BR-14				
Sample Date					15-Jun-16	9-Aug-16	12-Oct-16	15-Jun-16	9-Aug-16	12-Oct-16	18-Jun-16	2-Aug-16	2-Aug-16	12-Oct-16	12-Oct-16	16-Jun-16	3-Aug-16	3-Aug-16	13-Oct-16	13-Oct-16
Sample ID					MW16-BR-14	MW16-BR-14	MW16-BR-14	MW16-OB-14	MW16-OB-14	MW16-OB-14	MW17-OB-14	MW17-OB-14	DUP 2	MW17-OB-14	DUPLICATE 1	MW1-BR-14	MW1-BR-14	DUPLICATE 1	MW1-BR-14	DUPLICATE 3
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1811325	L1843856	L1784595	L1811325	L1843856	L1786341	L1807778	L1807778	L1843856	L1843856	L1785355	L1808958	L1808958	L1843864	L1843864
Laboratory Sample ID					L1784595-13	L1811325-2	L1843856-12	L1784595-12	L1811325-1	L1843856-9	L1786341-13	L1807778-5	L1807778-6	L1843856-5	L1843856-6	L1785355-6	L1808958-6	L1808958-7	L1843864-1	L1843864-9
Sample Type	Units	ODWS	MOE APV	Health Canada									Field Duplicate		Field Duplicate			Field Duplicate		Field Duplicate
Metals, Dissolved																				
Aluminum	µg/L	100^{D}	n/v	$<100/200_{a}^{G}$	15.4	4.8	56.6	12	16.3	**403^{DG}**	<20 GT	9	7.7	**248^{DG}**	**251^{DG}**	<2	9.7	<2	2.4	<2
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<0.1	<0.1	<0.1	<0.1	<0.1	0.11	<1 GT	0.14	0.12	0.13	0.15	0.18	0.24	0.19	0.17	0.17
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	1.06	0.7	0.75	0.68	0.74	1.14	<1 GT	0.54	0.56	0.59	0.57	1.9	1.94	1.69	1.35	1.51
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	34.2	28.4	29.7	36.4	33.3	39.1	54.9	64.8	63.2	75.1	75.9	41.2	47.2	46.6	45.9	47
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 GT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<10	<10	<10	<10	<10	<10	<100 GT	<10	<10	<50	<10	138	127	127	137	125
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	<0.005	<0.005	<0.005	<0.005	<0.005	0.0229	<0.05 GT	0.0439	0.046	0.0557	0.0616	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/L	n/v	n/v	n/v	74.0	73.5	73.0	74.1	73.0	75.2	143	135	131	176	180	195	200	200	205	200
Cesium	µg/L	n/v	n/v	n/v	0.013	<0.01	0.014	0.01	0.013	0.054	<0.1 GT	0.028	0.039	0.044	0.043	0.14	0.158	0.156	0.134	0.127
Chromium	µg/L	50^{A}	64^{F}	50^{H}	<0.1	<0.1	<0.1	0.26	0.4	0.92	<1 GT	0.25	0.17	0.48	0.45	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	µg/L	n/v	5.2^{F}	n/v	0.89	0.37	0.75	1.43	1.29	1.71	2.3	1.76	1.75	1.89	2.34	0.82	1.1	0.84	0.82	0.81
Copper	µg/L	1000^{C}	6.9^{F}	$\leq1000^{G}$	<0.2	0.34	<0.2	0.32	0.69	5.33	2.5	2.94	2.86	2.32	2.19	<0.2	0.26	<0.2	<0.2	<0.2
Iron	µg/L	300^{C}	n/v	$\leq300^{G}$	**353^{CG}**	**665^{CG}**	**623^{CG}**	**439^{CG}**	**745^{CG}**	**1210^{CG}**	<100 GT	<10	<10	191	186	**337^{CG}**	**324^{CG}**	**310^{CG}**	**308^{CG}**	**307^{CG}**
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	<0.05	<0.05	<0.05	<0.05	<0.05	**2.5^{F}**	0.65	<0.05	<0.05	0.116	0.126	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	n/v	n/v	n/v	1.5	2.5	2.2	<1	<1	<1	<10 GT	2	2	3.1	3.3	3.8	3.5	3.4	4	3.5
Magnesium	mg/L	n/v	n/v	n/v	13.8	15.8	16.3	13.6	13.3	13.6	17.7	20.4	20.7	28.6	27.7	40.9	45.7	43.9	42.3	42.2
Manganese	µg/L	50^{C}	n/v	$\leq50^{G}$	**76.2^{CG}**	**69.9^{CG}**	**84.6^{CG}**	**258^{CG}**	**280^{CG}**	**246^{CG}**	**1140^{CG}**	**1090^{CG}**	**1110^{CG}**	**1020^{CG}**	**1030^{CG}**	**236^{CG}**	**254^{CG}**	**245^{CG}**	**243^{CG}**	**244^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0149	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	0.802	0.502	0.391	0.82	0.903	0.554	0.78	0.74	0.686	0.494	0.443	0.762	0.819	0.829	0.803	0.794
Nickel	µg/L	n/v	39^{F}	n/v	2.3	0.79	0.85	<0.5	<0.5	1.17	<5 GT	4.08	4.1	3.43	3.61	1.43	1.7	1.56	1.63	1.68
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<500 GT	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	1.76	1.67	1.74	0.723	0.738	0.771	0.92	1.22	1.24	1.09	1.20	2.17	2.31	2.24	2.15	2.20
Rubidium	µg/L	n/v	n/v	n/v	3.22	2.68	2.98	2.61	2.3	2.99	<2 GT	2.16	2.1	2.54	2.67	9.04	9.61	9.24	9.17	9.4
Selenium	µg/L	10^{A}	5^{F}	50^{H}	0.237	<0.05	0.096	<0.05	<0.05	0.063	<0.5 GT	0.103	0.072	0.067	0.058	1.61	<0.05	<0.05	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	5550	5890	6320	4840	4790	6230	3680	4520	4380	6130	6100	4990	5150	5070	5260	5370
Silver	µg/L	n/v	0.12^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	<0.1 GT	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	$\leq200^{G}$	3.81	3.72	4.65	4.02	2.84	2.59	**708^{CEFG}**	**726^{CEFG}**	**727^{CEFG}**	**635^{CEFG}**	**676^{CEFG}**	**37.2^{E}**	**36.4^{E}**	**35.1^{E}**	**34.2^{E}**	**34.9^{E}**
Strontium	µg/L	n/v	n/v	n/v	104	97.1	99.2	72.4	71	72.6	271	223	217	292	291	244	250	263	244	240
Sulfur	µg/L	n/v	n/v	n/v	1850	1810	1810	<500	<500	<500	10400	13200	13200	10600	10800	115000	114000	112000	118000	119000
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2 GT	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	0.015	<0.1 GT	0.031	0.031	0.034	0.034	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	0.13	0.29	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	0.84	<0.3	2.24	0.96	1.41	23	<3 GT	0.33	0.34	10.2	11.7	<0.3	<0.3	<0.3	<0.3	<0.3
Tungsten	µg/L	n/v	n/v	n/v	20.4	17.5	11.5	<0.1	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1	<0.1	0.86	0.79	0.79	0.78	0.75
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.463	0.269	0.295	0.76	0.707	0.561	0.62	0.574	0.579	0.498	0.474	3.09	3.32	3.32	3.37	3.27
Vanadium	µg/L	n/v	20^{F}	n/v	<0.5	<0.5	<0.5	1.77	2.52	3.42	<5 GT	<0.5	<0.5	0.73	0.85	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	5000^{C}	89^{F}	$\leq5000^{G}$	<1	2.9	1	1.4	4.2	2.4	<10 GT	1.9	<1	1	1.1	<1	1.4	<1	<1	<1
Zirconium	µg/L	n/v	n/v	n/v	<0.3	0.3	0.43	1.21	1.35	2.33	<3 GT	0.72	0.67	0.93	0.92	0.42	0.47	0.45	0.36	0.33

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Sample Location					Groundwater															
					MW16-BR-14			MW16-OB-14			MW17-OB-14					MW1-BR-14				
Sample Date					15-Jun-16	9-Aug-16	12-Oct-16	15-Jun-16	9-Aug-16	12-Oct-16	18-Jun-16	2-Aug-16	2-Aug-16	12-Oct-16	12-Oct-16	16-Jun-16	3-Aug-16	3-Aug-16	13-Oct-16	13-Oct-16
Sample ID					MW16-BR-14	MW16-BR-14	MW16-BR-14	MW16-OB-14	MW16-OB-14	MW16-OB-14	MW17-OB-14	MW17-OB-14	DUP 2	MW17-OB-14	DUPLICATE 1	MW1-BR-14	MW1-BR-14	DUPLICATE 1	MW1-BR-14	DUPLICATE 3
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1811325	L1843856	L1784595	L1811325	L1843856	L1786341	L1807778	L1807778	L1843856	L1843856	L1785355	L1808958	L1808958	L1843864	L1843864
Laboratory Sample ID					L1784595-13	L1811325-2	L1843856-12	L1784595-12	L1811325-1	L1843856-9	L1786341-13	L1807778-5	L1807778-6	L1843856-5	L1843856-6	L1785355-6	L1808958-6	L1808958-7	L1843864-1	L1843864-9
Sample Type	Units	ODWS	MOE APV	Health Canada									Field Duplicate		Field Duplicate			Field Duplicate		Field Duplicate
Metals, Total																				
Aluminum	µg/L	100^{D}	n/v	<100/200_{a}^{G}	29700^{DG}	576^{DG}	540^{DG}	25600^{DG}	48800^{DG}	65400^{DG}	69300^{DG}	26700^{DG}	25400^{DG}	36000^{DG}	35500^{DG}	155^{DG}	919^{DG}	1050^{DG}	59	52
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<1 DM	<0.1	<0.1	<1 DM	<1 DM	<1 DM	1.2	<1 DM	<1 DM	0.74	0.73	0.36	<1 DM	1.1	0.22	0.2
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	17.6^{H}	1.02	0.95	12.3^{H}	18.6^{H}	30.2^{BH}	80.9^{BH}	29^{BH}	27.3^{BH}	33.6^{BH}	32.8^{BH}	2.06	3.1	3	1.47	2.23
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	239	30.6	31.4	242	370	506	427	256	243	270	265	73.1	167	184	50	51
Beryllium	µg/L	n/v	5.3^{F}	n/v	1.1	<0.1	<0.1	1.1	1.9	2.5	2.8	<1 DM	<1 DM	1.16	1.1	<0.1	<1 DM	<1 DM	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.5 DM	<0.05	<0.05	<0.5 DM	0.86	1.22	1.03	<0.5 DM	<0.5 DM	0.37	0.35	<0.05	<0.5 DM	<0.5 DM	<0.05	<0.05
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<100 DM	10	<10	<100 DM	130	190	110	<100 DM	<100 DM	50	<50 DM	128	150	150	135	141
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	0.362^{F}	0.0081	0.0064	0.525^{F}	0.88^{F}	1.26^{F}	1.23^{F}	0.37^{F}	0.351^{F}	0.505^{F}	0.48^{F}	0.0083	<0.05 DM	<0.05 DM	<0.005	<0.005
Calcium	mg/L	n/v	n/v	n/v	903	86.2	82.0	968	1810	3240	1540	496	464	767	689	212	199	204	196	200
Cesium	µg/L	n/v	n/v	n/v	2.57	0.054	0.049	1.84	4.24	5.42	6.48	2.63	2.44	3.01	2.96	0.186	0.38	0.4	0.146	0.141
Chromium	µg/L	50^{A}	64^{F}	50^{H}	91.8^{AFH}	1.96	1.52	66.5^{AFH}	153^{AFH}	210^{AFH}	220^{AFH}	86.3^{AFH}	79.8^{AFH}	104^{AFH}	102^{AFH}	0.74	4	1.8	0.4	0.37
Cobalt	µg/L	n/v	5.2^{F}	n/v	23.3^{F}	0.82	0.79	24.5^{F}	50^{F}	74.8^{F}	75.3^{F}	26.9^{F}	26^{F}	32^{F}	30.7^{F}	1.02	1.8	1.8	0.89	0.91
Copper	µg/L	1000^{C}	6.9^{F}	≤1000^{G}	127^{F}	1.82	2.53	67.4^{F}	185^{F}	280^{F}	234^{F}	81.1^{F}	77.1^{F}	97.1^{F}	93.9^{F}	1.28	6.8	8.1^{F}	<0.5	0.51
Iron	µg/L	300^{C}	n/v	≤300^{G}	43200^{CG}	1400^{CG}	1380^{CG}	37300^{CG}	78000^{CG}	104000^{CG}	111000^{CG}	38700^{CG}	37400^{CG}	50400^{CG}	49100^{CG}	3150^{CG}	13400^{CG}	14900^{CG}	838^{CG}	780^{CG}
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	21.5^{AFH}	0.416	0.366	25^{AFH}	60.3^{AFH}	93.4^{AFH}	57.9^{AFH}	20.2^{AFH}	18.1^{AFH}	26.3^{AFH}	25.2^{AFH}	0.264	1.65	1.95	0.093	0.104
Lithium	µg/L	n/v	n/v	n/v	40	2.1	2.4	38	68	94	104	35	35	45.7	43.4	4.2	<10 DM	<10 DM	3.7	3.9
Magnesium	mg/L	n/v	n/v	n/v	242	19.1	17.8	225	537	905	313	101	98.1	138	146	45.4	48.6	50.8	44.3	42.2
Manganese	µg/L	50^{C}	n/v	≤50^{G}	1540^{CG}	93.6^{CG}	104^{CG}	1780^{CG}	3380^{CG}	5330^{CG}	4490^{CG}	2100^{CG}	2020^{CG}	2340^{CG}	2170^{CG}	275^{CG}	300^{CG}	324^{CG}	250^{CG}	254^{CG}
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	0.025	<0.005	<0.005	0.033	0.0441	0.0419	0.109	0.0661	0.0195	0.0664	0.0406	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	2.55	-	0.47	1.28	3.77	1.84	2.13	1.47	1.28	1.23	1.19	1.02	3.84	1.03	0.986	0.963
Nickel	µg/L	n/v	39^{F}	n/v	75.2^{F}	1.82	1.78	46.3^{F}	101^{F}	148^{F}	201^{F}	74.8^{F}	69.6^{F}	85.7^{F}	83.8^{F}	2	<5 DM	<5 DM	2.11	2.16
Phosphorus	µg/L	n/v	n/v	n/v	3490	68	66	5170	6360	13400	4330	1340	1200	1770	1880	<50	<500 DM	<500 DM	<50	<50
Potassium	mg/L	n/v	n/v	n/v	8.45	1.80	1.71	5.02	8.20	10.0	8.93	5.91	5.69	6.42	6.30	2.45	2.38	2.47	2.17	2.22
Rubidium	µg/L	n/v	n/v	n/v	36.4	3.43	3.29	26.6	58	80	75.3	32.5	31.5	39.1	38.6	10	10.9	10.4	9.26	9.32
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.5 DM	<0.05	<0.05	<0.5 DM	<0.5 DM	0.91	0.64	<0.5 DM	<0.5 DM	<0.25 DM	<0.25 DM	<0.05	<0.5 DM	<0.5 DM	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	51900	6860	6880	44100	71700	88700	89400	49700	47200	61500	62700	5770	6910	7180	5400	5470
Silver	µg/L	n/v	0.12^{F}	n/v	22.2^{F}	0.292^{F}	0.781^{F}	0.25^{F}	0.44^{F}	0.68^{F}	0.55^{F}	0.21^{F}	0.19^{F}	0.244^{F}	0.235^{F}	0.373^{F}	2.15^{F}	2.63^{F}	0.067	0.076
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	≤200^{G}	8.12	4.33	4.54	6.33	6.82	7.23	663^{CEFG}	732^{CEFG}	735^{CEFG}	615^{CEFG}	617^{CEFG}	38.3^{E}	36.1^{E}	39.2^{E}	34.4^{E}	35.1^{E}
Strontium	µg/L	n/v	n/v	n/v	625	110	95.7	628	1070	1640	1100	481	447	627	585	273	261	272	243	246
Sulfur	µg/L	n/v	n/v	n/v	<5000 DM	1890	2190	<5000 DM	<5000 DM	6600	9900	10200	8700	10400	9600	119000	104000	107000	124000	125000
Tellurium	µg/L	n/v	n/v	n/v	<2 DM	<0.2	<0.2	<2 DM	<2 DM	<2 DM	<2 DM	<2 DM	<2 DM	<1 DM	<1 DM	<0.2	<2 DM	<2 DM	<0.2	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	0.47	<0.01	<0.01	0.45	1.2	1.81	1.17	0.41	0.36	0.505	0.49	<0.01	<0.1 DM	<0.1 DM	<0.01	<0.01
Thorium	µg/L	n/v	n/v	n/v	14	0.28	0.28	15.9	31.3	39.7	34.4	13.5	12.1	17.5	16.7	0.14	1	1.2	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	2	0.29	0.38	2.3	1.1	<1 DM	1.9	1	1	1.12	1.15	0.2	<1 DM	<1 DM	0.15	0.13
Titanium	µg/L	n/v	n/v	n/v	2730	52	44.7	2880	3610	2820	4040	1970	1870	2520	2550	6.74	33.7	40.7	2.44	1.93
Tungsten	µg/L	n/v	n/v	n/v	273	25.9	18.5	<1 DM	<1 DM	<1 DM	<1 DM	<1 DM	<1 DM	<0.5 DM	<0.5 DM	2.52	9.8	7.9	1.1	1.29
Uranium	µg/L	20^{A}	33^{F}	20^{H}	5.4	0.392	0.343	4.92	7.9	11.6	4.36	2.04	1.86	2.42	2.35	3.41	3.52	3.48	3.49	3.49
Vanadium	µg/L	n/v	20^{F}	n/v	82.9^{F}	1.57	1.42	84.6^{F}	154^{F}	192^{F}	179^{F}	67^{F}	63^{F}	84.9^{F}	84.7^{F}	<0.5	<5 DM	<5 DM	<0.5	<0.5
Zinc	µg/L	5000^{C}	89^{F}	≤5000^{G}	143^{F}	4.2	3.4	77	158^{F}	223^{F}	266^{F}	109^{F}	102^{F}	113^{F}	108^{F}	<3	<30 DM	<30 DM	<3	<3
Zirconium	µg/L	n/v	n/v	n/v	15.1	0.86	0.75	12.2	12	6.9	23.1	16.8	12.4	21.1	18.6	0.7	<3 DM	<3 DM	0.45	0.44

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater															
Sample Location					**MW1-OB-14**				**MW2-OB-13**		**MW3-BR-13**				**MW3-OB-13**			**MW4-OB-13**		
Sample Date					**16-Jun-16**	**16-Jun-16**	**3-Aug-16**	**13-Oct-16**	**8-Aug-16**	**17-Oct-16**	**16-Jun-16**	**16-Oct-16**	**5-Aug-16**	**16-Oct-16**	**20-Jun-16**	**6-Aug-16**	**16-Oct-16**	**16-Jun-16**	**5-Aug-16**	**15-Oct-16**
Sample ID					**MW1-OB-14**	**DUP 2**	**MW1-OB-14**	**MW1-OB-14**	**MW2-OB-13**	**MW2-OB-13**	**MW3-BR-13**	**DUPLICATE 6**	**MW3-BR-13**	**MW3-BR-13**	**MW3-OB-13**	**MW3-OB-13**	**MW3-OB-13**	**MW4-OB-13**	**MW4-OB-13**	**MW4-OB-13**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1785355**	**L1785355**	**L1808958**	**L1843864**	**L1810700**	**L1846519**	**L1785355**	**L1844384**	**L1810001**	**L1844384**	**L1786744**	**L1810001**	**L1844384**	**L1785355**	**L1810001**	**L1844417**
Laboratory Sample ID					**L1785355-7**	**L1785355-8**	**L1808958-3**	**L1843864-2**	**L1810700-1**	**L1846519-8**	**L1785355-5**	**L1844384-12**	**L1810001-6**	**L1844384-5**	**L1786744-7**	**L1810001-12**	**L1844384-10**	**L1785355-4**	**L1810001-7**	**L1844417-8**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**		**Field Duplicate**						**Field Duplicate**								
Field Parameters																				
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	1	-	1.02	2.8	6.53	2.85	0.22	-	0.35	0.95	4.63	5.62	2.29	3.83	1.87	1.73
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	1001	-	825	992	395	489	460	-	674	883	490	662	794	420	616	724
pH, Field	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	**6.76^{G}**	-	**6.64^{G}**	**6.81^{G}**	7.35	7.67	**6.66^{G}**	-	**6.96^{G}**	7.13	7.06	7.06	7.36	**6.3^{DG}**	**6.68^{G}**	**6.02^{DG}**
Temperature, Field	deg C	15^{C}	n/v	≤15^{G}	6.57	-	9.41	10.05	11.9	5.93	4.68	-	6.09	3.1	6.36	5.87	4.36	5.22	6.51	5.6
General Chemistry																				
Acidity as CaCO3	mg/L	n/v	n/v	n/v	33.2	39.7	65.2	46.5	7.5	9.1	27.9	30.0	26.8	33.6	28.5	19.1	30.6	64.1	56.5	79.1
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	391	385	-	420	255	277	315	331	317	336	435	429	449	394	422	425
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500^{D}	n/v	n/v	391	385	372	420	255	277	315	331	317	336	435	429	449	394	422	425
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.293	0.298	<0.20 DM	0.059	0.27	0.310	0.512	0.544	0.545	0.546	0.487	0.38	0.422	2.51	2.44	2.70
Anion Sum	meq/L	n/v	n/v	n/v	10.7	10.4	10.1	11.5	5.52	6.01	8.61	10.0	8.40	9.63	9.32	9.26	9.73	7.94	8.46	8.54
Cation Sum	meq/L	n/v	n/v	n/v	11.9	11.7	11.1	11.5	5.38	5.45	8.90	9.94	9.38	9.99	8.84	7.66	9.36	8.18	9.03	9.07
Chloride	mg/L	250^{C}	180^{F}	≤250^{G}	100	94.7	95.7	110	11.5	10.9	10.5	15.0	9.32	12.7	3.87	3.84	3.97	0.39	0.10	<0.10
Color, True	TCU	5^{C}	n/v	n/v	4.5	4.9	**5.3^{C}**	**9.9^{C}**	**9.6^{C}**	**9.7^{C}**	**7.9^{C}**	**11.9^{C}**	**7.8^{C}**	**10.5^{C}**	2.8	2.7	**11.9^{C}**	**25.7^{C}**	**20.8^{C}**	**22.2^{C}**
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	**6.2^{C}**	**6.1^{C}**	**6.9^{C}**	**8.0^{C}**	3.9	**5.1^{C}**	**6.6^{C}**	**5.1^{C}**	**5.6^{C}**	**6.1^{C}**	4.8	**5.2^{C}**	**5.9^{C}**	**16.8^{C}**	**14.3^{C}**	**16.3^{C}**
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	952	946	960	1000	504	496	757	850	804	844	755	804	774	681	739	694
Fluoride	mg/L	1.5_{b}^{A}	n/v	1.5^{H}	0.080	0.078	0.075	0.061	0.075	0.069	0.228	0.165	0.159	0.156	0.298	0.279	0.264	0.145	0.153	0.120
Hardness (as CaCO3)	mg/L	80-100^{D}	n/v	n/v	**441^{D}**	**430^{D}**	**422^{D}**	**412^{D}**	**253^{D}**	**255^{D}**	**405^{D}**	**454^{D}**	**427^{D}**	**456^{D}**	**409^{D}**	**364^{D}**	**436^{D}**	**364^{D}**	**399^{D}**	**397^{D}**
Ion Balance	%	n/v	n/v	n/v	5.5	6.0	4.7	0.2	<0.000	<0.000	1.6	<0.000	5.5	1.9	<0.000	<0.000	<0.000	1.5	3.2	3.0
Nitrate (as N)	mg/L	10.0_{d}^{A}	n/v	10^{H}	<0.020	<0.020	<0.020	<0.040 DM	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.025	0.022	0.047	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	1.0_{d}^{A}	n/v	1^{H}	<0.010	<0.010	<0.010	<0.020 DM	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.28	7.23	7.06	7.29	7.69	7.91	7.33	7.42	7.29	7.35	7.50	7.54	7.52	7.05	7.03	7.03
Phosphorus, Total	mg/L	n/v	n/v	n/v	4.71	3.20	1.36	0.252	0.474	0.135	0.041	0.063	0.084	0.067	2.92	1.97	1.51	0.700	1.71	7.52
Phosphorus, Total	mg/L	n/v	n/v	n/v	<0.0030	0.0045	0.0046	0.0172	0.0038	0.0075	0.0348	0.0438	0.0445	0.0448	<0.0030	<0.0030	0.0124	0.203	0.178	0.150
Sulfate	mg/L	500_{h}^{C}	n/v	$≤500_{j}^{G}$	2.11	0.58	0.57	<0.60 DM	4.67	7.54	96.9	142	85.8	122	24.5	26.7	30.4	2.08	1.29	1.32
Total Dissolved Solids	mg/L	500^{C}	n/v	≤500^{G}	**1030^{CG}**	**1180^{CG}**	**552^{CG}**	**588^{CG}**	300	298	**503^{CG}**	**572^{CG}**	**513^{CG}**	**571^{CG}**	**910^{CG}**	462	465	**583^{CG}**	463	497
Total Organic Carbon	mg/L	n/v	n/v	n/v	15.7	10.9	13.1	7.8	18.5	15.6	6.6	5.0	6.4	6.2	13.3	13.7	12	98.8	20.1	18.1
Total Suspended Solids	mg/L	n/v	n/v	n/v	6840	15600	3260	1020	825	798	13.0	34.7	61.8	33.5	5400	9960	14400	1370	768	12400

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater															
Sample Location					MW1-OB-14				MW2-OB-13		MW3-BR-13				MW3-OB-13			MW4-OB-13		
Sample Date					16-Jun-16	16-Jun-16	3-Aug-16	13-Oct-16	8-Aug-16	17-Oct-16	16-Jun-16	16-Oct-16	5-Aug-16	16-Oct-16	20-Jun-16	6-Aug-16	16-Oct-16	16-Jun-16	5-Aug-16	15-Oct-16
Sample ID					MW1-OB-14	DUP 2	MW1-OB-14	MW1-OB-14	MW2-OB-13	MW2-OB-13	MW3-BR-13	DUPLICATE 6	MW3-BR-13	MW3-BR-13	MW3-OB-13	MW3-OB-13	MW3-OB-13	MW4-OB-13	MW4-OB-13	MW4-OB-13
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1785355	L1785355	L1808958	L1843864	L1810700	L1846519	L1785355	L1844384	L1810001	L1844384	L1786744	L1810001	L1844384	L1785355	L1810001	L1844417
Laboratory Sample ID					L1785355-7	L1785355-8	L1808958-3	L1843864-2	L1810700-1	L1846519-8	L1785355-5	L1844384-12	L1810001-6	L1844384-5	L1786744-7	L1810001-12	L1844384-10	L1785355-4	L1810001-7	L1844417-8
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**		Field Duplicate						Field Duplicate								
Metals, Dissolved																				
Aluminum	µg/L	100^{D}	n/v	$<100/200_{a}^{G}$	2.2	<2	2.7	17.5	4.9	5.5	2	2.6	2.6	<2	<2	<2	<2	6.9	5.8	<20 DM
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<0.1	<0.1	<0.1	<0.1	0.16	0.14	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 DM
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	**29.5^{BH}**	**29.1^{BH}**	**19.4^{H}**	**32.8^{BH}**	1.23	1.31	**43.5^{BH}**	**43.1^{BH}**	**40.3^{BH}**	**42.8^{BH}**	1.62	0.63	2.59	**67.1^{BH}**	**92.5^{BH}**	**69.8^{BH}**
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	31.8	31.8	32.7	33.7	23.5	22.4	269	304	295	301	98	57	98.7	43.8	53	71.7
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 DM
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 DM
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<10	<10	13	<10	<10	<10	25	21	21	21	33	36	39	15	16	<100 DM
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	0.0066	0.0056	0.0058	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05 DM
Calcium	mg/L	n/v	n/v	n/v	139	135	131	129	77.3	78.9	123	139	127	138	102	102	107	122	129	126
Cesium	µg/L	n/v	n/v	n/v	<0.01	<0.01	<0.01	<0.01	0.016	0.018	1.2	1.21	1.19	1.2	<0.01	<0.01	0.01	<0.01	<0.01	<0.1 DM
Chromium	µg/L	50^{A}	64^{F}	50^{H}	0.14	<0.1	<0.1	<0.1	<0.1	0.11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.17	0.25	<1 DM
Cobalt	µg/L	n/v	5.2^{F}	n/v	0.92	0.92	0.64	0.91	0.11	<0.1	0.23	0.24	0.25	0.23	0.38	0.22	0.32	0.71	0.77	<1 DM
Copper	µg/L	1000^{C}	6.9^{F}	$\leq 1000^{G}$	<0.2	<0.2	<0.2	<0.2	<0.2	0.37	<0.2	<0.2	0.44	<0.2	0.26	<0.2	0.23	<0.2	0.21	<2 DM
Iron	µg/L	300^{C}	n/v	$\leq 300^{G}$	**9020^{CG}**	**8900^{CG}**	**5640^{CG}**	**9470^{CG}**	**785^{CG}**	**780^{CG}**	**5530^{CG}**	**5880^{CG}**	**5660^{CG}**	**5840^{CG}**	**407^{CG}**	26	**470^{CG}**	**6730^{CG}**	**7290^{CG}**	**7560^{CG}**
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.208	<0.05	<0.05	<0.5 DM
Lithium	µg/L	n/v	n/v	n/v	2.9	2.9	4.6	3	1.3	1.2	8	7	7.7	7.4	8	8.8	9.7	8	7.2	<10 DM
Magnesium	mg/L	n/v	n/v	n/v	22.9	22.8	23.3	21.7	14.6	14.0	23.5	26.0	26.4	27.1	37.4	26.6	40.7	14.5	18.8	19.9
Manganese	µg/L	50^{C}	n/v	$\leq 50^{G}$	**517^{CG}**	**535^{CG}**	**544^{CG}**	**464^{CG}**	**83.9^{CG}**	**82.4^{CG}**	**411^{CG}**	**433^{CG}**	**422^{CG}**	**446^{CG}**	**81.5^{CG}**	**51.3^{CG}**	**81.3^{CG}**	**328^{CG}**	**350^{CG}**	**365^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0074	<0.005	<0.005	<0.005	0.0054	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	0.385	0.392	0.505	0.391	4.83	4.35	0.406	0.314	0.356	0.322	2.17	1.64	1.62	2.52	4.12	3.72
Nickel	µg/L	n/v	39^{F}	n/v	0.62	0.58	0.54	0.62	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	0.51	0.82	0.87	<5 DM
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	60	<50	56	63	<50	<50	<50	246	227	<500 DM
Potassium	mg/L	n/v	n/v	n/v	1.18	1.17	1.31	1.35	1.64	1.68	2.89	2.82	2.86	2.86	4.80	2.89	4.55	0.949	1.12	1.38
Rubidium	µg/L	n/v	n/v	n/v	1.03	1.06	1.05	1.41	6.46	6.84	1.9	1.91	1.95	1.96	1.96	1.13	1.81	0.78	0.77	<2 DM
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.05	0.055	<0.05	<0.05	<0.05	<0.05	1.09	0.472	<0.05	<0.05	<0.05	<0.05	0.052	0.348	0.062	<0.5 DM
Silicon	µg/L	n/v	n/v	n/v	8640	8830	10300	10100	7100	7550	8810	8750	9050	8860	9640	10300	10400	8740	10700	11100
Silver	µg/L	n/v	0.12^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 DM
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	$\leq 200^{G}$	**59.3^{E}**	**59.0^{E}**	**54.1^{E}**	**63.1^{E}**	4.97	5.68	9.87	9.95	9.69	10.2	11.1	6.61	11.1	11.6	10.2	11.5
Strontium	µg/L	n/v	n/v	n/v	168	173	158	162	77.2	79.4	395	426	414	428	580	539	546	182	211	213
Sulfur	µg/L	n/v	n/v	n/v	<500	<500	<500	<500	1050	1620	37900	53000	40100	52200	8610	10000	13200	790	<500	<5000 DM
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2 DM
Thallium	µg/L	n/v	40^{F}	n/v	<0.01	<0.01	0.011	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.11
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 DM
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 DM
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	0.85	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.54	0.5	<3 DM
Tungsten	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	0.16	0.16	1.87	1.75	1.93	1.77	0.11	<0.1	0.44	<0.1	<0.1	<1 DM
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.09	0.091	0.125	0.059	0.57	0.433	1.21	1.41	1.34	1.42	0.692	0.702	0.704	0.049	0.053	<0.1 DM
Vanadium	µg/L	n/v	20^{F}	n/v	0.54	0.53	<0.5	0.6	0.57	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.65	0.68	<5 DM
Zinc	µg/L	5000^{C}	89^{F}	$\leq 5000^{G}$	1	<1	<1	1.5	<1	2.4	3.3	<1	<1	1.5	1.2	<1	<1	3.6	2.1	<10 DM
Zirconium	µg/L	n/v	n/v	n/v	0.95	0.87	0.65	1	<0.3	<0.3	4	4.01	4.27	4.1	<0.3	<0.3	<0.3	0.88	0.92	<3 DM

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater															
Sample Location					MW1-OB-14				MW2-OB-13		MW3-BR-13				MW3-OB-13			MW4-OB-13		
Sample Date					16-Jun-16	16-Jun-16	3-Aug-16	13-Oct-16	8-Aug-16	17-Oct-16	16-Jun-16	16-Oct-16	5-Aug-16	16-Oct-16	20-Jun-16	6-Aug-16	16-Oct-16	16-Jun-16	5-Aug-16	15-Oct-16
Sample ID					MW1-OB-14	DUP 2	MW1-OB-14	MW1-OB-14	MW2-OB-13	MW2-OB-13	MW3-BR-13	DUPLICATE 6	MW3-BR-13	MW3-BR-13	MW3-OB-13	MW3-OB-13	MW3-OB-13	MW4-OB-13	MW4-OB-13	MW4-OB-13
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1785355	L1785355	L1808958	L1843864	L1810700	L1846519	L1785355	L1844384	L1810001	L1844384	L1786744	L1810001	L1844384	L1785355	L1810001	L1844417
Laboratory Sample ID					L1785355-7	L1785355-8	L1808958-3	L1843864-2	L1810700-1	L1846519-8	L1785355-5	L1844384-12	L1810001-6	L1844384-5	L1786744-7	L1810001-12	L1844384-10	L1785355-4	L1810001-7	L1844417-8
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**		Field Duplicate						Field Duplicate								
Metals, Total																				
Aluminum	µg/L	100^{D}	n/v	<100/200$_{a}^{G}$	**42500^{DG}**	**39900^{DG}**	**32800^{DG}**	**5030^{DG}**	**5310^{DG}**	**6060^{DG}**	96.2	**218^{DG}**	**537^{DG}**	**228^{DG}**	**37200^{DG}**	**24700^{DG}**	**41700^{DG}**	**9580^{DG}**	**27700^{DG}**	**93100^{DG}**
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<1 DM	<1 DM	<1 DM	0.14	<1 DM	0.82	<0.1	<0.1	0.28	<0.1	<1 DM	<1 DM	<1 GT	<1 DM	<1 DM	<1 GT
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	**51.9^{BH}**	**50.5^{BH}**	**34^{BH}**	**35.6^{BH}**	3.4	3.3	**37.1^{BH}**	**41.6^{BH}**	**41.1^{BH}**	**42^{BH}**	**34^{BH}**	**12.2^{H}**	**17.2^{H}**	**59^{BH}**	**93.9^{BH}**	**104^{BH}**
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	279	265	220	85.1	55.7	56.8	270	312	290	306	367	269	513	104	218	659
Beryllium	µg/L	n/v	5.3^{F}	n/v	1.5	1.4	1.1	0.19	<1 DM	0.18	<0.1	<0.1	<0.1	<0.1	1.4	1.8	1.6	<1 DM	<1 DM	4
Bismuth	µg/L	n/v	n/v	n/v	<0.5 DM	<0.5 DM	<0.5 DM	<0.05	<0.5 DM	0.054	<0.05	<0.05	<0.05	<0.05	<0.5 DM	<0.5 DM	<0.5 GT	<0.5 DM	<0.5 DM	0.76
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<100 DM	<100 DM	<100 DM	21	<100 DM	11	22	23	21	24	<100 DM	<100 DM	<100 GT	<100 DM	<100 DM	110
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	**0.469^{F}**	**0.456^{F}**	**0.32^{F}**	0.0473	0.086	0.0946	0.007	<0.005	0.04	<0.005	**0.377^{F}**	**0.313^{F}**	**0.592^{F}**	0.126	**0.217^{F}**	**0.856^{F}**
Calcium	mg/L	n/v	n/v	n/v	999	919	725	193	169	117	133	139	125	138	833	640	1400	254	510	1770
Cesium	µg/L	n/v	n/v	n/v	3.46	3.33	2.71	0.47	0.54	0.783	1.33	1.53	1.59	1.48	2.99	2.18	4.08	0.8	2.42	8.86
Chromium	µg/L	50^{A}	64^{F}	50^{H}	**104^{AFH}**	**96.3^{AFH}**	**68.9^{AFH}**	10.7	16.6	18.8	0.61	0.7	2.6	0.71	**103^{AFH}**	**64.6^{AFH}**	**117^{AFH}**	21.8	**67.5^{AFH}**	**241^{AFH}**
Cobalt	µg/L	n/v	5.2^{F}	n/v	**27.8^{F}**	**25.7^{F}**	**19.6^{F}**	3.81	4.6	4.6	0.38	0.51	0.86	0.52	**24.1^{F}**	**16.1^{F}**	**27.5^{F}**	**6^{F}**	**17.6^{F}**	**62.8^{F}**
Copper	µg/L	1000^{C}	6.9^{F}	≤1000^{G}	**70.9^{F}**	**65.8^{F}**	**50.6^{F}**	**8.76^{F}**	**12.6^{F}**	**15.8^{F}**	<0.5	1.05	4.05	1.2	**59.6^{F}**	**37.4^{F}**	**70.8^{F}**	**13.7^{F}**	**43.8^{F}**	**158^{F}**
Iron	µg/L	300^{C}	n/v	≤300^{G}	**67100^{CG}**	**63300^{CG}**	**45900^{CG}**	**16200^{CG}**	**8670^{CG}**	**7290^{CG}**	**5810^{CG}**	**6330^{CG}**	**6960^{CG}**	**6240^{CG}**	**53500^{CG}**	**35300^{CG}**	**61400^{CG}**	**17800^{CG}**	**43900^{CG}**	**135000^{CG}**
Lead	µg/L	10$_{c}^{A}$	2^{F}	10^{H}	**23.9^{AFH}**	**22.1^{AFH}**	**17.3^{AFH}**	**2.67^{F}**	**4.33^{F}**	**4.09^{F}**	0.19	0.435	1.48	0.678	**23.6^{AFH}**	**15.7^{AFH}**	**30.6^{AFH}**	**5.42^{F}**	**16.2^{AFH}**	**54^{AFH}**
Lithium	µg/L	n/v	n/v	n/v	57	54	41	9.7	<10 DM	9.1	8.3	8.3	7.6	8	50	43	73	19	42	144
Magnesium	mg/L	n/v	n/v	n/v	218	206	175	37.3	34.2	24.6	25.2	27.3	27.8	27.2	240	194	244	48.2	122	356
Manganese	µg/L	50^{C}	n/v	≤50^{G}	**2380^{CG}**	**2230^{CG}**	**1740^{CG}**	**610^{CG}**	**219^{CG}**	**138^{CG}**	**435^{CG}**	**457^{CG}**	**454^{CG}**	**456^{CG}**	**1680^{CG}**	**1170^{CG}**	**2710^{CG}**	**716^{CG}**	**1470^{CG}**	**4480^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	0.0598	0.0554	0.0191	0.008	0.0182	0.0109	<0.005	<0.005	<0.005	<0.005	0.0452	0.0208	0.014	0.0194	0.0193	0.0238
Molybdenum	µg/L	n/v	730^{F}	n/v	1.01	0.86	0.73	0.454	4.24	5.99	0.513	0.335	0.623	0.337	2.59	2.35	2.32	3.17	4.18	4.15
Nickel	µg/L	n/v	39^{F}	n/v	**64.6^{F}**	**60^{F}**	**45.1^{F}**	8.23	10.3	11.5	<0.5	0.75	2.05	0.69	**59.6^{F}**	38.8	**71.8^{F}**	14.3	**42.6^{F}**	**153^{F}**
Phosphorus	µg/L	n/v	n/v	n/v	2810	2530	2200	250	<500 DM	214	57	68	74	63	2620	1880	2820	710	1760	5830
Potassium	mg/L	n/v	n/v	n/v	9.14	8.74	7.70	2.54	2.60	2.98	2.98	2.89	2.95	2.88	12.7	10.1	12.9	3.04	6.30	16.3
Rubidium	µg/L	n/v	n/v	n/v	59.6	55.6	43.4	9.03	13.5	16.9	2.13	2.16	2.66	2.04	52.2	31.2	61.4	13.9	37.4	134
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.5 DM	<0.5 DM	<0.5 DM	<0.05	<0.5 DM	0.186	<0.05	<0.05	<0.05	<0.05	<0.5 DM	0.55	<0.5 GT	<0.5 DM	<0.5 DM	<0.5 GT
Silicon	µg/L	n/v	n/v	n/v	77700	73900	66200	20300	15500	17400	9460	9770	9840	9120	70500	52000	78500	26300	56900	136000
Silver	µg/L	n/v	0.12^{F}	n/v	**0.31^{F}**	**0.3^{F}**	**0.2^{F}**	0.036	<0.1 DM	0.06	0.026	**0.138^{F}**	**0.198^{F}**	0.12	**0.21^{F}**	**0.18^{F}**	**0.24^{F}**	<0.1 DM	**0.17^{F}**	**0.53^{F}**
Sodium	mg/L	200$_{g}^{C}$ 20$_{g}^{E}$	180^{F}	≤200^{G}	**61.6^{E}**	**63.0^{E}**	**60.8^{E}**	**65.1^{E}**	5.99	5.25	9.78	11.1	9.90	10.7	16.2	14.5	16.8	13.2	13.2	18.5
Strontium	µg/L	n/v	n/v	n/v	724	684	520	202	140	120	428	469	397	455	1090	924	1510	289	476	1270
Sulfur	µg/L	n/v	n/v	n/v	<5000 DM	<5000 DM	<5000 DM	<500	<5000 DM	870	36900	56500	39600	52800	12500	9900	13600	<5000 DM	<5000 DM	<5000 GT
Tellurium	µg/L	n/v	n/v	n/v	<2 DM	<2 DM	<2 DM	<0.2	<2 DM	<0.2	<0.2	<0.2	<0.2	<0.2	<2 DM	<2 DM	<2 GT	<2 DM	<2 DM	<2 GT
Thallium	µg/L	n/v	40^{F}	n/v	0.59	0.55	0.43	0.083	<0.1 DM	0.086	<0.01	<0.01	<0.01	<0.01	0.44	0.38	0.59	0.15	0.35	1.17
Thorium	µg/L	n/v	n/v	n/v	23.9	22.2	15.7	2.36	<1 DM	0.72	<0.1	0.12	0.46	0.12	19.5	12.9	24	4.1	13.6	45
Tin	µg/L	n/v	n/v	n/v	1.6	1.5	1.3	0.45	<1 DM	0.5	<0.1	<0.1	0.44	<0.1	1.9	1.5	1.4	<1 DM	1	2.1
Titanium	µg/L	n/v	n/v	n/v	3390	3170	2540	384	231	269	5.2	8.97	27.5	9.33	3280	2100	3110	646	1820	5180
Tungsten	µg/L	n/v	n/v	n/v	<1 DM	<1 DM	<1 DM	<0.1	<1 DM	0.87	2.1	2.2	3.11	2.12	<1 DM	<1 DM	<1 GT	<1 DM	<1 DM	<1 GT
Uranium	µg/L	20^{A}	33^{F}	20^{H}	2.66	2.44	1.78	0.295	1.35	1.68	1.28	1.6	1.46	1.43	3.98	3.06	6.58	0.6	1.82	6.29
Vanadium	µg/L	n/v	20^{F}	n/v	**109^{F}**	**101^{F}**	**79.3^{F}**	12.2	15.8	16	0.67	0.84	1.46	0.88	**98.1^{F}**	**65.4^{F}**	**107^{F}**	**21.6^{F}**	**66.8^{F}**	**226^{F}**
Zinc	µg/L	5000^{C}	89^{F}	≤5000^{G}	**120^{F}**	**112^{F}**	86	13.6	<30 DM	26.3	<3	<3	7.6	<3	**112^{F}**	82	**134^{F}**	<30 DM	77	**278^{F}**
Zirconium	µg/L	n/v	n/v	n/v	24.8	25.1	19.8	4.69	<3 DM	1.48	4.87	5.14	4.13	5.01	22.6	17	12.1	9.7	19.7	18.5

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater														
Sample Location					MW5-OB1-13					MW5-OB2-13			MW6-OB-13				MW7-BR-13		
Sample Date					19-Jun-16	19-Jun-16	5-Aug-16	16-Oct-16	16-Oct-16	19-Jun-16	5-Aug-16	16-Oct-16	20-Jun-16	20-Jun-16	2-Aug-16	16-Oct-16	18-Jun-16	3-Aug-16	12-Oct-16
Sample ID					MW5-OB1-13	DUP 5	MW5-OB1-13	MW5OB 1-13	DUP 7	MW5-OB2	MW5-OB2-13	MW5OB 2-13	MW6-OB-13	DUP 6	MW6-OB-13	MW6-OB-13	MW7-BR-13	MW7-BR-13	MW7-BR-13
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1786341	L1810001	L1844384	L1844384	L1786341	L1810001	L1844384	L1786744	L1786744	L1807778	L1844384	L1786341	L1808958	L1843856
Laboratory Sample ID					L1786341-16	L1786341-17	L1810001-1	L1844384-1	L1844384-4	L1786341-18	L1810001-2	L1844384-2	L1786744-5	L1786744-6	L1807778-8	L1844384-14	L1786341-12	L1808958-2	L1843856-3
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**		Field Duplicate			Field Duplicate					Field Duplicate					
Field Parameters																			
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	0.07	-	0.46	0.48	-	1.13	0.43	0.47	2.36	-	4.55	0.82	3.65	5.48	4.87
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	426	-	359	428	-	413	352	420	809	-	817	994	501	440	506
pH, Field	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	7.22	-	7.43	7.39	-	7.3	7.47	7.45	**6.58[G]**	-	**6.72[G]**	**6.72[G]**	7.68	7.66	7.25
Temperature, Field	deg C	15[C]	n/v	≤15[G]	3.03	-	4.65	4.5	-	3.35	5.63	5.73	7.27	-	12.72	11.17	5.73	7.82	3.37
General Chemistry																			
Acidity as CaCO3	mg/L	n/v	n/v	n/v	6.7	8.3	6.5	10.9	11.0	6.1	3.8	7.1	37.9	38.2	53.1	88.2	6.6	4.8	12.5
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	216	226	223	235	228	232	229	241	253	244	271	321	282	-	303
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500[D]	n/v	n/v	216	226	223	235	228	232	229	241	253	244	271	321	282	281	303
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.049	0.068	0.049	0.049	0.043	0.155	0.128	0.143	0.340	0.374	0.59	0.341	0.372	0.362	0.266
Anion Sum	meq/L	n/v	n/v	n/v	4.55	4.79	4.75	4.99	4.81	4.77	4.74	4.98	9.13	8.73	9.34	10.5	5.70	8.34	6.10
Cation Sum	meq/L	n/v	n/v	n/v	5.29	5.01	5.03	4.79	4.71	5.05	4.87	4.81	8.81	8.88	9.85	10.7	6.01	5.88	5.84
Chloride	mg/L	250[C]	180[F]	≤250[G]	2.76	3.09	3.13	3.21	2.68	0.81	0.88	0.96	115	115	122	119	0.71	96.1	0.61
Color, True	TCU	5[C]	n/v	n/v	3.6	3.8	3.7	**6.7[C]**	**6.8[C]**	3.0	2.9	**8.7[C]**	**61.2[C]**	**64.9[C]**	**83.2[C]**	**60.0[C]**	3.0	2.3	3.7
Cyanide	mg/L	n/v	0.0052[F]	0.2[H]	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2[A]	n/v	0.2[H]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5[C]	n/v	n/v	3.5	3.4	3.6	4.4	**5.3[C]**	3.7	2.6	3.9	**17.8[C]**	**17.8[C]**	**20.6[C]**	**20.9[C]**	1.6	2.5	3.1
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	410	410	446	417	422	401	432	421	853	827	938	984	479	503	485
Fluoride	mg/L	1.5_{b}^{A}	n/v	1.5[H]	0.046	0.052	0.045	0.044	0.049	0.154	0.160	0.147	0.033	0.035	0.029	0.038	0.261	0.072	0.225
Hardness (as CaCO3)	mg/L	80-100[D]	n/v	n/v	**251[D]**	**237[D]**	**239[D]**	**228[D]**	**223[D]**	**237[D]**	**230[D]**	**228[D]**	**266[D]**	**272[D]**	**311[D]**	**339[D]**	**244[D]**	**242[D]**	**238[D]**
Ion Balance	%	n/v	n/v	n/v	7.5	2.3	2.9	<0.000	<0.000	2.9	1.4	<0.000	<0.000	0.9	2.7	0.8	2.7	<0.000	<0.000
Nitrate (as N)	mg/L	10.0_{d}^{A}	n/v	10[H]	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.093	<0.020	0.101
Nitrite (as N)	mg/L	1.0_{d}^{A}	n/v	1[H]	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	7.82	7.83	7.61	7.74	7.75	7.96	7.77	7.96	**6.99[G]**	7.01	**6.98[G]**	**6.85[G]**	7.98	7.93	7.80
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.023	0.021	0.024	0.030	0.030	0.530	0.135	0.164	1.07	1.02	1.38	1.52	0.059	0.039	0.182
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0145	0.0199	0.0145	0.0210	0.0185	0.0261	0.0200	0.0264	<0.0030	<0.0030	0.0046	0.0097	<0.0030	<0.0030	0.0103
Sulfate	mg/L	500_{h}^{C}	n/v	$≤500_{j}^{G}$	7.93	8.83	9.68	9.85	8.06	4.78	6.41	6.61	39.4	28.8	22.8	36.6	1.18	0.91	0.85
Total Dissolved Solids	mg/L	500[C]	n/v	≤500[G]	268	269	249	261	254	269	264	266	**526[CG]**	**531[CG]**	**584[CG]**	**583[CG]**	311	290	299
Total Organic Carbon	mg/L	n/v	n/v	n/v	3.3	3.2	3.1	4.7	5.2	5.7	2.9	4.9	30.1	27.7	27.0	23.8	3.4	4.3	5.9
Total Suspended Solids	mg/L	n/v	n/v	n/v	8.2	13.8	8.5	41.9	56.3	444	206	628	3490	3320	3000	4820	451	414	294

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater														
Sample Location					**MW5-OB1-13**					**MW5-OB2-13**			**MW6-OB-13**				**MW7-BR-13**		
Sample Date					19-Jun-16	19-Jun-16	5-Aug-16	16-Oct-16	16-Oct-16	19-Jun-16	5-Aug-16	16-Oct-16	20-Jun-16	20-Jun-16	2-Aug-16	16-Oct-16	18-Jun-16	3-Aug-16	12-Oct-16
Sample ID					MW5-OB1-13	DUP 5	MW5-OB1-13	MW5OB 1-13	DUP 7	MW5-OB2	MW5-OB2-13	MW5OB 2-13	MW6-OB-13	DUP 6	MW6-OB-13	MW6-OB-13	MW7-BR-13	MW7-BR-13	MW7-BR-13
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1786341	L1810001	L1844384	L1844384	L1786341	L1810001	L1844384	L1786744	L1786744	L1807778	L1844384	L1786341	L1808958	L1843856
Laboratory Sample ID					L1786341-16	L1786341-17	L1810001-1	L1844384-1	L1844384-4	L1786341-18	L1810001-2	L1844384-2	L1786744-5	L1786744-6	L1807778-8	L1844384-14	L1786341-12	L1808958-2	L1843856-3
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**		Field Duplicate			Field Duplicate					Field Duplicate					
Metals, Dissolved																			
Aluminum	µg/L	100^{D}	n/v	$<100/200_{a}^{G}$	<2	<2	<2	19.1	18.7	<2	2.2	2.6	64.3	59.8	68	**324^{DG}**	2.6	3.5	**166^{DG}**
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<0.1	<0.1	<0.1	<0.1	0.14	<0.1	<0.1	<0.1	<0.1	<0.1	<1 DM	<0.1	0.11	0.11	0.35
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	6.16	6.31	6.23	5.89	5.95	1.46	1.36	1.62	8.59	8.66	**11.5^{H}**	**11.2^{H}**	0.78	0.86	0.7
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	21.9	21.9	20.9	21.6	21.6	32.5	31.7	34.5	65.2	65	82.7	101	25.9	27.8	30.7
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 DM	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 DM	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<10	<10	<10	<10	<10	12	12	14	<10	<10	<100 DM	<10	42	46	41
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05 DM	<0.005	<0.005	<0.005	<0.005
Calcium	mg/L	n/v	n/v	n/v	79.6	73.6	74.7	72.1	69.1	71.6	69.0	69.6	87.1	89.2	98.9	109	57.1	57.0	56.0
Cesium	µg/L	n/v	n/v	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 DM	0.022	3	3.69	2.36
Chromium	µg/L	50^{A}	64^{F}	50^{H}	<0.1	<0.1	<0.1	<0.1	0.14	<0.1	<0.1	<0.1	1.39	1.09	1.4	1.88	<0.1	<0.1	0.14
Cobalt	µg/L	n/v	5.2^{F}	n/v	0.21	0.2	0.18	0.29	0.79	<0.1	<0.1	<0.1	**6.3^{F}**	**6.14^{F}**	**7.5^{F}**	**8.06^{F}**	0.19	0.17	1.11
Copper	µg/L	1000^{C}	6.9^{F}	$\leq1000^{G}$	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2 DM	0.67	<0.2	0.36	0.37
Iron	µg/L	300^{C}	n/v	$\leq300^{G}$	**1950^{CG}**	**2140^{CG}**	**2070^{CG}**	**1810^{CG}**	**1880^{CG}**	**584^{CG}**	**388^{CG}**	**403^{CG}**	**5030^{CG}**	**5240^{CG}**	**6010^{CG}**	**9200^{CG}**	43	32	123
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 DM	0.279	<0.05	<0.05	0.095
Lithium	µg/L	n/v	n/v	n/v	1.4	1.2	1.6	1.3	1.3	4.4	5	4.9	1	<1	<10 DM	<1	5.1	7.4	6.2
Magnesium	mg/L	n/v	n/v	n/v	12.8	12.9	12.7	11.5	12.2	14.2	14.1	13.0	11.9	11.9	15.6	16.2	24.5	24.1	23.8
Manganese	µg/L	50^{C}	n/v	$\leq50^{G}$	**155^{CG}**	**157^{CG}**	**150^{CG}**	**143^{CG}**	**145^{CG}**	43	37.9	38.9	**1710^{CG}**	**1750^{CG}**	**1820^{CG}**	**2370^{CG}**	**175^{CG}**	**152^{CG}**	**139^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	0.0052	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0107	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	0.957	0.921	0.925	0.865	0.905	0.424	0.428	0.438	0.924	0.929	0.98	0.817	0.256	0.213	0.238
Nickel	µg/L	n/v	39^{F}	n/v	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.82	0.75	<5 DM	1.33	0.79	0.94	1.35
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<500 DM	<50	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	0.570	0.592	0.568	0.586	0.594	1.43	1.39	1.45	1.94	1.89	2.25	2.49	3.33	3.38	3.34
Rubidium	µg/L	n/v	n/v	n/v	0.47	0.48	0.44	0.47	0.47	0.48	0.39	0.41	0.37	0.36	<2 DM	0.69	3.13	2.88	3.11
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.05	<0.05	0.116	<0.05	<0.05	<0.05	0.11	<0.05	0.12	0.136	<0.5 DM	0.397	<0.05	<0.05	0.091
Silicon	µg/L	n/v	n/v	n/v	6130	6690	6720	6720	6980	8220	8560	8810	4520	4490	5340	6560	6820	7290	7320
Silver	µg/L	n/v	0.12^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 DM	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	$\leq200^{G}$	3.17	3.14	2.94	2.80	2.85	5.29	4.67	4.46	**70.7^{E}**	**69.5^{E}**	**72.2^{E}**	**74.1^{E}**	**23.6^{E}**	**21.4^{E}**	**22.0^{E}**
Strontium	µg/L	n/v	n/v	n/v	118	110	111	103	104	180	174	165	133	136	142	150	325	345	329
Sulfur	µg/L	n/v	n/v	n/v	2560	3140	3060	3260	3350	1630	1650	2000	10200	10600	9500	12100	<500	<500	<500
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2 DM	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.1 DM	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.23	0.21	<1 DM	0.31	<0.1	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 DM	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	0.93	0.75	<0.3	<0.3	<0.3	1.54	1.4	<3 DM	10.3	<0.3	<0.3	5.4
Tungsten	µg/L	n/v	n/v	n/v	3.53	3.37	3.36	2.94	3.08	1.37	1.61	1.27	<0.1	<0.1	<1 DM	<0.1	1.58	1.23	1.76
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.045	0.039	0.044	0.042	0.044	0.024	0.015	0.011	0.203	0.187	0.23	0.293	0.214	0.199	0.266
Vanadium	µg/L	n/v	20^{F}	n/v	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	4.32	4.31	5.1	5.03	0.53	<0.5	0.6
Zinc	µg/L	5000^{C}	89^{F}	$\leq5000^{G}$	<1	2.4	1.2	<1	1.4	<1	1.6	1.1	3.2	2.1	<10 DM	1.1	1	6.6	2.3
Zirconium	µg/L	n/v	n/v	n/v	0.77	0.71	0.79	0.75	0.74	<0.3	<0.3	<0.3	1.02	1.08	<3 DM	1.55	0.67	0.78	0.64

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater														
Sample Location					**MW5-OB1-13**					**MW5-OB2-13**			**MW6-OB-13**				**MW7-BR-13**		
Sample Date					**19-Jun-16**	**19-Jun-16**	**5-Aug-16**	**16-Oct-16**	**16-Oct-16**	**19-Jun-16**	**5-Aug-16**	**16-Oct-16**	**20-Jun-16**	**20-Jun-16**	**2-Aug-16**	**16-Oct-16**	**18-Jun-16**	**3-Aug-16**	**12-Oct-16**
Sample ID					**MW5-OB1-13**	**DUP 5**	**MW5-OB1-13**	**MW5OB 1-13**	**DUP 7**	**MW5-OB2**	**MW5-OB2-13**	**MW5OB 2-13**	**MW6-OB-13**	**DUP 6**	**MW6-OB-13**	**MW6-OB-13**	**MW7-BR-13**	**MW7-BR-13**	**MW7-BR-13**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1786341**	**L1786341**	**L1810001**	**L1844384**	**L1844384**	**L1786341**	**L1810001**	**L1844384**	**L1786744**	**L1786744**	**L1807778**	**L1844384**	**L1786341**	**L1808958**	**L1843856**
Laboratory Sample ID					**L1786341-16**	**L1786341-17**	**L1810001-1**	**L1844384-1**	**L1844384-4**	**L1786341-18**	**L1810001-2**	**L1844384-2**	**L1786744-5**	**L1786744-6**	**L1807778-8**	**L1844384-14**	**L1786341-12**	**L1808958-2**	**L1843856-3**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**		**Field Duplicate**			**Field Duplicate**					**Field Duplicate**					
Metals, Total																			
Aluminum	µg/L	100^{D}	n/v	<100/200$_{a}^{G}$	**171**^{DG}	**154**^{DG}	99.3	**253**^{DG}	**484**^{DG}	**6690**^{DG}	**2380**^{DG}	**2520**^{DG}	**15200**^{DG}	**14900**^{DG}	**13900**^{DG}	**5620**^{DG}	**2360**^{DG}	**1940**^{DG}	**9900**^{DG}
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<0.1	<0.1	<0.1	<0.1	<0.1	0.18	<0.1	<0.1	<2 DM	<1 DM	<1 DM	<1 DM	0.23	0.19	0.61
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	6.02	5.89	6.26	6.39	6.74	4.19	2.22	2.46	**98.9**^{BH}	**42.7**^{BH}	**19.5**^{H}	**15.3**^{H}	1.66	1.46	4.91
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	21.3	21.1	21.6	23.1	24.3	105	48.6	60.7	188	172	184	153	44.2	40.5	105
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	0.29	<0.1	0.15	<2 DM	<1 DM	<1 DM	<1 DM	<0.1	<0.1	0.32
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	0.074	0.08	<0.05	<0.05	<1 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.05	<0.05	0.067
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<10	<10	<10	<10	<10	22	13	19	<200 DM	<100 DM	<100 DM	<100 DM	44	45	52
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	0.0066	0.0057	<0.005	0.0094	0.0136	0.0565	0.0166	0.0393	0.17	0.185	0.189	0.111	0.0157	0.0126	0.0803
Calcium	mg/L	n/v	n/v	n/v	71.2	68.9	68.5	70.1	69.5	147	88.8	145	312	317	375	290	70.3	61.7	162
Cesium	µg/L	n/v	n/v	n/v	0.021	0.02	0.013	0.03	0.054	0.544	0.199	0.227	1.04	1.05	0.93	0.47	3.65	4.48	5.97
Chromium	µg/L	50^{A}	64^{F}	50^{H}	0.86	0.82	0.46	1.02	1.86	14.3	5.31	6.46	**50.1**^{AH}	47.8	44.4	19	5.58	5.17	26.3
Cobalt	µg/L	n/v	5.2^{F}	n/v	0.75	0.68	0.46	1.05	1.64	4.69	1.53	2.37	**23.7**^{F}	**22.3**^{F}	**21.5**^{F}	**15.7**^{F}	1.46	1.28	**6.48**^{F}
Copper	µg/L	1000^{C}	6.9^{F}	≤1000^{G}	4.62	2.04	1.04	2.97	5.99	**23.6**^{F}	5.75	4.46	**31**^{F}	**28.1**^{F}	**27.2**^{F}	**12.8**^{F}	3.71	3.2	**16.6**^{F}
Iron	µg/L	300^{C}	n/v	≤300^{G}	**2700**^{CG}	**2680**^{CG}	**2430**^{CG}	**2750**^{CG}	**3090**^{CG}	**8400**^{CG}	**2940**^{CG}	**4230**^{CG}	**28600**^{CG}	**27200**^{CG}	**25100**^{CG}	**19100**^{CG}	**2580**^{CG}	**2150**^{CG}	**12800**^{CG}
Lead	µg/L	10$_{c}^{A}$	2^{F}	10^{H}	0.455	0.388	0.235	0.866	1.21	**5.49**^{F}	1.44	**2.6**^{F}	**12.9**^{AFH}	**11.7**^{AFH}	**11**^{AFH}	**6.08**^{F}	1.66	1.74	**8.36**^{F}
Lithium	µg/L	n/v	n/v	n/v	1.8	1.6	1.4	1.9	2.1	12.6	6.7	8.9	<20 DM	11	19	<10 DM	7.1	6.7	17.5
Magnesium	mg/L	n/v	n/v	n/v	12.4	12.5	12.6	12.3	12.4	32.5	20.7	30.5	86.1	82.4	103	56.9	27.3	26.0	43.5
Manganese	µg/L	50^{C}	n/v	≤50^{G}	**152**^{CG}	**151**^{CG}	**157**^{CG}	**163**^{CG}	**164**^{CG}	**245**^{CG}	**106**^{CG}	**216**^{CG}	**2370**^{CG}	**2310**^{CG}	**2430**^{CG}	**2810**^{CG}	**228**^{CG}	**187**^{CG}	**476**^{CG}
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	<0.005	<0.005	<0.005	<0.005	<0.005	0.011	<0.005	<0.005	0.0268	0.0234	<0.005	0.0194	0.0075	<0.005	0.0052
Molybdenum	µg/L	n/v	730^{F}	n/v	1.05	1.02	0.947	0.907	0.876	0.693	0.467	0.394	1.2	1.28	1.3	1.11	0.349	0.34	0.475
Nickel	µg/L	n/v	39^{F}	n/v	1.68	1.13	0.79	1.83	3.32	8.91	3.37	4.57	31	28.4	26.8	12.4	4.01	3.86	16.8
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	381	134	350	1300	1270	1410	530	83	62	563
Potassium	mg/L	n/v	n/v	n/v	0.583	0.569	0.599	0.610	0.618	3.12	2.03	2.14	4.7	4.61	4.63	3.47	4.13	3.75	5.44
Rubidium	µg/L	n/v	n/v	n/v	0.61	0.56	0.51	0.69	0.89	9.35	3.59	4.45	12.7	12.4	11	5.4	6.47	5.66	16.3
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.05	0.06	0.106
Silicon	µg/L	n/v	n/v	n/v	6700	6620	6890	7200	7580	20100	12700	13400	29000	30000	27100	15500	11700	10300	24300
Silver	µg/L	n/v	0.12^{F}	n/v	0.015	0.023	<0.01	0.014	0.024	**3.38**^{F}	**0.476**^{F}	**0.2**^{F}	***<0.2 DM***	0.12	0.12	<0.1 DM	0.075	0.093	**0.395**^{F}
Sodium	mg/L	200$_{g}^{C}$ 20$_{g}^{E}$	180^{F}	≤200^{G}	3.25	2.86	3.07	3.04	2.97	5.82	5.19	5.47	**76.5**^{E}	**75.5**^{E}	**79.6**^{E}	**87.4**^{E}	**22.9**^{E}	**22.9**^{E}	**21.3**^{E}
Strontium	µg/L	n/v	n/v	n/v	109	106	104	109	108	238	179	233	282	281	310	286	354	354	418
Sulfur	µg/L	n/v	n/v	n/v	2950	2840	3200	3270	2900	1910	1770	2100	<10000 DM	8800	8700	11400	<500	<500	<500
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<4 DM	<2 DM	<2 DM	<2 DM	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	<0.01	<0.01	<0.01	0.013	<0.01	0.073	0.026	0.032	<0.2 DM	0.18	0.17	<0.1 DM	0.033	0.024	0.12
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	0.2	0.26	3.88	1.65	1.68	4.6	4.5	4.9	2.5	0.76	0.77	3.75
Tin	µg/L	n/v	n/v	n/v	0.12	0.1	<0.1	<0.1	<0.1	1.04	0.25	0.17	<2 DM	1.4	1.8	1.4	0.52	0.24	2.74
Titanium	µg/L	n/v	n/v	n/v	7.95	6.99	3.97	12	23.6	379	148	139	1180	1110	1130	344	164	148	725
Tungsten	µg/L	n/v	n/v	n/v	4.37	3.97	3.49	3.28	4.1	19.3	4.31	2.31	<2 DM	<1 DM	<1 DM	<1 DM	1.92	1.65	2.59
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.05	0.048	0.051	0.069	0.078	0.974	0.249	0.39	1.39	1.32	1.34	0.99	0.407	0.397	0.973
Vanadium	µg/L	n/v	20^{F}	n/v	0.67	0.67	0.51	1.04	1.66	13.5	5.01	7.04	**50**^{F}	**47.2**^{F}	**42.9**^{F}	**22.1**^{F}	5.6	4.77	**22.8**^{F}
Zinc	µg/L	5000^{C}	89^{F}	≤5000^{G}	6.3	<3	<3	<3	4.5	28.4	8.2	12.5	<60 DM	49	50	<30 DM	10.2	8.9	52.2
Zirconium	µg/L	n/v	n/v	n/v	1.36	1.33	1.13	1.92	2.21	3	1.39	2.11	<6 DM	5.1	4.7	<3 DM	2.28	1.73	4.01

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater														
Sample Location						**MW8-OB-14**			**MW9-OB1-13**			**MW9-OB2-13**			**MWS-14-01**			**MWS-14-02 (BR)**	
Sample Date					**16-Jun-16**	**7-Aug-16**	**18-Oct-16**	**18-Jun-16**	**2-Aug-16**	**12-Oct-16**	**18-Jun-16**	**2-Aug-16**	**19-Jun-16**	**2-Aug-16**	**12-Oct-16**	**15-Jun-16**	**15-Jun-16**	**7-Aug-16**	**17-Oct-16**
Sample ID					**MW8-OB-14**	**MW8-OB-14**	**MW8-OB-14**	**MW9-OB1-13**	**MW9-OB1-13**	**MW9-OB1-13**	**MW9-OB2-13**	**MW9-OB2-13**	**MWS-14-01**	**MWS-14-01**	**MWS-14-01**	**MWS-14-02 BR**	**DUP 4**	**MWS-14-02 (BR)**	**MWS-14-02(BR)**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1785355**	**L1810001**	**L1846557**	**L1786341**	**L1807778**	**L1843856**	**L1786341**	**L1807778**	**L1786341**	**L1807778**	**L1843856**	**L1784595**	**L1784595**	**L1810001**	**L1846519**
Laboratory Sample ID					**L1785355-3**	**L1810001-19**	**L1846557-2**	**L1786341-10**	**L1807778-3**	**L1843856-2**	**L1786341-9**	**L1807778-4**	**L1786341-21**	**L1807778-9**	**L1843856-4**	**L1784595-3**	**L1784595-4**	**L1810001-18**	**L1846519-2**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**													**Field Duplicate**		
Field Parameters																			
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	8.11	2.7	3.32	6.41	9.8	6.92	9.25	9.46	4.71	6.17	1.72	2.41	-	0.53	0.45
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	325	452	568	585	499	560	746	665	671	589	688	312	-	440	542
pH, Field	S.U.	$6.5-8.5^{D}$	n/v	$7.0-10.5^{G}$	7.27	7.41	7.37	7.11	7.62	7.56	**6.85**^{G}	7.09	7.06	7.25	7.59	7.3	-	7.23	7.29
Temperature, Field	deg C	15^{C}	n/v	$\leq 15^{G}$	10.05	9.71	4.45	5.11	7.99	4.12	5.73	8.68	4.79	5.44	3.62	4.37	-	5.08	2.96
General Chemistry																			
Acidity as CaCO3	mg/L	n/v	n/v	n/v	14.0	8.1	10.4	6.5	10.4	2.2	32.9	39.8	21.0	23.5	20.5	13.8	14.6	10.1	9.5
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	329	320	341	327	321	330	418	411	374	389	409	298	301	300	313
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	$30-500^{D}$	n/v	n/v	329	320	341	327	321	330	418	411	374	389	409	298	301	300	313
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.172	<0.20 DM	0.186	0.306	0.44	0.325	0.035	0.15	0.201	0.26	0.096	0.122	0.144	0.125	0.120
Anion Sum	meq/L	n/v	n/v	n/v	6.64	6.45	6.87	6.86	6.73	6.72	8.65	8.57	7.72	7.98	8.41	6.19	6.24	6.22	6.49
Cation Sum	meq/L	n/v	n/v	n/v	6.61	6.96	6.51	7.19	6.87	6.62	9.95	9.17	8.36	8.23	8.20	6.25	6.23	6.24	6.16
Chloride	mg/L	250^{C}	180^{F}	$\leq 250^{G}$	0.97	0.52	0.54	1.08	0.96	0.83	2.61	2.70	0.99	0.59	0.51	0.25	0.25	0.29	0.22
Color, True	TCU	5^{C}	n/v	n/v	<2.0	<2.0	-	3.5	<2.0	2.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020 BL	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050 BL	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020 BL	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	1.7	1.7	2.6	2.8	1.5	3.2	2.8	1.9	2.5	1.9	3.2	<1.0	<1.0	1.2	2.0
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	553	570	551	562	585	546	716	756	649	680	659	531	528	556	534
Fluoride	mg/L	1.5_{b}^{A}	n/v	1.5^{H}	0.466	0.412	0.607	0.419	0.389	0.366	0.211	0.242	0.386	0.340	0.393	0.273	0.275	0.255	0.245
Hardness (as CaCO3)	mg/L	$80-100^{D}$	n/v	n/v	**297**^{D}	**315**^{D}	**290**^{D}	**300**^{D}	**287**^{D}	**269**^{D}	**481**^{D}	**443**^{D}	**369**^{D}	**359**^{D}	**357**^{D}	**296**^{D}	**295**^{D}	**293**^{D}	**289**^{D}
Ion Balance	%	n/v	n/v	n/v	<0.000	3.8	<0.000	2.3	1.0	<0.000	7.0	3.4	4.0	1.6	<0.000	0.5	<0.000	0.1	<0.000
Nitrate (as N)	mg/L	10.0_{d}^{A}	n/v	10^{H}	<0.020	0.054	<0.020	0.052	<0.020	<0.020	0.066	0.060	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	1.0_{d}^{A}	n/v	1^{H}	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	$6.5-8.5^{D}$	n/v	$7.0-10.5^{G}$	7.70	7.70	7.95	7.80	7.86	8.11	7.33	7.37	7.58	7.57	7.74	7.78	7.75	7.57	7.96
Phosphorus, Total	mg/L	n/v	n/v	n/v	6.35	3.89	2.74	2.21	1.00	0.392	3.03	3.50	1.38	0.650	0.143	0.054	0.055	0.057	0.066
Phosphorus, Total	mg/L	n/v	n/v	n/v	<0.0030	<0.0030	0.0108	0.0070	0.0041	0.0178	<0.0030	<0.0030	0.0043	0.0044	0.0046	0.0226	0.0231	0.0205	0.0254
Sulfate	mg/L	500_{h}^{C}	n/v	$\leq 500_{j}^{G}$	0.42	0.67	<0.30	13.4	12.8	4.37	9.69	12.6	9.79	8.16	9.71	9.77	9.81	10.1	10.2
Total Dissolved Solids	mg/L	500^{C}	n/v	$\leq 500^{G}$	**850**^{CG}	336	328	347	320	314	468	436	409	395	410	308	284	302	292
Total Organic Carbon	mg/L	n/v	n/v	n/v	9.1	9.7	6.1	<10	6.4	4.5	5.8	10.0	6.9	4.9	4.0	<1.0	<1.0	1.1	1.9
Total Suspended Solids	mg/L	n/v	n/v	n/v	17900	7330	2480	3920	18300	2880	1810	3700	2150	2500	743	48.8	55.5	100	76.5

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater														
Sample Location					MW8-OB-14			MW9-OB1-13			MW9-OB2-13		MWS-14-01			MWS-14-02 (BR)			
Sample Date					16-Jun-16	7-Aug-16	18-Oct-16	18-Jun-16	2-Aug-16	12-Oct-16	18-Jun-16	2-Aug-16	19-Jun-16	2-Aug-16	12-Oct-16	15-Jun-16	15-Jun-16	7-Aug-16	17-Oct-16
Sample ID					MW8-OB-14	MW8-OB-14	MW8-OB-14	MW9-OB1-13	MW9-OB1-13	MW9-OB1-13	MW9-OB2-13	MW9-OB2-13	MWS-14-01	MWS-14-01	MWS-14-01	MWS-14-02 BR	DUP 4	MWS-14-02 (BR)	MWS-14-02(BR)
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1785355	L1810001	L1846557	L1786341	L1807778	L1843856	L1786341	L1807778	L1786341	L1807778	L1843856	L1784595	L1784595	L1810001	L1846519
Laboratory Sample ID					L1785355-3	L1810001-19	L1846557-2	L1786341-10	L1807778-3	L1843856-2	L1786341-9	L1807778-4	L1786341-21	L1807778-9	L1843856-4	L1784595-3	L1784595-4	L1810001-18	L1846519-2
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**													Field Duplicate		
Metals, Dissolved																			
Aluminum	µg/L	100[D]	n/v	<100/200$_{a}$[G]	<2	4.3	205[DG]	3	2.7	114[DG]	<2	<2	<2	8.8	69.5	<2	<2	2.1	<2
Antimony	µg/L	6[B]	1600[F]	6[H]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	0.18	<0.1	<0.1	<0.1	<0.1
Arsenic	µg/L	25[B]	150[F]	10[H]	1.61	1.62	2.03	0.56	0.62	0.58	0.18	0.27	0.64	0.66	0.69	0.43	0.4	0.48	0.28
Barium	µg/L	1000[A]	2300[F]	1000[H]	25.6	28	28	51.6	51.4	49.5	33.9	38.5	49.4	54.5	55.4	44.7	44.4	46.9	46.3
Beryllium	µg/L	n/v	5.3[F]	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000[B]	3550[F]	5000[H]	50	48	46	44	40	52	12	11	50	41	47	13	13	15	15
Cadmium	µg/L	5[A]	0.21[F]	5[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0081	0.0069	0.0077	<0.005	0.0079	<0.005	<0.005	<0.005	<0.005
Calcium	mg/L	n/v	n/v	n/v	74.5	77.2	71.0	67.3	62.6	55.5	139	123	103	92.2	93.2	82.3	80.6	79.4	80.1
Cesium	µg/L	n/v	n/v	n/v	<0.01	<0.01	0.02	<0.01	<0.01	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.012	0.015
Chromium	µg/L	50[A]	64[F]	50[H]	<0.1	0.36	0.3	<0.1	<0.1	<0.1	1	0.93	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	µg/L	n/v	5.2[F]	n/v	1.09	1.06	1.22	0.42	0.35	0.43	<0.1	<0.1	0.45	0.54	1.14	<0.1	<0.1	<0.1	<0.1
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	<0.2	<0.2	0.46	<0.2	0.37	0.31	0.48	0.39	0.3	<0.2	0.3	<0.2	0.21	<0.2	<0.2
Iron	µg/L	300[C]	n/v	≤300[G]	48	69	243	23	65	218	12	<10	50	36	72	561[CG]	564[CG]	619[CG]	583[CG]
Lead	µg/L	10$_{c}$[A]	2[F]	10[H]	<0.05	<0.05	0.109	<0.05	<0.05	0.061	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	n/v	n/v	n/v	8.8	9.4	9.1	9.3	8.6	8.9	7.9	7.1	7.8	8.1	9.4	7.8	7.9	8.7	7.9
Magnesium	mg/L	n/v	n/v	n/v	27.0	29.6	27.4	32.1	31.8	31.6	32.7	33.0	27.3	31.4	30.1	21.9	22.6	22.9	21.5
Manganese	µg/L	50[C]	n/v	≤50[G]	191[CG]	197[CG]	196[CG]	30.7	27.3	32.1	13.5	7.2	185[CG]	196[CG]	195[CG]	43.2	43.5	42.6	42.1
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	5.34	5.91	5.16	1.66	1.62	1.49	0.774	0.767	5.38	4.84	4.65	0.776	0.755	1.2	0.844
Nickel	µg/L	n/v	39[F]	n/v	1.12	1.2	1.31	<0.5	0.56	0.61	0.75	0.83	1.36	1.6	1.78	<0.5	<0.5	<0.5	<0.5
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	4.07	4.19	4.27	3.55	3.49	3.70	1.90	2.14	3.70	4.28	4.22	2.33	2.31	2.37	2.38
Rubidium	µg/L	n/v	n/v	n/v	0.8	0.8	1.21	1.24	1.25	1.33	0.84	1.06	1.49	1.64	1.89	0.62	0.72	0.7	0.74
Selenium	µg/L	10[A]	5[F]	50[H]	<0.05	<0.05	0.064	<0.05	<0.05	<0.05	0.19	0.172	<0.05	<0.05	<0.05	0.079	0.059	<0.05	0.079
Silicon	µg/L	n/v	n/v	n/v	7800	8480	9090	7480	9370	9090	8120	8610	7320	7780	8080	7790	7810	7840	8360
Silver	µg/L	n/v	0.12[F]	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L	200$_{g}$[C] 20$_{g}$[E]	180[F]	≤200[G]	12.7	12.7	12.6	24.7[E]	23.2[E]	25.5[E]	6.50	6.10	20.2[E]	21.0[E]	21.5[E]	5.83	5.83	6.60	6.64
Strontium	µg/L	n/v	n/v	n/v	197	201	193	368	334	361	147	125	281	242	251	182	175	188	195
Sulfur	µg/L	n/v	n/v	n/v	<500	<500	<500	3030	4610	2640	3830	4300	2540	2780	2490	2830	2840	2680	3030
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40[F]	n/v	0.011	0.011	0.014	<0.01	<0.01	<0.01	0.012	0.015	0.014	0.015	0.021	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	9.86	<0.3	<0.3	3.9	<0.3	<0.3	<0.3	0.36	2.72	<3 DM	<0.3	<0.3	<0.3
Tungsten	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	6.36	6.53	6.67	<0.1	<0.1	0.12	0.14	0.13	<0.1	<0.1	0.12	0.14
Uranium	µg/L	20[A]	33[F]	20[H]	2.06	2.08	1.81	0.392	0.304	0.209	1.17	1.31	1.81	1.82	1.59	0.032	0.032	0.079	0.065
Vanadium	µg/L	n/v	20[F]	n/v	<0.5	<0.5	<0.5	0.68	<0.5	<0.5	<0.5	<0.5	0.81	0.54	0.56	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	<1	1.6	1.1	<1	2.3	1	3.4	<1	<1	<1	1.6	<1	<1	<1	<1
Zirconium	µg/L	n/v	n/v	n/v	<0.3	0.89	0.5	<0.3	<0.3	0.39	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater														
Sample Location					**MW8-OB-14**			**MW9-OB1-13**			**MW9-OB2-13**		**MWS-14-01**			**MWS-14-02 (BR)**			
Sample Date					**16-Jun-16**	**7-Aug-16**	**18-Oct-16**	**18-Jun-16**	**2-Aug-16**	**12-Oct-16**	**18-Jun-16**	**2-Aug-16**	**19-Jun-16**	**2-Aug-16**	**12-Oct-16**	**15-Jun-16**	**15-Jun-16**	**7-Aug-16**	**17-Oct-16**
Sample ID					**MW8-OB-14**	**MW8-OB-14**	**MW8-OB-14**	**MW9-OB1-13**	**MW9-OB1-13**	**MW9-OB1-13**	**MW9-OB2-13**	**MW9-OB2-13**	**MWS-14-01**	**MWS-14-01**	**MWS-14-01**	**MWS-14-02 BR**	**DUP 4**	**MWS-14-02 (BR)**	**MWS-14-02(BR)**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1785355**	**L1810001**	**L1846557**	**L1786341**	**L1807778**	**L1843856**	**L1786341**	**L1807778**	**L1786341**	**L1807778**	**L1843856**	**L1784595**	**L1784595**	**L1810001**	**L1846519**
Laboratory Sample ID					**L1785355-3**	**L1810001-19**	**L1846557-2**	**L1786341-10**	**L1807778-3**	**L1843856-2**	**L1786341-9**	**L1807778-4**	**L1786341-21**	**L1807778-9**	**L1843856-4**	**L1784595-3**	**L1784595-4**	**L1810001-18**	**L1846519-2**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**													**Field Duplicate**		
Metals, Total																			
Aluminum	µg/L	100^{D}	n/v	<100/200$_{a}^{G}$	**53400^{DG}**	**33500^{DG}**	**16200^{DG}**	**19800^{DG}**	**8290^{DG}**	**9430^{DG}**	**14100^{DG}**	**27400^{DG}**	**13400^{DG}**	**11600^{DG}**	**3990^{DG}**	**818^{DG}**	**882^{DG}**	**1000^{DG}**	**986^{DG}**
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<1 DM	<1 DM	<0.5 GT	<1 DM	<1 DM	0.2	<1 DM	<1 DM	<1 DM	<1 DM	0.11	<0.1	<0.1	<0.1	<0.1
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	**33.2^{BH}**	**18.2^{H}**	8.96	6.9	3.8	3.71	5.1	**10.6^{H}**	4.7	3.5	1.64	0.9	0.78	1.03	0.65
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	379	246	132	188	108	127	148	228	159	137	87.6	56.9	58.3	55.2	52.3
Beryllium	µg/L	n/v	5.3^{F}	n/v	2.4	1.4	0.65	1	<1 DM	0.71	<1 DM	1	<1 DM	<1 DM	0.14	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	0.6	<0.5 DM	<0.25 GT	<0.5 DM	<0.5 DM	0.158	<0.5 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	200	120	95	<100 DM	<100 DM	75	<100 DM	<100 DM	<100 DM	<100 DM	62	15	15	15	16
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	**1.02^{F}**	**0.461^{F}**	0.194	0.176	0.097	0.121	0.195	**0.333^{F}**	0.147	0.095	0.0368	0.0104	0.0073	0.0063	0.0064
Calcium	mg/L	n/v	n/v	n/v	2770	1260	558	445	277	261	590	818	302	246	143	82.1	79.9	84.3	83.1
Cesium	µg/L	n/v	n/v	n/v	3.93	2.35	1.07	1.33	0.53	0.663	0.97	1.91	1.14	1.01	0.357	0.095	0.094	0.117	0.111
Chromium	µg/L	50^{A}	64^{F}	50^{H}	**135^{AFH}**	**74.3^{AFH}**	31.4	38.7	16.4	17.9	36.5	**80.1^{AFH}**	31.3	29.2	9.55	1.78	1.77	2.42	2.43
Cobalt	µg/L	n/v	5.2^{F}	n/v	**49.1^{F}**	**25.8^{F}**	**10.8^{F}**	**11.1^{F}**	4.9	**5.71^{F}**	**8.5^{F}**	**17.4^{F}**	**8.2^{F}**	**7.2^{F}**	2.65	0.54	0.5	0.61	0.53
Copper	µg/L	1000^{C}	6.9^{F}	≤1000^{G}	**128^{F}**	**64.1^{F}**	**25.6^{F}**	**28.4^{F}**	**14.7^{F}**	**19.9^{F}**	**21.6^{F}**	**44.4^{F}**	**20.8^{F}**	**16.6^{F}**	5.07	1.04	1.47	1.95	1.63
Iron	µg/L	300^{C}	n/v	≤300^{G}	**79400^{CG}**	**44700^{CG}**	**19400^{CG}**	**23200^{CG}**	**9920^{CG}**	**12400^{CG}**	**16300^{CG}**	**35600^{CG}**	**15900^{CG}**	**13500^{CG}**	**4560^{CG}**	**1870^{CG}**	**1830^{CG}**	**2170^{CG}**	**1760^{CG}**
Lead	µg/L	10$_{c}^{A}$	2^{F}	10^{H}	**47.9^{AFH}**	**23.1^{AFH}**	**10.1^{AFH}**	**17^{AFH}**	**6.64^{F}**	**10.5^{AFH}**	**9.05^{F}**	**18.2^{AFH}**	**7.95^{F}**	**5.91^{F}**	1.98	0.65	0.674	0.64	0.505
Lithium	µg/L	n/v	n/v	n/v	99	48	30.7	32	18	19.5	23	41	26	22	13.2	8.3	8.2	8.6	9.1
Magnesium	mg/L	n/v	n/v	n/v	793	412	189	139	95.8	69.9	117	218	83.5	74.7	40.1	22.9	22.6	24.3	23.7
Manganese	µg/L	50^{C}	n/v	≤50^{G}	**4200^{CG}**	**2140^{CG}**	**953^{CG}**	**752^{CG}**	**379^{CG}**	**417^{CG}**	**699^{CG}**	**1220^{CG}**	**656^{CG}**	**596^{CG}**	**318^{CG}**	**64.8^{CG}**	**66.7^{CG}**	**74.1^{CG}**	**70.2^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	0.076	0.15	0.0382	0.0322	<0.005	<0.005	0.0459	0.012	0.0217	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	5.32	5.65	6.04	2.14	1.82	1.66	0.96	1.48	4.88	5.03	5.69	0.972	0.904	1.63	0.9
Nickel	µg/L	n/v	39^{F}	n/v	**96.1^{F}**	**51.9^{F}**	21	22.7	10.3	11.5	19.5	**40.7^{F}**	21.2	18.9	6.78	1.15	1.19	1.56	1.43
Phosphorus	µg/L	n/v	n/v	n/v	9760	4840	2060	1460	1030	732	1140	2810	810	700	234	73	79	64	63
Potassium	mg/L	n/v	n/v	n/v	13.7	10.9	8.21	8.28	5.74	5.37	5.27	8.03	7.23	7.20	5.08	2.61	2.63	2.62	2.78
Rubidium	µg/L	n/v	n/v	n/v	66.5	34.7	17.2	23.8	9.6	12.3	17.8	33.9	20.8	17.8	7.62	1.76	1.88	2.11	2.21
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.5 DM	<0.5 DM	<0.25 GT	<0.5 DM	<0.5 DM	<0.05	<0.5 DM	<0.5 DM	<0.5 DM	<0.5 DM	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	83900	61100	39700	44400	24400	27100	32900	56200	32100	28100	15600	8970	9370	9760	10300
Silver	µg/L	n/v	0.12^{F}	n/v	**0.44^{F}**	**0.27^{F}**	0.112	0.1	<0.1 DM	0.054	<0.1 DM	**0.17^{F}**	<0.1 DM	<0.1 DM	0.026	0.021	0.023	0.022	0.018
Sodium	mg/L	200$_{g}^{C}$ 20$_{g}^{E}$	180^{F}	≤200^{G}	18.0	17.5	15.7	**30.5^{E}**	**26.8^{E}**	**25.8^{E}**	8.77	9.42	**23.0^{E}**	**23.1^{E}**	**21.9^{E}**	6.28	5.72	7.99	6.94
Strontium	µg/L	n/v	n/v	n/v	1690	860	504	675	491	527	437	541	389	366	304	193	187	189	200
Sulfur	µg/L	n/v	n/v	n/v	<5000 DM	<5000 DM	<2500 GT	<5000 DM	<5000 DM	2450	<5000 DM	<5000 DM	<5000 DM	<5000 DM	3320	2930	2910	3010	3160
Tellurium	µg/L	n/v	n/v	n/v	<2 DM	<2 DM	<1 GT	<2 DM	<2 DM	<0.2	<2 DM	<2 DM	<2 DM	<2 DM	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40^{F}	n/v	1.21	0.6	0.26	0.23	0.11	0.125	0.19	0.36	0.22	0.16	0.071	0.011	0.012	0.015	0.016
Thorium	µg/L	n/v	n/v	n/v	37.3	20.4	9.03	16.6	5.8	10.4	7.1	14.8	6	5.8	1.87	0.59	0.66	0.59	0.45
Tin	µg/L	n/v	n/v	n/v	1.2	1.9	1.47	1.3	<1 DM	1.63	1.1	<1 DM	1.1	<1 DM	0.66	0.15	0.14	0.16	0.11
Titanium	µg/L	n/v	n/v	n/v	3650	3360	1730	1470	831	617	1320	2610	1060	901	322	49	49.8	60	59.4
Tungsten	µg/L	n/v	n/v	n/v	<1 DM	<1 DM	<0.5 GT	6.1	6.1	6.08	<1 DM	<1 DM	<1 DM	<1 DM	0.2	0.36	0.23	0.54	0.46
Uranium	µg/L	20^{A}	33^{F}	20^{H}	10.7	6.37	4.02	4.17	1.61	2.86	2.59	3.72	2.81	2.72	2.13	0.244	0.275	0.29	0.209
Vanadium	µg/L	n/v	20^{F}	n/v	**143^{F}**	**90.8^{F}**	**40.4^{F}**	**43.5^{F}**	**20.8^{F}**	**20.6^{F}**	**34.4^{F}**	**73.7^{F}**	**31.2^{F}**	**26^{F}**	9.22	1.62	1.74	2.14	2.11
Zinc	µg/L	5000^{C}	89^{F}	≤5000^{G}	**183^{F}**	**104^{F}**	44	53	<30 DM	29.7	40	79	43	34	10.7	5.4	7.1	4.3	3.9
Zirconium	µg/L	n/v	n/v	n/v	15.1	25.5	16.4	6.1	3.7	4.44	7.6	14.1	9	4.3	3.13	0.44	0.47	0.68	1.5

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater													
Sample Location					MWS-14-02 (OB)			MWS-14-03 OB1			MWS-14-03 OB2			MWS-14-04		MWS-14-06		
Sample Date					15-Jun-16	7-Aug-16	17-Oct-16	19-Jun-16	6-Aug-16	18-Oct-16	21-Jun-16	4-Aug-16	18-Oct-16	8-Aug-16	18-Oct-16	19-Jun-16	5-Aug-16	16-Oct-16
Sample ID					MWS-14-02 OB	MWS-14-02 (OB)	MWS-14-02(OB)	MWS-14-03 OB1	MWS-14-03 OB1	MWS14-03-OB1	MWS-14-03 OB2	MWS-14-03 OB2	MWS14-03-OB2	MWS-14-04	MWS-14-04	MWS-14-06	MWS-14-06	MWS-14-06
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1810001	L1846519	L1786341	L1810001	L1846519	L1787602	L1809307	L1846557	L1810700	L1846557	L1786341	L1810001	L1844384
Laboratory Sample ID					L1784595-2	L1810001-17	L1846519-1	L1786341-19	L1810001-14	L1846519-9	L1787602-2	L1809307-4	L1846557-5	L1810700-2	L1846557-3	L1786341-22	L1810001-3	L1844384-3
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**														
Field Parameters																		
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	5.96	3.8	1.25	0.99	7	3.75	3.74	6.36	6.11	5.98	9.53	0.55	0.6	0.27
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	312	443	536	428	252	287	429	410	465	512	594	706	598	573
pH, Field	S.U.	$6.5\text{-}8.5^{D}$	n/v	$7.0\text{-}10.5^{G}$	7.26	7.25	7.19	7.91	8.12	7.52	7.59	7.35	7.45	7.05	7.12	7.04	7.08	7.08
Temperature, Field	deg C	15^{C}	n/v	$\leq 15^{G}$	4.87	5.9	4.11	3.91	**16.82^{CG}**	6.6	4.14	7	5.31	6.57	3.57	3.39	6.31	7.19
General Chemistry																		
Acidity as CaCO3	mg/L	n/v	n/v	n/v	13.4	8.4	9.1	<2.0	<2.0	<2.0	5.0	3.5	7.0	16.3	10.6	14.6	16.7	22.9
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	300	290	314	231	140	153	275	283	298	327	354	245	257	316
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	$30\text{-}500^{D}$	n/v	n/v	300	290	314	231	140	153	275	283	298	327	354	245	257	316
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.068	<0.20 DM	0.077	0.279	0.039	0.045	0.149	0.22	0.260	0.214	0.169	0.074	0.071	0.035
Anion Sum	meq/L	n/v	n/v	n/v	6.37	6.34	6.49	4.90	2.93	3.21	5.60	5.72	6.11	6.98	7.50	7.32	7.46	6.88
Cation Sum	meq/L	n/v	n/v	n/v	6.22	6.45	6.27	5.08	3.45	3.44	5.53	5.67	5.53	7.26	6.85	8.16	7.82	6.58
Chloride	mg/L	250^{C}	180^{F}	$\leq 250^{G}$	0.41	0.33	0.20	8.66	3.48	3.11	0.41	0.29	0.33	1.15	1.19	74.3	71.2	13.0
Color, True	TCU	5^{C}	n/v	n/v	<2.0	<2.0	<2.0	**16.6^{C}**	2.4	**7.7^{C}**	<2.0	<2.0	-	2.4	-	**9.2^{C}**	**9.2^{C}**	**21.2^{C}**
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	<1.0	1.3	1.5	**15.8^{C}**	**43.7^{C}**	**47.6^{C}**	1.7	1.1	2.1	2.6	3.2	**5.1^{C}**	4.3	**8.9^{C}**
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	522	550	520	423	298	307	478	482	510	635	616	682	736	578
Fluoride	mg/L	1.5_{b}^{A}	n/v	1.5^{H}	0.275	0.259	0.249	0.587	0.706	0.685	0.402	0.333	0.416	0.112	0.112	0.060	0.060	0.045
Hardness (as CaCO3)	mg/L	$80\text{-}100^{D}$	n/v	n/v	**298^{D}**	**309^{D}**	**300^{D}**	98.0	**123^{D}**	**124^{D}**	**236^{D}**	**247^{D}**	**232^{D}**	**348^{D}**	**327^{D}**	**381^{D}**	**360^{D}**	**316^{D}**
Ion Balance	%	n/v	n/v	n/v	<0.000	0.9	<0.000	1.9	8.1	3.4	<0.000	<0.000	<0.000	2.0	<0.000	5.4	2.3	<0.000
Nitrate (as N)	mg/L	10.0_{d}^{A}	n/v	10^{H}	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.042	0.074	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	1.0_{d}^{A}	n/v	1^{H}	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	$6.5\text{-}8.5^{D}$	n/v	$7.0\text{-}10.5^{G}$	7.77	7.66	7.95	8.15	7.85	8.07	7.91	7.84	7.78	7.49	7.98	7.53	7.39	7.52
Phosphorus, Total	mg/L	n/v	n/v	n/v	1.88	1.51	2.78	0.095	0.065	0.74	28.4	4.68	28.1	0.024	0.066	0.110	0.0168	0.023
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0080	0.0069	0.0101	0.0227	<0.0030	0.0039	<0.0030	0.0031	0.0031	<0.0030	0.0053	<0.0030	<0.0030	<0.0030
Sulfate	mg/L	500_{h}^{C}	n/v	$\leq 500_{j}^{G}$	16.7	25.2	9.89	0.51	1.41	1.33	3.66	2.13	5.75	19.2	18.2	15.8	15.4	9.50
Total Dissolved Solids	mg/L	500^{C}	n/v	$\leq 500^{G}$	340	325	308	291	225	238	447	297	311	364	367	449	435	351
Total Organic Carbon	mg/L	n/v	n/v	n/v	6.2	7.9	7.4	16.8	45.9	49.4	281	11.0	4.6	2.0	3.6	5.1	4.4	9.0
Total Suspended Solids	mg/L	n/v	n/v	n/v	3600	8400	6180	21.4	45.2	35.1	33000	10500	25500	113	75.2	283	11.4	22.7

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater													
Sample Location						**MWS-14-02 (OB)**			**MWS-14-03 OB1**			**MWS-14-03 OB2**			**MWS-14-04**		**MWS-14-06**	
Sample Date					**15-Jun-16**	**7-Aug-16**	**17-Oct-16**	**19-Jun-16**	**6-Aug-16**	**18-Oct-16**	**21-Jun-16**	**4-Aug-16**	**18-Oct-16**	**8-Aug-16**	**18-Oct-16**	**19-Jun-16**	**5-Aug-16**	**16-Oct-16**
Sample ID					**MWS-14-02 OB**	**MWS-14-02 (OB)**	**MWS-14-02(OB)**	**MWS-14-03 OB1**	**MWS-14-03 OB1**	**MWS14-03-OB1**	**MWS-14-03 OB2**	**MWS-14-03 OB2**	**MWS14-03-OB2**	**MWS-14-04**	**MWS-14-04**	**MWS-14-06**	**MWS-14-06**	**MWS-14-06**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1784595**	**L1810001**	**L1846519**	**L1786341**	**L1810001**	**L1846519**	**L1787602**	**L1809307**	**L1846557**	**L1810700**	**L1846557**	**L1786341**	**L1810001**	**L1844384**
Laboratory Sample ID					**L1784595-2**	**L1810001-17**	**L1846519-1**	**L1786341-19**	**L1810001-14**	**L1846519-9**	**L1787602-2**	**L1809307-4**	**L1846557-5**	**L1810700-2**	**L1846557-3**	**L1786341-22**	**L1810001-3**	**L1844384-3**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**														
Metals, Dissolved																		
Aluminum	µg/L	100[D]	n/v	<100/200$_{a}$[G]	<2	2.1	<2	<2	2.6	3.1	2.8	<2	11	<2	8.9	3.6	3.5	32.4
Antimony	µg/L	6[B]	1600[F]	6[H]	<0.1	<0.1	<0.1	0.17	0.71	0.3	0.38	0.38	0.31	0.42	0.55	<0.1	<0.1	0.15
Arsenic	µg/L	25[B]	150[F]	10[H]	0.59	0.44	0.32	1.39	0.48	0.29	1.34	1.82	2.32	1.58	2.15	8.72	9.96	**11.9[H]**
Barium	µg/L	1000[A]	2300[F]	1000[H]	37.1	39.1	40.6	25.9	24.5	18.7	49.8	51.7	50.2	161	140	35	38.7	36.7
Beryllium	µg/L	n/v	5.3[F]	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000[B]	3550[F]	5000[H]	10	11	11	51	16	15	20	20	20	16	17	14	16	12
Cadmium	µg/L	5[A]	0.21[F]	5[H]	<0.005	<0.005	<0.005	<0.005	0.0052	<0.005	<0.005	<0.005	<0.005	<0.005	0.0063	0.0163	<0.005	0.0095
Calcium	mg/L	n/v	n/v	n/v	83.0	84.9	86.2	22.1	33.0	35.3	61.1	64.0	58.5	98.5	91.2	124	111	96.9
Cesium	µg/L	n/v	n/v	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.341	0.25	0.114	0.116	0.122
Chromium	µg/L	50[A]	64[F]	50[H]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.28
Cobalt	µg/L	n/v	5.2[F]	n/v	0.17	0.17	<0.1	0.42	0.14	0.11	0.12	0.1	<0.1	0.27	0.41	**6.54[F]**	**6.45[F]**	**6.97[F]**
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	0.23	<0.2	<0.2	<0.2	<0.2	<0.2	0.27	0.32	<0.2	<0.2	0.44	0.57	0.52	1.09
Iron	µg/L	300[C]	n/v	≤300[G]	**438[CG]**	**422[CG]**	**490[CG]**	<10	<10	<10	14	<10	20	247	143	296	283	**333[CG]**
Lead	µg/L	10$_{c}$[A]	2[F]	10[H]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.069
Lithium	µg/L	n/v	n/v	n/v	6.9	7.1	7	4.8	2.4	1.8	6.7	9	7.4	4.1	4	1.9	2.1	1.9
Magnesium	mg/L	n/v	n/v	n/v	22.1	23.5	20.6	10.4	9.98	8.80	20.3	21.2	20.8	24.7	24.1	17.6	20.2	18.0
Manganese	µg/L	50[C]	n/v	≤50[G]	**61.5[CG]**	**55.9[CG]**	42.3	20.4	**66.2[CG]**	**79.4[CG]**	**63.1[CG]**	**54.9[CG]**	46	**79.4[CG]**	**57.1[CG]**	**947[CG]**	**950[CG]**	**854[CG]**
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	1.33	1.27	1.08	17	21.7	26	5.03	4.47	4.84	1.98	2.04	1.47	1.6	1.23
Nickel	µg/L	n/v	39[F]	n/v	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.04	1.88	2.46	2.6	3.38
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	2.49	2.52	2.51	2.09	1.57	1.58	1.94	1.83	2.24	0.882	0.973	0.732	0.860	0.906
Rubidium	µg/L	n/v	n/v	n/v	1.5	1.46	1.43	0.89	0.75	0.74	1.25	1.29	1.38	1.39	1.76	1.34	1.66	1.61
Selenium	µg/L	10[A]	5[F]	50[H]	<0.05	<0.05	<0.05	0.056	<0.05	<0.05	<0.05	<0.05	<0.05	0.094	0.15	<0.05	<0.05	0.064
Silicon	µg/L	n/v	n/v	n/v	6790	7160	7510	4790	1550	1260	7380	8280	8640	7580	7600	5970	6360	7250
Silver	µg/L	n/v	0.12[F]	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L	200$_{g}$[C] 20$_{g}$[E]	180[F]	≤200[G]	3.94	4.40	4.20	**70.1[E]**	**21.5[E]**	**20.8[E]**	17.3	15.6	18.8	6.02	6.25	10.8	12.6	4.34
Strontium	µg/L	n/v	n/v	n/v	131	136	140	145	109	92.9	228	229	215	263	264	211	199	171
Sulfur	µg/L	n/v	n/v	n/v	3560	4020	3200	<500	<500	<500	2570	820	760	5640	5480	5430	5110	3530
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40[F]	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.013
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	0.38	0.39	0.49	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.76	<0.3	<0.3	<0.3	<0.3	1.41
Tungsten	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	17	13.6	14.1	0.15	0.14	0.15	0.69	1.1	0.11	0.12	0.12
Uranium	µg/L	20[A]	33[F]	20[H]	0.68	0.83	0.198	0.205	0.266	0.134	1.35	1.31	0.972	1.95	1.82	1.22	1.37	1.18
Vanadium	µg/L	n/v	20[F]	n/v	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.91	0.9	1.13	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	2.7	<1	<1	<1	<1	<1	1.4	2.2	<1	1.2	2.2	1.3	1.6	<1
Zirconium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1.87	1.25	0.88	0.96	1.4

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater													
Sample Location					MWS-14-02 (OB)			MWS-14-03 OB1			MWS-14-03 OB2			MWS-14-04		MWS-14-06		
Sample Date					15-Jun-16	7-Aug-16	17-Oct-16	19-Jun-16	6-Aug-16	18-Oct-16	21-Jun-16	4-Aug-16	18-Oct-16	8-Aug-16	18-Oct-16	19-Jun-16	5-Aug-16	16-Oct-16
Sample ID					MWS-14-02 OB	MWS-14-02 (OB)	MWS-14-02(OB)	MWS-14-03 OB1	MWS-14-03 OB1	MWS14-03-OB1	MWS-14-03 OB2	MWS-14-03 OB2	MWS14-03-OB2	MWS-14-04	MWS-14-04	MWS-14-06	MWS-14-06	MWS-14-06
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1784595	L1810001	L1846519	L1786341	L1810001	L1846519	L1787602	L1809307	L1846557	L1810700	L1846557	L1786341	L1810001	L1844384
Laboratory Sample ID					L1784595-2	L1810001-17	L1846519-1	L1786341-19	L1810001-14	L1846519-9	L1787602-2	L1809307-4	L1846557-5	L1810700-2	L1846557-3	L1786341-22	L1810001-3	L1844384-3
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**														
Metals, Total																		
Aluminum	µg/L	100[D]	n/v	<100/200$_{a}$[G]	**23300**[DG]	**24000**[DG]	**13500**[DG]	**1240**[DG]	**1500**[DG]	**2870**[DG]	**84800**[DG]	**71300**[DG]	**46400**[DG]	**923**[DG]	**414**[DG]	**3730**[DG]	**548**[DG]	**568**[DG]
Antimony	µg/L	6[B]	1600[F]	6[H]	<0.5 DM	<1 DM	<0.5 IF	0.2	0.77	0.41	<1 DM	<1 DM	<1 GT	0.76	0.82	0.21	0.1	0.12
Arsenic	µg/L	25[B]	150[F]	10[H]	8.88	7.8	4.08	1.76	0.83	5.36	**41.1**[BH]	**30.2**[BH]	**19.4**[H]	2.73	3.87	**12.2**[H]	**10.4**[H]	**11.9**[H]
Barium	µg/L	1000[A]	2300[F]	1000[H]	195	194	151	38	37.7	45.6	628	441	385	202	167	66.4	41.6	38.7
Beryllium	µg/L	n/v	5.3[F]	n/v	0.89	<1 DM	0.54	<0.1	<0.1	0.11	4.1	3.2	1.8	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.25 DM	<0.5 DM	<0.25 IF	<0.05	<0.05	<0.05	0.88	0.75	<0.5 GT	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000[B]	3550[F]	5000[H]	73	<100 DM	<50 IF	58	15	15	280	170	120	16	17	14	14	12
Cadmium	µg/L	5[A]	0.21[F]	5[H]	**0.237**[F]	**0.245**[F]	0.155	0.0124	0.0127	0.0232	**1.69**[F]	**1**[F]	**0.72**[F]	0.0148	0.0181	0.0475	0.0235	0.0258
Calcium	mg/L	n/v	n/v	n/v	657	599	534	25.0	38.9	42.2	4490	2290	1820	102	92.8	113	104	95.8
Cesium	µg/L	n/v	n/v	n/v	1.89	1.98	1.15	0.121	0.149	0.299	6.3	5.3	3.72	0.562	0.406	1.1	0.317	0.35
Chromium	µg/L	50[A]	64[F]	50[H]	**54.7**[AH]	**57.7**[AH]	32.3	2.78	3.43	7.15	**279**[AFH]	**199**[AFH]	**141**[AFH]	1.46	0.88	15.9	2.54	2.59
Cobalt	µg/L	n/v	5.2[F]	n/v	**13.9**[F]	**14.2**[F]	**7.75**[F]	1.02	0.88	1.57	**80.2**[F]	**54.1**[F]	**35.7**[F]	0.73	0.62	**11.8**[F]	**7.33**[F]	**7.68**[F]
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	**37.2**[F]	**37.4**[F]	**17.9**[F]	2.38	2.25	4.29	**227**[F]	**139**[F]	**88.5**[F]	1.7	1.33	**26.1**[F]	6.51	**7**[F]
Iron	µg/L	300[C]	n/v	≤300[G]	**29300**[CG]	**30000**[CG]	**16700**[CG]	**1690**[CG]	**1800**[CG]	**3450**[CG]	**142000**[CG]	**103000**[CG]	**71600**[CG]	**1710**[CG]	**913**[CG]	**4700**[CG]	**941**[CG]	**1030**[CG]
Lead	µg/L	10$_{c}$[A]	2[F]	10[H]	**13.5**[AFH]	**14**[AFH]	**8.41**[F]	0.728	0.983	1.65	**75.3**[AFH]	**53.2**[AFH]	**31.5**[AFH]	1.43	0.638	**2.42**[F]	0.531	0.738
Lithium	µg/L	n/v	n/v	n/v	36.5	34	25.5	6.8	3.2	3.3	153	127	86	4.3	3.3	5.4	2.3	2.7
Magnesium	mg/L	n/v	n/v	n/v	190	168	107	10.7	11.3	10.8	116	618	364	27.5	23.5	21.4	20.9	17.9
Manganese	µg/L	50[C]	n/v	≤50[G]	**1080**[CG]	**1050**[CG]	**818**[CG]	47.3	**108**[CG]	**136**[CG]	**7110**[CG]	**4160**[CG]	**3340**[CG]	**92.9**[CG]	**82**[CG]	**1060**[CG]	**961**[CG]	**866**[CG]
Mercury	µg/L	1[A]	0.77[F]	1[H]	0.009	0.0154	0.0095	<0.005	<0.005	<0.005	0.0154	0.031	0.0396	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	2.32	2.09	1.45	17.1	21.6	27.7	5.69	4.41	4.54	2.43	2.16	2.01	1.69	1.41
Nickel	µg/L	n/v	39[F]	n/v	32.4	34.1	18.6	1.85	2.08	3.94	**191**[F]	**134**[F]	**91**[F]	2.78	1.98	13.9	4.45	5.5
Phosphorus	µg/L	n/v	n/v	n/v	2540	2070	1200	91	51	73	12400	7840	4010	<50	<50	78	<50	<50
Potassium	mg/L	n/v	n/v	n/v	8.28	7.95	6.24	2.50	1.97	2.35	16.9	13.3	10.8	1.37	1.11	1.55	0.957	0.938
Rubidium	µg/L	n/v	n/v	n/v	29.1	31.2	20.1	2.75	2.78	5.24	110	81.4	56.5	3.34	2.42	4.89	2.09	2.09
Selenium	µg/L	10[A]	5[F]	50[H]	<0.25 DM	<0.5 DM	<0.25 IF	0.068	<0.05	<0.05	0.6	<0.5 DM	<0.5 GT	0.197	0.114	0.056	<0.05	0.07
Silicon	µg/L	n/v	n/v	n/v	46800	46900	32800	7250	4600	7250	119000	99200	79300	9910	8550	13300	7100	8060
Silver	µg/L	n/v	0.12[F]	n/v	**0.142**[F]	**0.15**[F]	0.075	0.017	<0.01	0.014	**0.7**[F]	**0.45**[F]	**0.32**[F]	**0.146**[F]	0.103	**0.227**[F]	0.032	0.04
Sodium	mg/L	200$_{g}$[C] 20$_{g}$[E]	180[F]	≤200[G]	7.46	7.78	6.43	**67.9**[E]	**21.1**[E]	**20.2**[E]	**27.5**[E]	**24.4**[E]	**24.2**[E]	6.72	5.78	11.6	13.3	4.55
Strontium	µg/L	n/v	n/v	n/v	483	432	430	142	113	115	2690	1590	1310	297	277	203	188	186
Sulfur	µg/L	n/v	n/v	n/v	5300	<5000 DM	3000	<500	<500	<500	12900	5800	<5000 GT	6940	5550	5670	5190	3890
Tellurium	µg/L	n/v	n/v	n/v	<1 DM	<2 DM	<1 IF	<0.2	<0.2	<0.2	<2 DM	<2 DM	<2 GT	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40[F]	n/v	0.304	0.32	0.21	<0.01	0.017	0.028	1.68	1.12	0.73	0.03	0.02	0.029	0.017	0.021
Thorium	µg/L	n/v	n/v	n/v	11.9	12.9	6.86	0.71	0.97	1.61	51.1	43.3	24.9	1.47	0.6	0.56	0.11	0.13
Tin	µg/L	n/v	n/v	n/v	1.28	1	0.62	0.99	0.97	1.56	<1 DM	1.3	1.1	0.54	0.43	0.29	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	2300	2070	1100	60.2	74.5	143	3910	4240	3580	70.3	32.9	262	35.4	34.9
Tungsten	µg/L	n/v	n/v	n/v	<0.5 DM	<1 DM	<0.5 IF	15.6	12.7	13	<1 DM	<1 DM	<1 GT	1.36	1.18	0.66	0.18	0.2
Uranium	µg/L	20[A]	33[F]	20[H]	4.25	4.51	3	0.365	0.423	0.495	14	10.5	8.07	2.86	2.24	1.32	1.39	1.32
Vanadium	µg/L	n/v	20[F]	n/v	**59.5**[F]	**58.2**[F]	**33**[F]	2.61	2.82	5.61	**247**[F]	**186**[F]	**134**[F]	1.49	0.78	8.96	1.54	1.85
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	61	67	35	5.2	6.9	12.5	**308**[F]	**223**[F]	**151**[F]	7.7	6.6	12.7	3.3	4.2
Zirconium	µg/L	n/v	n/v	n/v	13.3	15.5	10.6	1.34	1.32	1.98	3.7	8.7	16	1.21	1.38	4.42	1.46	2.01

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater							Historical Tailings							
Sample Location					MWS-14-07 BR				MWS-14-07 OB			96-01				96-02			
Sample Date					17-Jun-16	6-Aug-16	12-Oct-16	12-Oct-16	17-Jun-16	6-Aug-16	12-Oct-16	14-Jun-16	4-Aug-16	4-Aug-16	16-Oct-16	14-Jun-16	4-Aug-16	14-Oct-16
Sample ID					MWS-14-07 BR	MWS-14-07 BR	MWS-14-07 BR	DUPLICATE 2	MWS-14-07 OB	MWS-14-07 OB	MWS-14-07 OB	96-01	96-01	DUPLICATE 3	96-01	96-02	96-02	96-02
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1810001	L1843856	L1843856	L1786341	L1810001	L1843856	L1783978	L1809307	L1809307	L1844384	L1783978	L1809307	L1844412
Laboratory Sample ID					L1786341-6	L1810001-15	L1843856-7	L1843856-13	L1786341-5	L1810001-16	L1843856-8	L1783978-7	L1809307-13	L1809307-14	L1844384-11	L1783978-8	L1809307-15	L1844412-7
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**				Field Duplicate						Field Duplicate				
Field Parameters																		
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	2.56	2.51	3.87	-	3.45	3.06	2.62	3.52	0.46	-	0.87	9.53	2.28	2.94
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	597	457	530	-	544	427	514	2815	2548	-	2989	2952	2646	3086
pH, Field	S.U.	$6.5\text{-}8.5^{D}$	n/v	$7.0\text{-}10.5^{G}$	**6.83^{G}**	7.03	**6.93^{G}**	-	**6.79^{G}**	7.02	**6.86^{G}**	**6.98^{G}**	**6.82^{G}**	-	**6.78^{G}**	**6.8^{G}**	**6.94^{G}**	**6.95^{G}**
Temperature, Field	deg C	15^{C}	n/v	$\leq 15^{G}$	2.51	4.32	4.47	-	2.31	4.67	5.13	8.03	7.39	-	4.34	8.49	7.4	4.27
General Chemistry																		
Acidity as CaCO3	mg/L	n/v	n/v	n/v	19.3	17.3	6.3	10.9	19.6	16.2	11.8	55.9	50.0	40.3	62.2	96.7	75.7	59.7
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	318	306	332	332	307	286	313	352	355	332	374	380	369	375
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	$30\text{-}500^{D}$	n/v	n/v	318	306	332	332	307	286	313	352	355	332	374	380	369	375
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.060	0.065	0.062	0.056	<0.020	<0.020	<0.020	0.634	0.611	0.87	0.678	4.06	0.96	1.73
Anion Sum	meq/L	n/v	n/v	n/v	6.49	6.30	6.78	6.79	6.28	5.85	6.40	40.9	42.1	44.8	43.9	44.5	44.8	45.8
Cation Sum	meq/L	n/v	n/v	n/v	7.05	6.52	6.79	6.57	6.69	5.95	6.35	42.2	42.7	42.7	42.8	45.0	45.7	46.0
Chloride	mg/L	250^{C}	180^{F}	$\leq 250^{G}$	0.47	0.50	0.57	0.57	0.51	0.55	0.78	6.3	5.0	5.5	5.43	7.54	6.8	6.9
Color, True	TCU	5^{C}	n/v	n/v	2.3	<2.0	<2.0	<2.0	3.6	2.5	<2.0	4.5	4.5	4.7	**14.0^{C}**	<2.0	<2.0	<2.0
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	**0.0280^{F}**	**0.0261^{F}**	**0.0251^{F}**	**0.0244^{F}**	**0.104^{F}**	**0.0214^{F}**	**0.301^{FH}**
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL	0.0034
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	**5.4^{C}**	4.3	3.8	3.8	3.9	4.1	3.6	4.9	**5.2^{C}**	4.9	**7.1^{C}**	2.4	2.1	3.1
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	545	570	554	559	541	535	527	2850	2900	2900	2900	2900	2880	2900
Fluoride	mg/L	1.5_{b}^{A}	n/v	1.5^{H}	0.054	0.050	0.054	0.054	0.058	0.054	0.066	<0.20 DM	<0.20 GT	<0.40 GT	0.11	0.19	<0.40 GT	<0.40 GT
Hardness (as CaCO3)	mg/L	$80\text{-}100^{D}$	n/v	n/v	**336^{D}**	**311^{D}**	**320^{D}**	**311^{D}**	**325^{D}**	**291^{D}**	**308^{D}**	**3440^{D}**	**1980^{D}**	**1980^{D}**	**1990^{D}**	**2070^{D}**	**2100^{D}**	**2130^{D}**
Ion Balance	%	n/v	n/v	n/v	4.1	1.7	0.0	<0.000	3.1	0.8	<0.000	1.6	0.7	<0.000	<0.000	0.5	1.0	0.3
Nitrate (as N)	mg/L	10.0_{d}^{A}	n/v	10^{H}	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.20 DM	<0.20 GT	<0.40 GT	<0.10 DM	<0.10 DM	<0.40 GT	<0.40 GT
Nitrite (as N)	mg/L	1.0_{d}^{A}	n/v	1^{H}	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.10 DM	<0.10 GT	<0.20 GT	<0.050 DM	<0.050 DM	<0.20 GT	<0.20 GT
pH	S.U.	$6.5\text{-}8.5^{D}$	n/v	$7.0\text{-}10.5^{G}$	7.43	7.50	7.89	7.82	7.46	7.43	7.82	**6.99^{G}**	7.10	7.12	7.19	**6.85^{G}**	**6.86^{G}**	**6.86^{G}**
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.682	0.173	0.648	0.720	0.029	0.054	0.152	3.07	1.22	6.29	1.42	31.8	2.77	67.6
Phosphorus, Total	mg/L	n/v	n/v	n/v	<0.0030	<0.0030	0.0059	0.0077	<0.0030	<0.0030	<0.0030	0.0038	0.0353	0.0252	0.0194	0.0641	0.0704	0.0698
Sulfate	mg/L	500_{h}^{C}	n/v	$\leq 500_{j}^{G}$	5.85	7.80	6.39	6.70	6.20	5.40	5.56	**1620^{CG}**	**1680^{CG}**	**1830^{CG}**	**1740^{CG}**	**1760^{CG}**	**1790^{CG}**	**1830^{CG}**
Total Dissolved Solids	mg/L	500^{C}	n/v	$\leq 500^{G}$	332	323	326	321	327	289	317	**2870^{CG}**	**2990^{CG}**	**2910^{CG}**	**2800^{CG}**	**2910^{CG}**	**2860^{CG}**	**2990^{CG}**
Total Organic Carbon	mg/L	n/v	n/v	n/v	6.8	4.0	7.6	6.7	4.0	3.7	4.8	15.9	4.7	21.2	<20 DM	154	9.6	10.0
Total Suspended Solids	mg/L	n/v	n/v	n/v	2060	501	2610	1610	74.6	110	565	20200	22200	18900	9830	20400	4070	60400

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater							Historical Tailings						
Sample Location					MWS-14-07 BR				MWS-14-07 OB			96-01				96-02		
Sample Date					17-Jun-16	6-Aug-16	12-Oct-16	12-Oct-16	17-Jun-16	6-Aug-16	12-Oct-16	14-Jun-16	4-Aug-16	4-Aug-16	16-Oct-16	14-Jun-16	4-Aug-16	14-Oct-16
Sample ID					MWS-14-07 BR	MWS-14-07 BR	MWS-14-07 BR	DUPLICATE 2	MWS-14-07 OB	MWS-14-07 OB	MWS-14-07 OB	96-01	96-01	DUPLICATE 3	96-01	96-02	96-02	96-02
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1810001	L1843856	L1843856	L1786341	L1810001	L1843856	L1783978	L1809307	L1809307	L1844384	L1783978	L1809307	L1844412
Laboratory Sample ID					L1786341-6	L1810001-15	L1843856-7	L1843856-13	L1786341-5	L1810001-16	L1843856-8	L1783978-7	L1809307-13	L1809307-14	L1844384-11	L1783978-8	L1809307-15	L1844412-7
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**				Field Duplicate						Field Duplicate				
Metals, Dissolved																		
Aluminum	µg/L	100^{D}	n/v	$<100/200_{a}^{G}$	3.1	3.1	42.3	46.1	2.1	2.2	44.2	**6490^{DG}**	<20 GT	<20 GT	<20 DM	<20 IF	38	<40 GT
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	0.14	0.16	0.15	0.16	<0.1	<0.1	0.11	<1	<1 GT	<1 GT	<1 DM	1.2	<1 GT	**8^{BH}**
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	2.34	2.74	3.4	3.37	1.18	1.13	1.32	7.9	5.5	4.3	<1 DM	**6640^{BFH}**	**6620^{BFH}**	**6270^{BFH}**
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	19.4	20.6	22.6	22.7	18.8	19.4	22.5	110	23.4	22.5	21.7	19.7	17.7	23.7
Beryllium	µg/L	n/v	5.3^{F}	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<1 GT	<1 GT	<1 DM	<1 IF	<1 GT	<2 GT
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 IF	<0.05	<1 GT
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<10	<10	<10	<10	<10	<10	<10	<100	<100 GT	<100 GT	<100 DM	<100 IF	<100 GT	<200 GT
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	<0.005	<0.005	<0.005	<0.005	0.0114	0.0078	0.0112	**0.609^{F}**	<0.05 GT	<0.05 GT	<0.05 DM	<0.05 IF	<0.05 GT	<0.1 GT
Calcium	mg/L	n/v	n/v	n/v	101	91.0	94.2	91.6	96.4	85.9	91.5	1120	573	579	579	510	528	526
Cesium	µg/L	n/v	n/v	n/v	0.099	0.081	0.088	0.088	0.046	0.044	0.04	0.57	<0.1 GT	<0.1 GT	<0.1 DM	<0.1 IF	<0.1 GT	<0.2 GT
Chromium	µg/L	50^{A}	64^{F}	50^{H}	<0.1	0.1	0.17	<0.1	0.13	0.13	<0.1	11.9	<1 GT	<1 GT	<1 DM	<1 IF	<1 GT	<2 GT
Cobalt	µg/L	n/v	5.2^{F}	n/v	1.44	1.61	1.43	1.48	0.26	0.2	0.61	**15.9^{F}**	**8.8^{F}**	**8.5^{F}**	**8.7^{F}**	1.2	1.1	2.9
Copper	µg/L	1000^{C}	6.9^{F}	$\leq 1000^{G}$	0.86	0.73	0.73	0.64	2.3	2.26	2.08	**9.1^{F}**	<2 GT	<2 GT	<2 DM	<2 IF	<2 GT	<4 GT
Iron	µg/L	300^{C}	n/v	$\leq 300^{G}$	**328^{CG}**	**412^{CG}**	**689^{CG}**	**644^{CG}**	<10	<10	47	**5580^{CG}**	**1060^{CG}**	**1040^{CG}**	**800^{CG}**	**47000^{CG}**	**45200^{CG}**	**40600^{CG}**
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	**4^{F}**	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 IF	<0.5 GT	<1 GT
Lithium	µg/L	n/v	n/v	n/v	1.5	1.6	2.1	1.9	1.2	1.5	1.8	17	<10 GT	<10 GT	<10 DM	13	<10 GT	<20 GT
Magnesium	mg/L	n/v	n/v	n/v	20.2	20.3	20.6	19.9	20.6	18.6	19.3	158	133	131	133	193	191	198
Manganese	µg/L	50^{C}	n/v	$\leq 50^{G}$	**59.5^{CG}**	**56.4^{CG}**	**68.8^{CG}**	**64.6^{CG}**	29.4	17.4	**64.3^{CG}**	**4320^{CG}**	**3370^{CG}**	**3390^{CG}**	**3330^{CG}**	**451^{CG}**	**426^{CG}**	**488^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	<0.005	<0.005	<0.005	<0.005	0.0082	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	0.676	0.829	0.584	0.599	0.609	0.514	0.804	0.74	0.53	0.61	0.6	3.83	5.84	13.7
Nickel	µg/L	n/v	39^{F}	n/v	4.11	4.73	4.07	3.99	2.93	2.69	3.12	13.3	<5 GT	<5 GT	<5 DM	<5 IF	<5 GT	<10 GT
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<50	<500	<500 GT	<500 GT	<500 DM	<500 IF	510	<1000 GT
Potassium	mg/L	n/v	n/v	n/v	1.49	1.74	1.83	1.80	1.26	1.27	1.60	6.25	3.92	3.92	3.94	35.6	35.5	36.8
Rubidium	µg/L	n/v	n/v	n/v	3.37	3.89	3.95	3.81	2.64	2.87	3.2	13	<2 GT	<2 GT	<2 DM	5.3	5.3	5.6
Selenium	µg/L	10^{A}	5^{F}	50^{H}	0.1	0.124	0.117	0.118	0.099	0.103	0.121	<0.5	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 IF	<0.5 GT	<1 GT
Silicon	µg/L	n/v	n/v	n/v	5240	5520	6200	5720	5340	5150	5810	28700	7810	7840	8160	11500	11200	11500
Silver	µg/L	n/v	0.12^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1 GT	<0.1 GT	<0.1 DM	<0.1 IF	<0.1 GT	***<0.2 GT***
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	$\leq 200^{G}$	6.33	5.40	6.72	6.20	3.49	2.33	3.33	**68.6^{E}**	**63.9^{E}**	**63.4^{E}**	**61.7^{E}**	5.56	6.06	5.3
Strontium	µg/L	n/v	n/v	n/v	88.5	84.1	82.2	85.1	77.6	73.2	72.5	1320	965	981	917	2610	2740	2540
Sulfur	µg/L	n/v	n/v	n/v	2150	2210	2550	2180	2360	1820	2110	610000	607000	608000	639000	667000	612000	612000
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<2 GT	<2 GT	<2 DM	<2 IF	<2 GT	<4 GT
Thallium	µg/L	n/v	40^{F}	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1 GT	<0.1 GT	<0.1 DM	<0.1 IF	<0.1 GT	<0.2 GT
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	4.1	<1 GT	<1 GT	<1 DM	<1 IF	<1 GT	<2 GT
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<1 GT	<1 GT	<1 DM	<1 IF	<1 GT	<2 GT
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	1.91	1.83	<0.3	<0.3	1.81	379	<3 GT	<3 GT	<3 DM	<3 IF	5.4	<6 GT
Tungsten	µg/L	n/v	n/v	n/v	1.22	1.4	1.4	1.38	0.1	<0.1	<0.1	<1	<1 GT	<1 GT	<1 DM	2.5	10.3	<2 GT
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.534	0.611	0.514	0.529	0.402	0.412	0.397	5.56	4.2	4.26	4.05	<0.1 IF	<0.1 GT	<0.2 GT
Vanadium	µg/L	n/v	20^{F}	n/v	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	14.7	<5 GT	<5 GT	<5 DM	<5 IF	<5 GT	<10 GT
Zinc	µg/L	5000^{C}	89^{F}	$\leq 5000^{G}$	1.6	1.6	1.3	1.7	1.2	1.4	1.3	15	<10 GT	<10 GT	<10 DM	<10 IF	<10 GT	<20 GT
Zirconium	µg/L	n/v	n/v	n/v	0.35	0.39	0.43	0.42	<0.3	<0.3	<0.3	10.2	<3 GT	<3 GT	<3 DM	<3 IF	<3 GT	<6 GT

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Groundwater							Historical Tailings						
Sample Location					MWS-14-07 BR				MWS-14-07 OB			96-01				96-02		
Sample Date					17-Jun-16	6-Aug-16	12-Oct-16	12-Oct-16	17-Jun-16	6-Aug-16	12-Oct-16	14-Jun-16	4-Aug-16	4-Aug-16	16-Oct-16	14-Jun-16	4-Aug-16	14-Oct-16
Sample ID					MWS-14-07 BR	MWS-14-07 BR	MWS-14-07 BR	DUPLICATE 2	MWS-14-07 OB	MWS-14-07 OB	MWS-14-07 OB	96-01	96-01	DUPLICATE 3	96-01	96-02	96-02	96-02
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786341	L1810001	L1843856	L1843856	L1786341	L1810001	L1843856	L1783978	L1809307	L1809307	L1844384	L1783978	L1809307	L1844412
Laboratory Sample ID					L1786341-6	L1810001-15	L1843856-7	L1843856-13	L1786341-5	L1810001-16	L1843856-8	L1783978-7	L1809307-13	L1809307-14	L1844384-11	L1783978-8	L1809307-15	L1844412-7
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**				Field Duplicate						Field Duplicate				
Metals, Total																		
Aluminum	µg/L	100[D]	n/v	<100/200$_a$[G]	**8230[DG]**	**2570[DG]**	**7890[DG]**	**7220[DG]**	**986[DG]**	**1100[DG]**	**4500[DG]**	<30 DM	**19000[DG]**	**79300[DG]**	**33700[DG]**	**169000[DG]**	**25000[DG]**	**121000[DG]**
Antimony	µg/L	6[B]	1600[F]	6[H]	<1 DM	0.39	0.62	0.61	0.26	0.13	0.24	<1 DM	<1 DM	<1 DM	<1 GT	***<10 DM***	4.8	6
Arsenic	µg/L	25[B]	150[F]	10[H]	8.2	4.75	9.65	9.58	3.7	3.86	**12[H]**	2.2	**20.3[H]**	**146[BH]**	**37.2[BH]**	**31300[BFH]**	**9290[BFH]**	**20600[BFH]**
Barium	µg/L	1000[A]	2300[F]	1000[H]	80	37	86	79.9	26	25.1	48.1	21.4	195	805	293	**1900[AH]**	223	**1010[AH]**
Beryllium	µg/L	n/v	5.3[F]	n/v	<1 DM	<0.1	0.29	0.29	<0.1	<0.1	0.11	<1 DM	<1 DM	3.7	1.6	***<10 DM***	<1 DM	4.8
Bismuth	µg/L	n/v	n/v	n/v	<0.5 DM	<0.05	0.101	0.096	<0.05	<0.05	0.088	<0.5 DM	<0.5 DM	1.06	<0.5	<5 DM	<0.5 DM	2.6
Boron	µg/L	5000[B]	3550[F]	5000[H]	<100 DM	<10	17	16	<10	<10	<10	<100 DM	<100 DM	150	<100 DM	<1000 DM	<100 DM	<200 DM
Cadmium	µg/L	5[A]	0.21[F]	5[H]	0.067	0.0321	0.0756	0.0664	0.0222	0.0211	0.0587	<0.05 DM	**0.426[F]**	**1.77[F]**	**0.586[F]**	**5.94[AFH]**	**0.529[F]**	**2.14[F]**
Calcium	mg/L	n/v	n/v	n/v	253	144	230	215	105	93.2	120	567	890	2660	1220	1890	642	1730
Cesium	µg/L	n/v	n/v	n/v	1.48	0.547	1.48	1.38	0.21	0.227	0.68	<0.1 DM	1.68	7.74	3.34	50.1	5.33	23.5
Chromium	µg/L	50[A]	64[F]	50[H]	20.6	6.45	20	18.7	2.88	3.7	13.2	<1 DM	**51[AH]**	**254[AFH]**	**91.3[AFH]**	**760[AFH]**	**104[AFH]**	**488[AFH]**
Cobalt	µg/L	n/v	5.2[F]	n/v	**10.3[F]**	4.14	**10.6[F]**	**10.1[F]**	2.39	2.95	**8.55[F]**	**8.9[F]**	**23.2[F]**	**85.6[F]**	**33.2[F]**	**209[F]**	**22.2[F]**	**89.4[F]**
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	**31.4[F]**	**19.8[F]**	**54.6[F]**	**50.4[F]**	**9.43[F]**	**10.2[F]**	**31.1[F]**	<5 DM	**34.5[F]**	**199[F]**	**63[F]**	**799[F]**	**71.9[F]**	**427[F]**
Iron	µg/L	300[C]	n/v	≤300[G]	**10700[CG]**	**3740[CG]**	**10700[CG]**	**10100[CG]**	**1630[CG]**	**1920[CG]**	**6900[CG]**	**590[CG]**	**27400[CG]**	**140000[CG]**	**48300[CG]**	**1410000[CG]**	**202000[CG]**	**562000[CG]**
Lead	µg/L	10$_c$[A]	2[F]	10[H]	**5.94[F]**	**2.01[F]**	**6.78[F]**	**5.94[F]**	0.98	1.11	**4.05[F]**	<0.5 DM	**11.6[AFH]**	**69.6[AFH]**	**22.7[AFH]**	**348[AFH]**	**32[AFH]**	**185[AFH]**
Lithium	µg/L	n/v	n/v	n/v	<10 DM	4	10.5	10	2.4	2.1	6.1	10	34	144	67	120	27	109
Magnesium	mg/L	n/v	n/v	n/v	74.2	38.4	54.4	51.3	19.6	21.6	27.2	134	228	694	275	636	249	435
Manganese	µg/L	50[C]	n/v	≤50[G]	**445[CG]**	**161[CG]**	**398[CG]**	**368[CG]**	**125[CG]**	**152[CG]**	**297[CG]**	**3420[CG]**	**4550[CG]**	**8340[CG]**	**5100[CG]**	**20700[CG]**	**2390[CG]**	**9350[CG]**
Mercury	µg/L	1[A]	0.77[F]	1[H]	0.0245	<0.005	<0.005	<0.005	0.0071	<0.005	<0.005	0.0914	0.03	0.0731	0.047	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	1.37	1.34	2.27	2.21	0.868	0.717	1.38	0.61	0.93	2.25	1.48	24.7	6.02	15
Nickel	µg/L	n/v	39[F]	n/v	20.8	10	23	24.2	7.57	7.73	22.2	<5 DM	35.1	**172[F]**	**61.9[F]**	**734[F]**	**75.2[F]**	**276[F]**
Phosphorus	µg/L	n/v	n/v	n/v	690	239	560	549	<50	67	180	<500 DM	1150	7180	2350	24200	1790	9600
Potassium	mg/L	n/v	n/v	n/v	3.99	2.47	3.97	3.98	1.49	1.58	2.46	3.77	7.76	16.6	9.90	89.0	41.3	69.0
Rubidium	µg/L	n/v	n/v	n/v	14.1	7.01	14.5	13.9	3.95	4.05	8.64	<2 DM	25.4	110	45.4	349	45	213
Selenium	µg/L	10[A]	5[F]	50[H]	<0.5 DM	0.115	0.128	0.157	0.093	0.088	0.13	<0.5 DM	<0.5 DM	0.76	<0.5 GT	<5 DM	<0.5 DM	<1 DM
Silicon	µg/L	n/v	n/v	n/v	18900	9990	19600	18300	6740	6850	12500	8200	42600	113000	65700	210000	47500	149000
Silver	µg/L	n/v	0.12[F]	n/v	**0.96[F]**	**0.192[F]**	**0.858[F]**	**0.716[F]**	0.028	0.019	0.058	<0.1 DM	**0.14[F]**	**0.58[F]**	**0.26[F]**	**3.3[F]**	**0.31[F]**	**1.66[F]**
Sodium	mg/L	200$_g$[C] 20$_g$[E]	180[F]	≤200[G]	9.48	5.40	7.43	7.22	3.20	2.77	3.65	**62.7[E]**	**71.6[E]**	**79.9[E]**	**72.9[E]**	8.1	6.18	7.6
Strontium	µg/L	n/v	n/v	n/v	212	116	181	172	87.6	77.2	98.9	958	1200	2270	1420	5880	2900	4370
Sulfur	µg/L	n/v	n/v	n/v	<5000 DM	2220	2980	3010	2270	1820	2110	634000	629000	685000	643000	765000	625000	658000
Tellurium	µg/L	n/v	n/v	n/v	<2 DM	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2 DM	<2 DM	<2 DM	<2 GT	<20 DM	<2 DM	<4 DM
Thallium	µg/L	n/v	40[F]	n/v	<0.1 DM	0.034	0.094	0.091	0.019	0.019	0.063	<0.1 DM	0.26	1.42	0.51	2.3	0.28	1.51
Thorium	µg/L	n/v	n/v	n/v	3.5	1.13	3.05	2.84	0.34	0.42	1.69	<1 DM	10.3	62.3	20.5	45	5.7	33.8
Tin	µg/L	n/v	n/v	n/v	<1 DM	0.53	1.08	1.05	0.22	0.22	0.36	<1 DM	<1 DM	2.4	1.5	<10 DM	1.3	2.4
Titanium	µg/L	n/v	n/v	n/v	702	220	628	600	61.8	75	283	<3 DM	1740	4670	2900	6620	1160	4580
Tungsten	µg/L	n/v	n/v	n/v	2.3	1.6	4.49	3.59	<0.1	<0.1	0.2	<1 DM	<1 DM	1.5	<1 GT	49	26.9	48.3
Uranium	µg/L	20[A]	33[F]	20[H]	1.89	0.963	1.72	1.65	0.472	0.476	0.679	4.32	5.86	14.6	7.87	6.6	0.93	3.87
Vanadium	µg/L	n/v	20[F]	n/v	20	6.61	18.7	17.8	2.55	3.17	10.8	<5 DM	**52.6[F]**	**232[F]**	**92.3[F]**	**375[F]**	**59[F]**	**266[F]**
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	30	11.8	33.4	30.7	10.4	9.6	25.5	<30 DM	57	**302[F]**	**106[F]**	**1370[F]**	**141[F]**	**683[F]**
Zirconium	µg/L	n/v	n/v	n/v	6.4	2.76	5.38	5.22	1.42	1.26	3.8	<3 DM	22	24.7	26.3	<30 DM	15.2	19.9

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Historical Tailings														
Sample Location					96-03			96-04			96-07A1			96-07A2			96-12A		
Sample Date					13-Jun-16	3-Aug-16	13-Oct-16	13-Jun-16	3-Aug-16	13-Oct-16	14-Jun-16	4-Aug-16	14-Oct-16	14-Jun-16	4-Aug-16	14-Oct-16	13-Jun-16	4-Aug-16	14-Oct-16
Sample ID					96-03	96-03	96-03	96-04	96-04	96-04	96-07A1	96-07A1	96-07A1	96-07A2	96-07A2	96-07A2	96-12A	96-12A	96-12A
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1783307	L1808958	L1843864	L1783307	L1808958	L1843864	L1783978	L1809307	L1844412	L1783978	L1809307	L1844412	L1783307	L1809307	L1844412
Laboratory Sample ID					L1783307-3	L1808958-4	L1843864-5	L1783307-4	L1808958-5	L1843864-4	L1783978-5	L1809307-9	L1844412-10	L1783978-6	L1809307-10	L1844412-9	L1783307-1	L1809307-12	L1844412-4
Sample Type	Units	ODWS	MOE APV	Health Canada															
Field Parameters																			
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	4.59	0.77	0.5	5.82	2.07	4.15	5.39	0.37	0.54	5.9	3.12	1.03	5.04	0.35	0.59
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	3227	2439	2705	2710	2925	3218	2973	2661	3153	3077	2776	3365	2962	2628	3025
pH, Field	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	7.05	**6.85[G]**	**6.96[G]**	**6.96[G]**	**6.75[G]**	**6.87[G]**	**6.77[G]**	**6.87[G]**	**6.94[G]**	**6.64[G]**	**6.77[G]**	**6.88[G]**	**6.82[G]**	**6.75[G]**	**6.8[G]**
Temperature, Field	deg C	15[C]	n/v	≤15[G]	6.79	6.8	6.29	8.24	6.92	6.52	8.04	7.48	4.09	9	9.95	4.47	6.8	6.94	4.64
General Chemistry																			
Acidity as CaCO3	mg/L	n/v	n/v	n/v	101	62.2	38.5	43.6	104	78.3	98.1	54.3	51.7	180	134	206	8.0	128	149
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	328	-	342	419	-	429	291	284	281	345	322	383	447	470	461
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500[D]	n/v	n/v	328	322	342	419	410	429	291	284	281	345	322	383	447	470	461
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.276	0.314	0.285	2.38	2.06	2.05	2.40	1.82	1.34	0.770	1.27	0.811	1.33	1.45	1.27
Anion Sum	meq/L	n/v	n/v	n/v	33.1	33.9	38.4	46.9	43.0	49.0	45.9	39.3	48.1	45.9	49.5	54.3	39.1	46.0	44.2
Cation Sum	meq/L	n/v	n/v	n/v	37.8	39.1	38.1	48.2	50.6	49.4	43.8	46.9	44.4	43.5	49.0	49.9	43.9	46.4	44.7
Chloride	mg/L	250[C]	180[F]	≤250[G]	45.8	44.7	53.4	5.8	3.6	4.6	10.7	9.0	11.0	5.4	4.58	4.3	6.8	8.8	7.55
Color, True	TCU	5[C]	n/v	n/v	2.9	3.0	2.8	2.4	2.1	**9.8[C]**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	**10.3[C]**	**17.5[C]**	**7.6[C]**
Cyanide	mg/L	n/v	0.0052[F]	0.2[H]	**0.0326[F]**	**0.0308[F]**	**0.0281[F]**	**0.0174[F]**	**0.0219[F]**	**0.0154[F]**	**0.0225[F]**	**0.0161[F]**	**0.0197[F]**	**0.0183[F]**	**0.0207[F]**	**0.0243[F]**	**0.0179[F]**	**0.0165[F]**	**0.0139[F]**
Cyanide (Free)	mg/L	0.2[A]	n/v	0.2[H]	<0.0050	<0.0050	<0.0050 BL	<0.0050 BL	<0.0050	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	0.0038	0.0049	0.0047	<0.0020 BL	<0.0020	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL	<0.0020 BL
Dissolved Organic Carbon (DOC)	mg/L	5[C]	n/v	n/v	**9.2[C]**	**8.6[C]**	**9.6[C]**	**5.6[C]**	3.0	2.6	3.9	1.8	2.7	2.4	2.7	3.4	**11.7[C]**	**11.7[C]**	**9.9[C]**
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	2700	2730	2680	3190	3160	3120	2940	2940	2940	2990	2990	3160	2970	2960	2960
Fluoride	mg/L	1.5$_b$[A]	n/v	1.5[H]	<0.40 GT	<0.40 GT	<0.40 GT	<0.40 GT	<0.40 GT	<0.40 GT	<0.20 DM	<0.40 GT	<0.10 GT	0.21	0.21	<0.20 GT	<0.40 GT	<0.20 GT	<0.10 GT
Hardness (as CaCO3)	mg/L	80-100[D]	n/v	n/v	**1680[D]**	**1740[D]**	**1700[D]**	**2230[D]**	**2340[D]**	**2290[D]**	**1990[D]**	**2140[D]**	**2020[D]**	**1930[D]**	**2210[D]**	**2220[D]**	**1960[D]**	**2060[D]**	**2010[D]**
Ion Balance	%	n/v	n/v	n/v	6.6	7.1	<0.000	1.4	8.1	0.4	<0.000	8.9	<0.000	<0.000	<0.000	<0.000	5.8	0.5	0.5
Nitrate (as N)	mg/L	10.0$_d$[A]	n/v	10[H]	<0.40 GT	<0.40 GT	<0.40 GT	<0.40 GT	<0.40 GT	<0.40 GT	<0.20 DM	<0.40 GT	<0.10 GT	<0.20 DM	<0.10 GT	<0.20 GT	<0.40 GT	<0.20 GT	<0.10 GT
Nitrite (as N)	mg/L	1.0$_d$[A]	n/v	1[H]	<0.20 GT	<0.20 GT	<0.20 GT	<0.20 GT	<0.20 GT	<0.20 GT	<0.10 DM	<0.20 GT	<0.050 GT	<0.10 DM	<0.050 GT	<0.10 GT	<0.20 GT	<0.10 GT	<0.050 GT
pH	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	7.29	7.13	7.42	**6.97[G]**	**6.96[G]**	7.14	**6.77[G]**	**6.76[G]**	**6.73[G]**	**6.72[G]**	**6.65[G]**	**6.67[G]**	**6.86[G]**	**6.88[G]**	**6.83[G]**
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.288	0.204	0.062	3.74	0.520	1.62	2.14	6.90	6.05	0.275	1.82	0.204	7.75	6.67	9.51
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0149	0.0108	0.0158	0.375	0.400	0.518	0.0642	0.0904	0.343	0.0453	0.0436	0.0917	0.186	0.202	0.0727
Sulfate	mg/L	500$_h$[C]	n/v	≤500$_j$[G]	**1210[CG]**	**1260[CG]**	**1440[CG]**	**1840[CG]**	**1670[CG]**	**1930[CG]**	**1910[CG]**	**1600[CG]**	**2020[CG]**	**1870[CG]**	**2060[CG]**	**2230[CG]**	**1440[CG]**	**1750[CG]**	**1670[CG]**
Total Dissolved Solids	mg/L	500[C]	n/v	≤500[G]	**2460[CG]**	**2460[CG]**	**2410[CG]**	**2820[CG]**	**3130[CG]**	**3150[CG]**	**2850[CG]**	**2990[CG]**	**2430[CG]**	**3020[CG]**	**3120[CG]**	**3180[CG]**	**3180[CG]**	**2830[CG]**	**2690[CG]**
Total Organic Carbon	mg/L	n/v	n/v	n/v	10.1	9.4	8.2	19.8	5.9	3.5	<5.0 DM	5.0	3.4	3.3	3.8	3.7	31.1	72.7	9.4
Total Suspended Solids	mg/L	n/v	n/v	n/v	1100	742	148	5040	3630	2310	5440	3430	3790	290	1060	259	26800	12600	70700

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Sample Location	Units	ODWS	MOE APV	Health Canada	Historical Tailings 96-03			96-04			96-07A1			96-07A2			96-12A		
Sample Date					13-Jun-16	3-Aug-16	13-Oct-16	13-Jun-16	3-Aug-16	13-Oct-16	14-Jun-16	4-Aug-16	14-Oct-16	14-Jun-16	4-Aug-16	14-Oct-16	13-Jun-16	4-Aug-16	14-Oct-16
Sample ID					96-03	96-03	96-03	96-04	96-04	96-04	96-07A1	96-07A1	96-07A1	96-07A2	96-07A2	96-07A2	96-12A	96-12A	96-12A
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1783307	L1808958	L1843864	L1783307	L1808958	L1843864	L1783978	L1809307	L1844412	L1783978	L1809307	L1844412	L1783307	L1809307	L1844412
Laboratory Sample ID					L1783307-3	L1808958-4	L1843864-5	L1783307-4	L1808958-5	L1843864-4	L1783978-5	L1809307-9	L1844412-10	L1783978-6	L1809307-10	L1844412-9	L1783307-1	L1809307-12	L1844412-4
Sample Type	Units	ODWS	MOE APV	Health Canada															
Metals, Dissolved																			
Aluminum	µg/L	100[D]	n/v	<100/200[a][G]	<20 GT	<20 GT	<20 DM	<20 GT	<20 GT	30	<20 GT	<20 GT	71	<20 IF	<20 GT	-	<20 GT	<20 GT	25
Antimony	µg/L	6[B]	1600[F]	6[H]	<1 GT	<1 GT	<1 DM	<1 GT	1.1	<1 DM	<1 GT	<1 GT	<1 GT	<1 IF	<1 GT	-	<1 GT	<1 GT	<1 DM
Arsenic	µg/L	25[B]	150[F]	10[H]	7.8	7.3	8.29	**16500[BFH]**	**18300[BFH]**	**17000[BFH]**	**9800[BFH]**	**8690[BFH]**	**9260[BFH]**	**5430[BFH]**	**5810[BFH]**	-	**5490[BFH]**	**5260[BFH]**	**5090[BFH]**
Barium	µg/L	1000[A]	2300[F]	1000[H]	36.5	36	36.3	14.6	14.4	14.1	12.1	11.5	12.2	13.3	13.1	-	147	148	163
Beryllium	µg/L	n/v	5.3[F]	n/v	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<1 GT	<1 IF	<1 GT	-	<1	<1 GT	<1 DM
Bismuth	µg/L	n/v	n/v	n/v	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 GT	<0.5 GT	<0.5 GT	<0.5 IF	<0.5 GT	-	<0.5 GT	<0.5 GT	<0.5 DM
Boron	µg/L	5000[B]	3550[F]	5000[H]	<100 GT	<100 GT	<100 DM	160	170	180	130	140	130	<100 IF	<100 GT	-	<100 GT	<100 GT	<100 DM
Cadmium	µg/L	5[A]	0.21[F]	5[H]	<0.05 GT	<0.05 GT	<0.05 DM	<0.05 GT	<0.05 GT	<0.05 DM	<0.05 GT	<0.05 GT	<0.05 GT	<0.05 IF	<0.05 GT	-	<0.05 GT	<0.05 GT	<0.05 DM
Calcium	mg/L	n/v	n/v	n/v	495	518	518	517	538	556	483	535	497	473	546	-	526	555	554
Cesium	µg/L	n/v	n/v	n/v	<0.1 GT	0.11	<0.1 DM	<0.1 GT	<0.1 GT	<0.1 DM	<0.1 GT	<0.1 GT	<0.1 GT	<0.1 IF	<0.1 GT	-	<0.1 GT	<0.1 GT	<0.1 DM
Chromium	µg/L	50[A]	64[F]	50[H]	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<1 GT	<1 IF	<1 GT	-	<1 GT	<1 GT	<1 DM
Cobalt	µg/L	n/v	5.2[F]	n/v	**21.4[F]**	**20.9[F]**	**20.9[F]**	3.4	3.5	3.5	**7[F]**	**6.7[F]**	**7.2[F]**	4.9	5.2	-	3.8	4.1	4.2
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	**12.9[F]**	<2 GT	<2 DM	<2 GT	<2 GT	<2 DM	2.9	<2 GT	<2 GT	<2 IF	<2 GT	-	**35.1[F]**	<2 GT	<2 DM
Iron	µg/L	300[C]	n/v	≤300[G]	**5010[CG]**	**4980[CG]**	**4750[CG]**	**35700[CG]**	**37100[CG]**	**37000[CG]**	**48600[CG]**	**51200[CG]**	**47400[CG]**	**67900[CG]**	**67500[CG]**	-	**27600[CG]**	**27900[CG]**	**25600[CG]**
Lead	µg/L	10[c][A]	2[F]	10[H]	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 GT	<0.5 GT	<0.5 GT	<0.5 IF	<0.5 GT	-	<0.5 GT	<0.5 GT	<0.5 DM
Lithium	µg/L	n/v	n/v	n/v	<10 GT	<10 GT	<10 DM	25	22	24	23	22	15	20	17	-	<10 GT	<10 GT	<10 DM
Magnesium	mg/L	n/v	n/v	n/v	107	109	97.5	229	243	218	190	195	190	181	205	-	156	164	151
Manganese	µg/L	50[C]	n/v	≤50[G]	**557[CG]**	**563[CG]**	**525[CG]**	**236[CG]**	**233[CG]**	**225[CG]**	**183[CG]**	**194[CG]**	**167[CG]**	**144[CG]**	**139[CG]**	-	**1760[CG]**	**1760[CG]**	**1750[CG]**
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	<0.5 GT	<0.5 GT	<0.5 DM	2.74	2.97	3.27	0.84	0.85	0.75	<0.5 IF	<0.5 GT	-	<0.5 GT	<0.5 GT	<0.5 DM
Nickel	µg/L	n/v	39[F]	n/v	<5 GT	<5 GT	<5 DM	<5 GT	<5 GT	<5 DM	<5 GT	<5 GT	<5 GT	<5 IF	<5 GT	-	<5 GT	<5 GT	<5 DM
Phosphorus	µg/L	n/v	n/v	n/v	<500 GT	<500 GT	<500 DM	<500 GT	<500 GT	<500 DM	<500 GT	<500 GT	<500 GT	<500 IF	<500 GT	-	<500 GT	<500 GT	<500 DM
Potassium	mg/L	n/v	n/v	n/v	4.04	3.97	3.86	46.7	46.8	45.0	43.0	42.4	40.2	42.5	42.9	-	25.5	25.9	25.6
Rubidium	µg/L	n/v	n/v	n/v	8.7	9.7	8.8	8.2	8.8	8.8	8.2	9.9	9.7	7.5	7.7	-	6.3	7	8.2
Selenium	µg/L	10[A]	5[F]	50[H]	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 GT	<0.5 GT	<0.5 GT	<0.5 IF	<0.5 GT	-	<0.5 GT	<0.5 GT	<0.5 DM
Silicon	µg/L	n/v	n/v	n/v	6080	6080	6080	10500	10900	11300	9370	9490	9690	10800	12000	-	8170	8620	8670
Silver	µg/L	n/v	0.12[F]	n/v	<0.1 GT	<0.1 GT	<0.1 DM	<0.1	<0.1 GT	<0.1 DM	<0.1 GT	<0.1 GT	<0.1 GT	<0.1 IF	<0.1 GT	-	<0.1 GT	<0.1 GT	<0.1 DM
Sodium	mg/L	200[g][C] 20[g][E]	180[F]	≤200[G]	**90.8[E]**	**89.7[E]**	**87.3[E]**	10.2	10.0	9.79	8.66	8.48	7.83	6.05	5.53	-	**59.5[E]**	**67.0[E]**	**54.6[E]**
Strontium	µg/L	n/v	n/v	n/v	461	471	459	4320	4650	4400	3630	3980	3580	4100	4350	-	2230	2200	2090
Sulfur	µg/L	n/v	n/v	n/v	557000	518000	505000	683000	678000	670000	681000	656000	640000	675000	673000	-	593000	588000	584000
Tellurium	µg/L	n/v	n/v	n/v	<2 GT	<2 GT	<2 DM	<2	<2 GT	<2 DM	<2 GT	<2 GT	<2 GT	<2 IF	<2 GT	-	<2 GT	<2 GT	<2 DM
Thallium	µg/L	n/v	40[F]	n/v	<0.1 GT	<0.1 GT	<0.1 DM	<0.1	<0.1 GT	<0.1 DM	<0.1 GT	<0.1 GT	<0.1 GT	<0.1 IF	<0.1 GT	-	<0.1 GT	<0.1 GT	<0.1 DM
Thorium	µg/L	n/v	n/v	n/v	<1 GT	<1 GT	<1 DM	<1	<1 GT	<1 DM	<1 GT	<1 GT	<1 GT	<1 IF	<1 GT	-	<1 GT	<1 GT	<1 DM
Tin	µg/L	n/v	n/v	n/v	<1 GT	<1 GT	<1 DM	<1	<1 GT	<1 DM	<1 GT	<1 GT	<1 GT	<1 IF	<1 GT	-	<1 GT	<1 GT	<1 DM
Titanium	µg/L	n/v	n/v	n/v	<3 GT	<3 GT	<3 DM	<3	<3 GT	<3 DM	<3 GT	<3 GT	<3 GT	<3 IF	<3 GT	-	<3 GT	<3 GT	<3 DM
Tungsten	µg/L	n/v	n/v	n/v	<1 GT	<1 GT	<1 DM	3.7	3.5	4.4	<1 GT	<1 GT	<1 GT	<1 IF	<1 GT	-	<1 GT	<1 GT	<1 DM
Uranium	µg/L	20[A]	33[F]	20[H]	<0.1 GT	<0.1 GT	0.1	0.46	0.5	0.45	0.33	0.35	0.35	0.96	0.97	-	0.41	0.37	0.57
Vanadium	µg/L	n/v	20[F]	n/v	<5 GT	<5 GT	<5 DM	<5	<5 GT	<5 DM	<5 GT	<5 GT	<5 GT	<5 IF	<5 GT	-	<5 GT	<5 GT	<5 DM
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	<10 GT	<10 GT	<10 DM	<10	<10 GT	<10 DM	<10 GT	<10 GT	<10 GT	<10 IF	<10 GT	-	<10 GT	<10 GT	<10 DM
Zirconium	µg/L	n/v	n/v	n/v	<3 GT	<3 GT	<3 DM	<3	<3 GT	<3 DM	<3 GT	<3 GT	<3 GT	<3 IF	<3 GT	-	5.2	5.9	5.1

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Historical Tailings														
Sample Location						**96-03**			**96-04**			**96-07A1**			**96-07A2**			**96-12A**	
Sample Date					**13-Jun-16**	**3-Aug-16**	**13-Oct-16**	**13-Jun-16**	**3-Aug-16**	**13-Oct-16**	**14-Jun-16**	**4-Aug-16**	**14-Oct-16**	**14-Jun-16**	**4-Aug-16**	**14-Oct-16**	**13-Jun-16**	**4-Aug-16**	**14-Oct-16**
Sample ID					**96-03**	**96-03**	**96-03**	**96-04**	**96-04**	**96-04**	**96-07A1**	**96-07A1**	**96-07A1**	**96-07A2**	**96-07A2**	**96-07A2**	**96-12A**	**96-12A**	**96-12A**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1783307**	**L1808958**	**L1843864**	**L1783307**	**L1808958**	**L1843864**	**L1783978**	**L1809307**	**L1844412**	**L1783978**	**L1809307**	**L1844412**	**L1783307**	**L1809307**	**L1844412**
Laboratory Sample ID					**L1783307-3**	**L1808958-4**	**L1843864-5**	**L1783307-4**	**L1808958-5**	**L1843864-4**	**L1783978-5**	**L1809307-9**	**L1844412-10**	**L1783978-6**	**L1809307-10**	**L1844412-9**	**L1783307-1**	**L1809307-12**	**L1844412-4**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**															
Metals, Total																			
Aluminum	µg/L	100[D]	n/v	<100/200$_{a}$[G]	**2270**[DG]	**1970**[DG]	**281**[DG]	**51500**[DG]	**6160**[DG]	**17100**[DG]	**43200**[DG]	**35800**[DG]	**38900**[DG]	**2130**[DG]	**7210**[DG]	**969**[DG]	**73700**[DG]	**87700**[DG]	**33100**[DG]
Antimony	µg/L	6[B]	1600[F]	6[H]	<1 DM	<1 GT	<1 DM	**9.6**[BH]	1.2	4.3	**7.5**[BH]	**7.4**[BH]	**9.8**[BH]	1.1	5.5	<1 GT	<1 DM	<1 DM	<2 GT
Arsenic	µg/L	25[B]	150[F]	10[H]	**13.4**[H]	**10.7**[H]	8.1	**25600**[BFH]	**18000**[BFH]	**19000**[BFH]	**14400**[BFH]	**11000**[BFH]	**11900**[BFH]	**6790**[BFH]	**7570**[BFH]	**7530**[BFH]	**6730**[BFH]	**6040**[BFH]	**5160**[BFH]
Barium	µg/L	1000[A]	2300[F]	1000[H]	55.1	46	38.1	597	48.6	202	188	148	178	33.1	94.7	20.2	**1860**[AH]	**2310**[AFH]	931
Beryllium	µg/L	n/v	5.3[F]	n/v	<1 DM	<1 GT	<1 DM	<5 DM	<1 GT	<1 DM	<5 DM	1.2	<2	<1 DM	<1 DM	<1 GT	3.3	4.8	<2 GT
Bismuth	µg/L	n/v	n/v	n/v	<0.5 DM	<0.5 GT	<0.5 DM	<2.5 DM	<0.5 GT	<0.5 DM	<2.5 DM	0.67	<1 DM	<0.5 DM	<0.5 DM	<0.5 GT	0.79	1.1	<1 GT
Boron	µg/L	5000[B]	3550[F]	5000[H]	<100 DM	<100 GT	<100 DM	<500 DM	190	170	<500 DM	160	<200 DM	<100 DM	<100 DM	<100 GT	220	330	<200 GT
Cadmium	µg/L	5[A]	0.21[F]	5[H]	<0.05 DM	<0.05 GT	<0.05 DM	**0.82**[F]	0.051	**0.236**[F]	**0.52**[F]	**0.399**[F]	**0.78**[F]	<0.05 DM	0.169	<0.05 GT	**1.15**[F]	**2.03**[F]	**0.51**[F]
Calcium	mg/L	n/v	n/v	n/v	539	579	507	714	539	553	678	614	766	574	502	518	2940	4740	1740
Cesium	µg/L	n/v	n/v	n/v	0.4	0.37	0.14	7.99	1.06	2.58	5.53	4.04	4.91	0.4	1.37	0.21	6.92	8.27	3.28
Chromium	µg/L	50[A]	64[F]	50[H]	12.1	9.4	1.9	**233**[AFH]	39.3	**79.5**[AFH]	**166**[AFH]	**119**[AFH]	**152**[AFH]	14.1	**57.7**[AH]	6.3	**233**[AFH]	**307**[AFH]	**93.6**[AFH]
Cobalt	µg/L	n/v	5.2[F]	n/v	**23.7**[F]	**22.6**[F]	**22**[F]	**44.2**[F]	**10.2**[F]	**17**[F]	**58.1**[F]	**41.6**[F]	**56.6**[F]	**8.3**[F]	**18.2**[F]	**6.3**[F]	**64.3**[F]	**97.8**[F]	**27.1**[F]
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	<5 DM	<5 GT	<5 DM	**318**[F]	**31.8**[F]	**103**[F]	**180**[F]	**149**[F]	**174**[F]	**17.2**[F]	**90.9**[F]	**8.4**[F]	**161**[F]	**270**[F]	**66**[F]
Iron	µg/L	300[C]	n/v	≤300[G]	**8390**[CG]	**7860**[CG]	**5190**[CG]	**276000**[CG]	**61700**[CG]	**116000**[CG]	**280000**[CG]	**283000**[CG]	**361000**[CG]	**86400**[CG]	**169000**[CG]	**74900**[CG]	**151000**[CG]	**191000**[CG]	**76200**[CG]
Lead	µg/L	10$_{c}$[A]	2[F]	10[H]	1.2	1.43	<0.5 DM	**78.6**[AFH]	**5.08**[F]	**25**[AFH]	**52.1**[AFH]	**48.3**[AFH]	**63.5**[AFH]	**3.58**[F]	**16.7**[AFH]	1.56	**57.6**[AFH]	**91.9**[AFH]	**23.9**[AFH]
Lithium	µg/L	n/v	n/v	n/v	11	<10 GT	<10 DM	60	33	31	<50 DM	47	44	20	24	18	140	180	68
Magnesium	mg/L	n/v	n/v	n/v	121	128	103	307	252	249	265	236	273	197	212	224	826	1340	341
Manganese	µg/L	50[C]	n/v	≤50[G]	**669**[CG]	**675**[CG]	**548**[CG]	**3050**[CG]	**487**[CG]	**1100**[CG]	**3280**[CG]	**2850**[CG]	**5420**[CG]	**400**[CG]	**1230**[CG]	**230**[CG]	**6840**[CG]	**10800**[CG]	**4740**[CG]
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01 DM	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	0.0164	0.0059
Molybdenum	µg/L	n/v	730[F]	n/v	<0.5 DM	<0.5 GT	<0.5 DM	6.7	3.48	3.87	3.6	2.68	3.2	<0.5 DM	1.75	<0.5 GT	1.91	2.21	1.1
Nickel	µg/L	n/v	39[F]	n/v	<5 DM	<5 GT	<5 DM	**138**[F]	20.2	**46.7**[F]	**163**[F]	**110**[F]	**167**[F]	11.3	**49.2**[F]	<5 GT	**143**[F]	**212**[F]	**60**[F]
Phosphorus	µg/L	n/v	n/v	n/v	<500 DM	<500 GT	<500 DM	3100	<500 GT	880	<2500 DM	2150	2400	<500 DM	540	<500 GT	8450	15600	2600
Potassium	mg/L	n/v	n/v	n/v	4.63	4.43	4.03	59.4	48.5	47.3	51.4	43.7	45.8	46.0	42.1	43.9	38.9	44.7	35.0
Rubidium	µg/L	n/v	n/v	n/v	12.9	12.2	9.8	88	20.4	33.5	57	40.9	52.8	11.7	17.7	9.4	117	155	56.5
Selenium	µg/L	10[A]	5[F]	50[H]	<0.5 DM	<0.5 GT	<0.5 DM	<2.5 DM	<0.5 GT	<0.5 DM	<2.5 DM	<0.5 DM	<1 DM	<0.5 DM	<0.5 DM	<0.5 GT	<0.5 DM	0.88	<1 GT
Silicon	µg/L	n/v	n/v	n/v	10100	10000	6600	80000	21000	34400	65400	52200	60000	15200	21500	14000	110000	124000	62900
Silver	µg/L	n/v	0.12[F]	n/v	<0.1 DM	<0.1 GT	<0.1 DM	**0.99**[F]	0.1	**0.34**[F]	**0.54**[F]	**0.54**[F]	**0.53**[F]	<0.1 DM	**0.15**[F]	<0.1 GT	**0.58**[F]	**0.83**[F]	**0.25**[F]
Sodium	mg/L	200$_{g}$[C] 20$_{g}$[E]	180[F]	≤200[G]	**94.7**[E]	**91.3**[E]	**90.0**[E]	12.6	9.73	10.1	9.1	8.73	8.6	6.57	5.64	5.58	**68.9**[E]	**82.3**[E]	**73.0**[E]
Strontium	µg/L	n/v	n/v	n/v	511	509	447	5620	4530	4370	4620	4310	4630	4440	4500	4300	3870	4520	3100
Sulfur	µg/L	n/v	n/v	n/v	500000	534000	550000	692000	679000	692000	732000	612000	642000	706000	622000	667000	639000	699000	649000
Tellurium	µg/L	n/v	n/v	n/v	<2 DM	<2 GT	<2 DM	<10 DM	<2 GT	<2 DM	<10 DM	<2 DM	<4 DM	<2 DM	<2 DM	<2 GT	<2 DM	<2 DM	<4 GT
Thallium	µg/L	n/v	40[F]	n/v	<0.1 DM	<0.1 GT	0.13	0.71	<0.1 GT	0.2	<0.5 DM	0.22	0.3	<0.1 DM	<0.1 DM	<0.1 GT	1.29	1.95	0.47
Thorium	µg/L	n/v	n/v	n/v	<1 DM	<1 GT	<1 DM	8.2	<1 GT	3.1	6.1	4.6	6.6	<1 DM	1.7	<1 GT	47	67.3	20
Tin	µg/L	n/v	n/v	n/v	<1 DM	<1 GT	<1 DM	<5 DM	<1 GT	1	247	1.7	2.1	<1 DM	1.6	<1 GT	<1 DM	<1 DM	<2 GT
Titanium	µg/L	n/v	n/v	n/v	233	192	22.4	1700	241	567	1010	669	920	65.7	222	29.5	5230	3270	3050
Tungsten	µg/L	n/v	n/v	n/v	<1 DM	<1 GT	<1 DM	51.3	14	28.4	28.6	22.1	43.4	9.1	26.1	2.9	<1 DM	<1 DM	<2 GT
Uranium	µg/L	20[A]	33[F]	20[H]	0.45	0.51	0.16	2.54	0.52	1.13	1.67	1.38	1.63	1.21	1.71	1.07	13.7	**24**[AH]	10.1
Vanadium	µg/L	n/v	20[F]	n/v	7.5	6.3	<5 DM	**130**[F]	**21.7**[F]	**41.9**[F]	**106**[F]	**77.8**[F]	**94**[F]	<5 DM	18.4	<5 GT	**228**[F]	**294**[F]	**101**[F]
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	<30 DM	<30 GT	<30 DM	**310**[F]	33	**90**[F]	**230**[F]	**202**[F]	**261**[F]	<30 DM	70	<30 GT	**268**[F]	**379**[F]	**110**[F]
Zirconium	µg/L	n/v	n/v	n/v	4	3.8	<3 DM	31	5.1	14.3	27	21.4	23.7	<3 DM	8.7	<3 GT	27.5	8.2	36.6

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Historical Tailings														
Sample Location					**96-12B**			**96-14B**			**H96-06A1**			**H96-06A2**			**H96-06A3**		
Sample Date					**13-Jun-16**	**4-Aug-16**	**14-Oct-16**	**14-Jun-16**	**3-Aug-16**	**13-Oct-16**	**20-Jun-16**	**2-Aug-16**	**17-Oct-16**	**20-Jun-16**	**4-Aug-16**	**18-Oct-16**	**20-Jun-16**	**2-Aug-16**	**18-Oct-16**
Sample ID					**96-12B**	**96-12B**	**96-12B**	**96-14B**	**96-14B**	**96-14B**	**H96-06A1**	**H96-06A1**	**H96-06A1**	**H96-06A2**	**H96-06A2**	**H96-06A2**	**H96-06A3**	**H96-06A3**	**H96-06A3**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1783307**	**L1809307**	**L1844412**	**L1783978**	**L1808958**	**L1843864**	**L1786744**	**L1807778**	**L1846519**	**L1786744**	**L1809307**	**L1846557**	**L1786744**	**L1807778**	**L1846519**
Laboratory Sample ID					**L1783307-2**	**L1809307-11**	**L1844412-3**	**L1783978-4**	**L1808958-8**	**L1843864-3**	**L1786744-1**	**L1807778-1**	**L1846519-5**	**L1786744-2**	**L1809307-1**	**L1846557-1**	**L1786744-3**	**L1807778-2**	**L1846519-11**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**															
Field Parameters																			
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	4.85	0.48	0.55	4.11	0.73	0.7	1.94	0.65	0.35	0.89	0.74	0.44	0.19	0.3	1.5
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	2950	2602	3081	1600	1607	1579	1794	4632	3245	5760	5013	4628	2646	1458	2773
pH, Field	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	**6.82[G]**	**6.74[G]**	**6.87[G]**	7.27	**6.97[G]**	7.14	7.37	7.23	7.06	7.04	7.02	7.29	**6.84[G]**	**6.86[G]**	**6.76[G]**
Temperature, Field	deg C	15[C]	n/v	≤15[G]	6.97	6.25	3.38	7.63	6.56	6.95	7.09	**16.35[CG]**	4.3	10.41	**17.65[CG]**	6.91	7.79	14.74	6.76
General Chemistry																			
Acidity as CaCO3	mg/L	n/v	n/v	n/v	92.3	120	145	36.4	49.7	31.7	34.1	66.1	50.1	44.4	57.6	37.1	71.2	77.1	72.3
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	413	440	405	385	-	404	556	413	488	369	362	398	605	557	666
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500[D]	n/v	n/v	413	440	405	385	388	404	**556[D]**	413	488	369	362	398	**605[D]**	**557[D]**	**666[D]**
Ammonia (as N)	mg/L	n/v	n/v	n/v	1.63	1.60	1.59	2.13	2.42	2.27	0.349	0.596	0.387	0.547	1.27	0.710	0.334	0.528	0.294
Anion Sum	meq/L	n/v	n/v	n/v	37.9	43.0	43.9	20.8	22.4	20.4	23.0	71.2	43.4	98.3	101	107	35.9	29.0	40.9
Cation Sum	meq/L	n/v	n/v	n/v	41.8	42.9	41.0	22.6	23.6	19.6	28.2	62.8	48.7	104	112	102	42.9	30.4	35.8
Chloride	mg/L	250[C]	180[F]	≤250[G]	4.9	6.0	5.7	24.5	21.2	24.0	1.01	3.0	1.0	7.7	4.5	5.3	0.51	<0.20 GT	<2.0 DM
Color, True	TCU	5[C]	n/v	n/v	**6.9[C]**	**8.3[C]**	4.3	**5.8[C]**	**5.1[C]**	**5.7[C]**	<2.0	4.4	**10.3[C]**	5.0	**7.9[C]**	-	2.1	<2.0	3.9
Cyanide	mg/L	n/v	0.0052[F]	0.2[H]	**0.0178[F]**	**0.0214[F]**	**0.0229[F]**	**0.0192[F]**	**0.0826[F]**	**0.0139[F]**	**0.0062[F]**	**0.044[F]**	**0.0103[F]**	**0.0223[F]**	**0.0178[F]**	**0.0337[F]**	**0.0201[F]**	**0.0089[F]**	**0.0691[F]**
Cyanide (Free)	mg/L	0.2[A]	n/v	0.2[H]	<0.0050 BL	<0.0050 BL	<0.0050	0.0054	<0.0050	<0.0050	<0.0050	0.0126	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050	<0.0050 BL
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	0.0025	0.0039	<0.0020	0.0064	<0.0020	0.0044	<0.0020	0.0150	<0.0020 BL	<0.0020 BL	<0.0020 BL	0.0055	<0.0020 BL	0.0033	<0.0020 BL
Dissolved Organic Carbon (DOC)	mg/L	5[C]	n/v	n/v	**9.1[C]**	**8.2[C]**	**6.6[C]**	**6.1[C]**	**6.4[C]**	**5.6[C]**	2.0	3.0	3.0	**5.1[C]**	**7.1[C]**	**7.1[C]**	2.6	2.3	3.7
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	2910	2870	2850	1620	1790	1590	1780	4100	3240	5810	5610	5650	2590	2130	2580
Fluoride	mg/L	1.5_{b}[A]	n/v	1.5[H]	<0.40 GT	<0.20 GT	<0.40 LH	0.095	<0.10 GT	<0.10 DM	<0.10 GT	<0.20 DM	<0.20 DM	<0.40 GT	<0.40 GT	<0.40 DM	<0.10 GT	<0.040 GT	<0.40 DM
Hardness (as CaCO3)	mg/L	80-100[D]	n/v	n/v	**1910[D]**	**1960[D]**	**1880[D]**	**954[D]**	**1030[D]**	**847[D]**	**1360[D]**	**3060[D]**	**2390[D]**	**5080[D]**	**5460[D]**	**4970[D]**	**2080[D]**	**1470[D]**	**1750[D]**
Ion Balance	%	n/v	n/v	n/v	4.9	<0.000	<0.000	4.1	2.6	<0.000	10.1	<0.000	5.8	2.7	5.2	<0.000	8.9	2.3	<0.000
Nitrate (as N)	mg/L	10.0_{d}[A]	n/v	10[H]	<0.40 GT	<0.20 GT	<0.40 LH	<0.040 DM	<0.10 GT	<0.10 DM	<0.10 GT	<0.20 DM	<0.20 DM	<0.40 GT	<0.40 GT	<0.40 DM	<0.10 GT	<0.040 GT	<0.40 DM
Nitrite (as N)	mg/L	1.0_{d}[A]	n/v	1[H]	<0.20 GT	<0.10 GT	<0.20 LH	<0.020 DM	<0.050 GT	<0.050 DM	<0.050 GT	<0.10 DM	<0.10 DM	<0.20 GT	<0.20 GT	<0.20 DM	<0.050	<0.020 GT	<0.20 DM
pH	S.U.	6.5-8.5[D]	n/v	7.0-10.5[G]	**6.89[G]**	**6.84[G]**	**6.82[G]**	7.31	7.29	7.55	7.42	7.19	7.52	7.28	7.17	7.69	7.25	7.26	7.44
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.307	0.384	0.183	0.330	3.71	0.655	0.067	0.346	0.258	1.96	4.01	2.77	0.029	0.060	0.038
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0409	0.368	0.294	0.0100	<0.0060 DM	0.0169	0.0462	0.300	0.0822	0.303	0.584	0.629	0.0444	0.0278	0.0429
Sulfate	mg/L	500_{h}[C]	n/v	$≤500_{j}$[G]	**1420[CG]**	**1640[CG]**	**1710[CG]**	**595[CG]**	**675[CG]**	**562[CG]**	**571[CG]**	**3020[CG]**	**1610[CG]**	**4360[CG]**	**4480[CG]**	**4770[CG]**	**1140[CG]**	**857[CG]**	**1320[CG]**
Total Dissolved Solids	mg/L	500[C]	n/v	≤500[G]	**2810[CG]**	**2800[CG]**	**2770[CG]**	**1220[CG]**	**1460[CG]**	**1190[CG]**	**1440[CG]**	**4370[CG]**	**3330[CG]**	**7030[CG]**	**6790[CG]**	**6680[CG]**	**2460[CG]**	**1850[CG]**	**2420[CG]**
Total Organic Carbon	mg/L	n/v	n/v	n/v	8.4	7.8	6.6	5.9	10.3	7.3	1.3	3.4	3.5	6.2	6.4	6.7	2.0	2.1	3.7
Total Suspended Solids	mg/L	n/v	n/v	n/v	109	104	57.4	557	1550	1270	22.4	45.4	52.1	1270	192	811	34.2	29.5	20.4

See notes on last page

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Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Historical Tailings														
Sample Location					96-12B			96-14B			H96-06A1			H96-06A2			H96-06A3		
Sample Date					13-Jun-16	4-Aug-16	14-Oct-16	14-Jun-16	3-Aug-16	13-Oct-16	20-Jun-16	2-Aug-16	17-Oct-16	20-Jun-16	4-Aug-16	18-Oct-16	20-Jun-16	2-Aug-16	18-Oct-16
Sample ID					96-12B	96-12B	96-12B	96-14B	96-14B	96-14B	H96-06A1	H96-06A1	H96-06A1	H96-06A2	H96-06A2	H96-06A2	H96-06A3	H96-06A3	H96-06A3
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1783307	L1809307	L1844412	L1783978	L1808958	L1843864	L1786744	L1807778	L1846519	L1786744	L1809307	L1846557	L1786744	L1807778	L1846519
Laboratory Sample ID					L1783307-2	L1809307-11	L1844412-3	L1783978-4	L1808958-8	L1843864-3	L1786744-1	L1807778-1	L1846519-5	L1786744-2	L1809307-1	L1846557-1	L1786744-3	L1807778-2	L1846519-11
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**															
Metals, Dissolved																			
Aluminum	µg/L	100^{D}	n/v	$<100/200_{a}^{G}$	<20 GT	<20 GT	<20	**3580^{DG}**	<2	69	<10 GT	<20 GT	<20 GT	<10 GT	<20 GT	<40 IF	<10 GT	<20 GT	<20 GT
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<1 GT	<1 GT	<1	<1 IF	1.22	<1 DM	<0.5 GT	<1 GT	<1 GT	0.69	<1 GT	<2 IF	<0.5 GT	<1 GT	<1 GT
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	**9810^{BFH}**	**10700^{BFH}**	**10300^{BFH}**	**121^{BH}**	**108^{BH}**	**83.2^{BH}**	**6300^{BFH}**	**15700^{BFH}**	**5950^{BFH}**	**29700^{BFH}**	**28800^{BFH}**	**28600^{BFH}**	**3990^{BFH}**	**5190^{BFH}**	**2290^{BFH}**
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	110	114	106	625	108	50.5	15.8	19	14	8.93	9.64	11.5	15.9	10.5	14.9
Beryllium	µg/L	n/v	5.3^{F}	n/v	<1 GT	<1 GT	<1	<1 IF	<0.1	<1 DM	<0.5 GT	<1 GT	<1 GT	<0.5 GT	<1 GT	<2 IF	<0.5 GT	<1 GT	<1 GT
Bismuth	µg/L	n/v	n/v	n/v	<0.5 GT	<0.5 GT	<0.5	<0.5 IF	<0.05	<0.5 DM	<0.25 GT	<0.5 GT	<0.5 GT	<0.25 GT	<0.5 GT	<1 IF	<0.25 GT	<0.5 GT	<0.5 GT
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	<100 GT	<100 GT	110	<100 IF	38	<100 DM	<50 GT	<100 GT	<100 GT	74	<100 GT	<200 IF	<50 GT	<100 GT	<100 GT
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	<0.05 GT	<0.05 GT	<0.05	<0.05 IF	<0.005	<0.05 DM	<0.025 GT	<0.05 GT	<0.05 GT	<0.025 GT	<0.05 GT	<0.1 IF	<0.025 GT	<0.05 GT	<0.05 GT
Calcium	mg/L	n/v	n/v	n/v	487	493	481	244	261	218	222	339	422	418	413	386	517	318	380
Cesium	µg/L	n/v	n/v	n/v	<0.1 GT	<0.1 GT	0.1	7.57	5.85	6.03	0.33	0.18	0.14	0.072	<0.1 GT	<0.2 IF	0.207	0.24	0.27
Chromium	µg/L	50^{A}	64^{F}	50^{H}	<1 GT	<1 GT	<1	8.4	<0.1	<1 DM	<0.5 GT	<1 GT	<1 GT	<0.5 GT	<1 GT	<2 IF	<0.5 GT	<1 GT	<1 GT
Cobalt	µg/L	n/v	5.2^{F}	n/v	4.9	**5.3^{F}**	**5.3^{F}**	**7.8^{F}**	**5.51^{F}**	**6.1^{F}**	<0.5 GT	1.7	<1 GT	3.18	3.1	3.1	0.61	<1 GT	1.2
Copper	µg/L	1000^{C}	6.9^{F}	$\leq 1000^{G}$	3.6	<2 GT	<2	**7.6^{F}**	0.83	<2 DM	<1 GT	<2 GT	<2 GT	<1 GT	<2 GT	<4 IF	<1 GT	<2 GT	<2 GT
Iron	µg/L	300^{C}	n/v	$\leq 300^{G}$	**29800^{CG}**	**30600^{CG}**	**28500^{CG}**	**14800^{CG}**	**9960^{CG}**	**8030^{CG}**	**7530^{CG}**	**14000^{CG}**	**4170^{CG}**	**18600^{CG}**	**18600^{CG}**	**18900^{CG}**	**15100^{CG}**	**10100^{CG}**	**6120^{CG}**
Lead	µg/L	10_{c}^{A}	2^{F}	10^{H}	<0.5 GT	<0.5 GT	<0.5	**12.3^{AFH}**	0.355	<0.5 DM	<0.25 GT	<0.5 GT	<0.5 GT	<0.25 GT	<0.5 GT	<1 IF	<0.25 GT	<0.5 GT	<0.5 GT
Lithium	µg/L	n/v	n/v	n/v	13	<10 GT	<10	<10 IF	5.8	<10 DM	9	16	15	23.5	36	30	7.8	<10 GT	14
Magnesium	mg/L	n/v	n/v	n/v	169	178	165	84.0	90.9	73.3	197	538	325	980	1080	973	191	165	195
Manganese	µg/L	50^{C}	n/v	$\leq 50^{G}$	**1610^{CG}**	**1630^{CG}**	**1540^{CG}**	**1290^{CG}**	**1270^{CG}**	**926^{CG}**	32.4	**119^{CG}**	**93.6^{CG}**	**307^{CG}**	**317^{CG}**	**326^{CG}**	**116^{CG}**	32.9	**137^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0054	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	<0.5 GT	<0.5 GT	1.17	<0.5 IF	0.407	<0.5 DM	6.42	5.28	4.87	1.96	1.57	1.6	2.63	3.38	2.46
Nickel	µg/L	n/v	39^{F}	n/v	<5 GT	<5 GT	<5 DM	7.4	0.89	<5 DM	<2.5 GT	<5 GT	<5 GT	2.8	<5 GT	<10 IF	<2.5 GT	<5 GT	<5 GT
Phosphorus	µg/L	n/v	n/v	n/v	<500 GT	<500 GT	<500 DM	<500 IF	<50	<500 DM	<250 GT	<500 GT	<500 GT	<250 GT	<500 GT	<1000 IF	<250 GT	<500 GT	<500 GT
Potassium	mg/L	n/v	n/v	n/v	34.7	35.0	33.5	8.73	8.87	8.54	12.3	23.2	17.0	35.5	36.9	34.1	13.5	10.1	11.9
Rubidium	µg/L	n/v	n/v	n/v	8.4	8.1	8.7	9.8	5.73	5	15.6	26.7	21.3	32.5	35.5	36.2	12.6	9.6	11.7
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 IF	<0.05	<0.5 DM	<0.25 GT	<0.5 GT	<0.5 GT	<0.25 GT	<0.5 GT	<1 IF	<0.25 GT	<0.5 GT	<0.5 GT
Silicon	µg/L	n/v	n/v	n/v	8620	8920	9000	16100	7870	7970	10600	12100	11800	12700	13300	13600	12100	12200	11300
Silver	µg/L	n/v	0.12^{F}	n/v	<0.1 GT	<0.1 GT	<0.1 DM	**0.34^{F}**	<0.01	<0.1 DM	<0.05 GT	<0.1 GT	<0.1 GT	<0.05 GT	<0.1 GT	***<0.2 IF***	<0.05 GT	<0.1 GT	<0.1 GT
Sodium	mg/L	200_{g}^{C} 20_{g}^{E}	180^{F}	$\leq 200^{G}$	**24.7^{E}**	**24.0^{E}**	**22.9^{E}**	**43.2^{E}**	**48.4^{E}**	**41.9^{E}**	3.90	6.36	4.78	11.1	10.0	9.9	3.74	2.91	3.51
Strontium	µg/L	n/v	n/v	n/v	2830	3010	2750	2200	2590	2040	896	1570	1510	2630	2570	2620	1090	607	955
Sulfur	µg/L	n/v	n/v	n/v	575000	574000	573000	198000	260000	191000	236000	931000	742000	1690000	1680000	1700000	470000	308000	437000
Tellurium	µg/L	n/v	n/v	n/v	<2 GT	<2 GT	<2 DM	<2 IF	<0.2	<2 DM	<1 GT	<2 GT	<2 GT	<1 GT	<2 GT	<4 IF	<1 GT	<2 GT	<2 GT
Thallium	µg/L	n/v	40^{F}	n/v	<0.1 GT	<0.1 GT	<0.1 DM	<0.1 IF	<0.01	<0.1 DM	<0.05 GT	<0.1 GT	<0.1 GT	<0.05 GT	<0.1 GT	<0.2 IF	<0.05 GT	<0.1 GT	<0.1 GT
Thorium	µg/L	n/v	n/v	n/v	<1 GT	<1 GT	<1 DM	5.8	<0.1	<1 DM	<0.5 GT	<1 GT	<1 GT	<0.5 GT	<1 GT	<2 IF	<0.5 GT	<1 GT	<1 GT
Tin	µg/L	n/v	n/v	n/v	<1 GT	<1 GT	<1 DM	<1 IF	<0.1	<1 DM	<0.5 GT	<1 GT	<1 GT	<0.5 GT	<1 GT	<2 IF	<0.5 GT	<1 GT	<1 GT
Titanium	µg/L	n/v	n/v	n/v	<3 GT	<3 GT	<3 DM	88.8	<0.3	<3 DM	<1.5 GT	<3 GT	<3 GT	<1.5 GT	<3 GT	<6 IF	<1.5 GT	<3 GT	<3 GT
Tungsten	µg/L	n/v	n/v	n/v	<1 GT	<1 GT	<1 DM	11.9	0.62	<1 DM	20.1	14.9	9.3	1.87	2	2.3	6.48	10.7	4.8
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.35	0.38	0.47	4.07	2.21	1.95	0.765	1.74	1.47	1.8	1.6	1.55	2.37	1.46	2.01
Vanadium	µg/L	n/v	20^{F}	n/v	<5 GT	<5 GT	<5 DM	6.5	<0.5	<5 DM	<2.5 GT	<5 GT	<5 GT	<2.5 GT	<5 GT	<10 IF	<2.5 GT	<5 GT	<5 GT
Zinc	µg/L	5000^{C}	89^{F}	$\leq 5000^{G}$	<10 GT	<10 GT	<10 DM	18	2.1	<10 DM	<5 GT	<10 GT	<10 GT	<5 GT	<10 GT	<20 IF	<5 GT	<10 GT	<10 GT
Zirconium	µg/L	n/v	n/v	n/v	3.9	4.2	4	5.6	1.45	<3 DM	<1.5 GT	<3 GT	<3 GT	<1.5 GT	<3 GT	<6 IF	<1.5 GT	<3 GT	<3 GT

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Historical Tailings																	
Sample Location					**96-12B**			**96-14B**			**H96-06A1**			**H96-06A2**			**H96-06A3**		
Sample Date					**13-Jun-16**	**4-Aug-16**	**14-Oct-16**	**14-Jun-16**	**3-Aug-16**	**13-Oct-16**	**20-Jun-16**	**2-Aug-16**	**17-Oct-16**	**20-Jun-16**	**4-Aug-16**	**18-Oct-16**	**20-Jun-16**	**2-Aug-16**	**18-Oct-16**
Sample ID					**96-12B**	**96-12B**	**96-12B**	**96-14B**	**96-14B**	**96-14B**	**H96-06A1**	**H96-06A1**	**H96-06A1**	**H96-06A2**	**H96-06A2**	**H96-06A2**	**H96-06A3**	**H96-06A3**	**H96-06A3**
Sampling Company					**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**	**GGM**
Laboratory					**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**	**ALS-EDM**
Laboratory Work Order					**L1783307**	**L1809307**	**L1844412**	**L1783978**	**L1808958**	**L1843864**	**L1786744**	**L1807778**	**L1846519**	**L1786744**	**L1809307**	**L1846557**	**L1786744**	**L1807778**	**L1846519**
Laboratory Sample ID					**L1783307-2**	**L1809307-11**	**L1844412-3**	**L1783978-4**	**L1808958-8**	**L1843864-3**	**L1786744-1**	**L1807778-1**	**L1846519-5**	**L1786744-2**	**L1809307-1**	**L1846557-1**	**L1786744-3**	**L1807778-2**	**L1846519-11**
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**															
Metals, Total																			
Aluminum	µg/L	100[D]	n/v	<100/200$_{a}$[G]	**253[DG]**	**631[DG]**	35	<30 XH	**61300[DG]**	**12700[DG]**	5.7	<30 GT	<30 GT	**8060[DG]**	**799[DG]**	**5450[DG]**	<30 GT	<30 GT	39
Antimony	µg/L	6[B]	1600[F]	6[H]	<0.1	<1 DM	<1 GT	<1 DM	5.3	2.3	0.12	<1 GT	<1 GT	**7[BH]**	<1 GT	6	<1 GT	<1 GT	<1 DM
Arsenic	µg/L	25[B]	150[F]	10[H]	**11700[BFH]**	**11700[BFH]**	**11200[BFH]**	**95.6[BH]**	**7770[BFH]**	**377[BFH]**	**6790[BFH]**	**17800[BFH]**	**11900[BFH]**	**33900[BFH]**	**31300[BFH]**	**33300[BFH]**	**4070[BFH]**	**5380[BFH]**	**2460[BFH]**
Barium	µg/L	1000[A]	2300[F]	1000[H]	115	130	117	58.4	891	**1020[AH]**	17.2	19.7	18.5	84.3	16.5	59.2	17.5	11.1	17.7
Beryllium	µg/L	n/v	5.3[F]	n/v	<0.1	<1 DM	<1 GT	<1 DM	2.6	<1	<0.1	<1 GT	<1 GT	<2 DM	<1 GT	<2 GT	<1 GT	<1 GT	<1 DM
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.5 DM	<0.5 GT	<0.5 DM	1.8	<0.5	<0.05	<0.5 GT	<0.5 GT	<1 DM	<0.5 GT	<1 GT	<0.5 GT	<0.5 GT	<0.5 DM
Boron	µg/L	5000[B]	3550[F]	5000[H]	89	<100 DM	100	<100 DM	<100 DM	<100	23	<100 GT	<100 GT	<200 DM	<100 GT	<200 GT	<100 GT	<100 GT	<100 DM
Cadmium	µg/L	5[A]	0.21[F]	5[H]	<0.005	<0.05 DM	<0.05 GT	<0.05 DM	**0.615[F]**	0.13	<0.005	<0.05 GT	<0.05 GT	**0.38[F]**	<0.05 GT	**0.31[F]**	<0.05 GT	<0.05 GT	<0.05 DM
Calcium	mg/L	n/v	n/v	n/v	491	493	528	249	564	289	185	333	423	449	407	401	503	319	385
Cesium	µg/L	n/v	n/v	n/v	0.206	0.56	0.1	6.33	19.8	12.6	0.3	0.18	0.13	0.88	0.17	0.65	0.22	0.22	0.26
Chromium	µg/L	50[A]	64[F]	50[H]	1.74	6	<1 GT	<1 XH	**277[AFH]**	31	0.37	<1 GT	<1 GT	41.2	3.8	26.5	<1 GT	<1 GT	<1 DM
Cobalt	µg/L	n/v	5.2[F]	n/v	**5.52[F]**	**6.5[F]**	**5.3[F]**	**6.5[F]**	**126[F]**	**17.2[F]**	0.36	1.8	1	**15.4[F]**	3.8	**11.1[F]**	<1 GT	<1 GT	1.4
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	0.53	<5 DM	<5 GT	<5 DM	**314[F]**	**50.8[F]**	<0.5	<5 GT	<5 GT	**90[F]**	5.5	**59[F]**	<5 GT	<5 GT	<5 DM
Iron	µg/L	300[C]	n/v	≤300[G]	**31900[CG]**	**31800[CG]**	**30600[CG]**	**8870[CG]**	**214000[CG]**	**33500[CG]**	**8480[CG]**	**15000[CG]**	**15700[CG]**	**176000[CG]**	**30700[CG]**	**125000[CG]**	**15600[CG]**	**10600[CG]**	**6960[CG]**
Lead	µg/L	10$_{c}$[A]	2[F]	10[H]	0.19	1.46	<0.5 GT	<0.5 XH	**76.9[AFH]**	**25.9[AFH]**	<0.05	<0.5 GT	<0.5 GT	**34.6[AFH]**	**3.78[F]**	**21.8[AFH]**	<0.5 GT	<0.5 GT	<0.5 DM
Lithium	µg/L	n/v	n/v	n/v	10.7	12	12	<10 DM	56	16	5.8	16	<10 GT	<20 DM	25	<20 GT	10	<10 GT	<10 DM
Magnesium	mg/L	n/v	n/v	n/v	183	183	177	86.6	202	98.6	187	568	348	997	1080	1040	185	163	233
Manganese	µg/L	50[C]	n/v	≤50[G]	**1660[CG]**	**1690[CG]**	**1610[CG]**	**1200[CG]**	**4710[CG]**	**1320[CG]**	35.7	**133[CG]**	**99.9[CG]**	**1220[CG]**	**386[CG]**	**900[CG]**	**121[CG]**	34.7	**166[CG]**
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	0.0053	<0.005	<0.005	<0.005	0.0067	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	0.305	0.76	<0.5 GT	0.54	3.87	0.73	5.74	7.2	4.89	3.7	1.64	2.6	2.8	3.54	1.86
Nickel	µg/L	n/v	39[F]	n/v	0.6	<5 DM	<5 GT	<5 DM	**312[F]**	29	<0.5	<5 GT	<5 GT	30	<5 GT	19	<5 GT	<5 GT	5.6
Phosphorus	µg/L	n/v	n/v	n/v	<50	<500 DM	<500 GT	<500 DM	2820	630	<50 RW	<500 GT	<500 GT	1200	<500 GT	<1000 GT	<500 GT	<500 GT	<500 DM
Potassium	mg/L	n/v	n/v	n/v	35.7	35.6	35.2	9.18	22.4	10.4	12.8	24.0	18.8	36.2	37.2	38.4	13.1	9.88	13.7
Rubidium	µg/L	n/v	n/v	n/v	9.21	9.4	8.9	5.8	94.6	16.8	16.6	27	22	38.2	35.2	36.4	13.6	10.3	13.2
Selenium	µg/L	10[A]	5[F]	50[H]	0.055	<0.5 DM	<0.5 GT	<0.5 DM	1.29	<0.5	0.052	<0.5 GT	<0.5 GT	<1 DM	<0.5 GT	<1 GT	<0.5 GT	<0.5 GT	<0.5 DM
Silicon	µg/L	n/v	n/v	n/v	10100	10200	9530	8550	85700	27900	10800	11700	11800	23900	14900	21700	11900	12400	10700
Silver	µg/L	n/v	0.12[F]	n/v	0.03	**0.14[F]**	<0.1 GT	<0.1 XH	**10.4[F]**	**12.8[F]**	<0.1 GT	<0.1 GT	<0.1 GT	**0.35[F]**	<0.1 GT	***<0.2 GT***	<0.1 GT	<0.1 GT	<0.1 DM
Sodium	mg/L	200$_{g}$[C] 20$_{g}$[E]	180[F]	≤200[G]	**26.0[E]**	**26.6[E]**	**27.1[E]**	**46.0[E]**	**48.3[E]**	**42.2[E]**	3.91	7.11	5.09	10.1	10.5	10.6	3.77	3.11	3.98
Strontium	µg/L	n/v	n/v	n/v	3000	2860	3050	2370	3300	2310	767	1600	1510	2670	2530	2640	1150	642	942
Sulfur	µg/L	n/v	n/v	n/v	572000	578000	617000	225000	263000	191000	251000	919000	702000	1760000	1640000	1650000	499000	307000	460000
Tellurium	µg/L	n/v	n/v	n/v	0.39	<2 DM	<2 GT	<2 DM	<2 DM	<2 DM	<0.2	<2 GT	<2 GT	<4 DM	<2 GT	<4 GT	<2 GT	<2 GT	<2 DM
Thallium	µg/L	n/v	40[F]	n/v	<0.01	<0.1 DM	<0.1 GT	<0.1 DM	0.76	0.17	0.01	<0.1 GT	<0.1 GT	<0.2 DM	<0.1 GT	<0.2 GT	0.17	<0.1 GT	<0.1 DM
Thorium	µg/L	n/v	n/v	n/v	0.4	<1 DM	<1 GT	<1 XH	32.5	11.6	<0.1	<1 GT	<1 GT	<2 DM	<1 GT	<2 GT	<1 GT	<1 GT	<1 DM
Tin	µg/L	n/v	n/v	n/v	<0.1	<1 DM	<1 GT	<1 DM	1.2	<1 DM	<0.1	<1 GT	<1 GT	<2 DM	<1 GT	<2 GT	<1 GT	<1 GT	<1 DM
Titanium	µg/L	n/v	n/v	n/v	8.78	23.1	<3 GT	<3 XH	1410	230	<0.3	<3 GT	<3 GT	119	11.2	78.2	<3 GT	<3 GT	<3 DM
Tungsten	µg/L	n/v	n/v	n/v	0.14	2.2	<1 GT	<1 XH	30.2	28.8	18.1	15.1	10	36.6	7.7	30.6	6.7	9.8	3.5
Uranium	µg/L	20[A]	33[F]	20[H]	0.454	0.63	0.4	2.2	10.3	5.25	0.641	1.59	1.54	2.1	1.52	1.59	2.43	1.4	2.13
Vanadium	µg/L	n/v	20[F]	n/v	1.63	<5 DM	<5 GT	<5 DM	**179[F]**	**21.5[F]**	<0.5	<5 GT	<5 GT	15	<5 GT	11	<5 GT	<5 GT	<5 DM
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	<3	<30 DM	<30 GT	<30 DM	**345[F]**	54	<3	<30 GT	<30 GT	**150[F]**	<30 GT	**98[F]**	<30 GT	<30 GT	<30 DM
Zirconium	µg/L	n/v	n/v	n/v	4.45	4	4.5	<3 DM	9.6	4.2	0.36	<3 GT	<3 GT	7.9	<3 GT	<6 GT	<3 GT	<3 GT	<3 DM

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Stantec

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Sample Location					Historical Tailings H96-06B					Seeps SEEP 1		SEEP 3			SEEP 5		SEEP 6		
Sample Date					20-Jun-16	4-Aug-16	4-Aug-16	17-Oct-16	17-Oct-16	5-Aug-16	16-Oct-16	21-Jun-16	5-Aug-16	15-Oct-16	7-Aug-16	14-Oct-16	14-Jun-16	3-Aug-16	13-Oct-16
Sample ID					H96-06B	H96-06B	DUPLICATE 4	H96-06B	DUPLICATE 8	SEEP 1	SEEP 1	SEEP 3	SEEP 3	SEEP 3	SEEP 5	SEEP 5	SEEP 6	SEEP 6	SEEP 6
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786744	L1809307	L1809307	L1846519	L1846519	L1810001	L1844384	L1787602	L1810001	L1844417	L1810001	L1844412	L1783978	L1808958	L1843864
Laboratory Sample ID					L1786744-4	L1809307-2	L1809307-3	L1846519-6	L1846519-7	L1810001-11	L1844384-7	L1787602-7	L1810001-9	L1844417-7	L1810001-23	L1844412-12	L1783978-1	L1808958-9	L1843864-6
Sample Type	Units	ODWS	MOE APV	Health Canada			Field Duplicate		Field Duplicate										
Field Parameters																			
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	1.82	0.54	-	8.58	-	7.83	9.22	1.52	3.15	4.47	5.04	7.03	5.01	3.04	9.48
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	1889	2221	-	2019	-	2890	3360	265	206	332	252	549	2953	3042	2903
pH, Field	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	**6.78^{G}**	**6.51^{G}**	-	**6.93^{G}**	-	7.5	7.86	**6.73^{G}**	**6.89^{G}**	**6.87^{G}**	7.66	7.41	**6.75^{G}**	**6.87^{G}**	7.34
Temperature, Field	deg C	15^{C}	n/v	≤15^{G}	6.94	**15.75^{CG}**	-	7.79	-	**21.27^{CG}**	6.26	12.12	**18.71^{CG}**	7.84	**17.48^{CG}**	3.12	**25.94^{CG}**	**31.78^{CG}**	5.98
General Chemistry																			
Acidity as CaCO3	mg/L	n/v	n/v	n/v	42.4	74.5	75.1	39.1	39.0	10.9	10.3	12.7	14.4	45.4	<2.0	<2.0	25.6	62.4	25.8
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	395	481	475	449	431	306	324	147	130	150	141	226	349	-	354
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500^{D}	n/v	n/v	395	481	475	449	431	306	324	147	130	150	141	226	349	338	354
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.259	0.297	0.325	0.258	0.281	<0.020	0.032	0.064	0.092	0.033	<0.020	0.073	0.291	0.733	0.509
Anion Sum	meq/L	n/v	n/v	n/v	27.3	37.2	37.5	28.3	28.0	42.4	41.0	2.99	2.64	3.83	3.19	5.28	40.2	47.2	39.0
Cation Sum	meq/L	n/v	n/v	n/v	31.6	37.8	38.1	26.9	28.2	32.2	41.0	3.31	3.03	4.03	3.31	4.99	38.3	50.9	42.1
Chloride	mg/L	250^{C}	180^{F}	≤250^{G}	3.58	2.6	2.6	4.03	3.68	**428^{CFG}**	**331^{CFG}**	0.40	0.25	0.27	12.1	15.9	3.49	3.5	4.99
Color, True	TCU	5^{C}	n/v	n/v	**10.9^{C}**	**8.8^{C}**	**9.3^{C}**	**9.1^{C}**	**9.6^{C}**	**17.3^{C}**	**20.8^{C}**	**126^{C}**	**101^{C}**	**116^{C}**	**23.3^{C}**	**10.3^{C}**	4.7	**5.1^{C}**	2.8
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	**0.0394^{F}**	**0.0210^{F}**	**0.0222^{F}**	**0.0327^{F}**	**0.0349^{F}**	<0.0020	**0.0129^{F}**	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	**0.0101^{F}**	**0.0070^{F}**	**0.0114^{F}**
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050 BL	0.0111	0.0127	<0.0050 BL	<0.0050 BL	<0.0050	0.0082	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0071	<0.0050 BL	<0.0050 BL
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	0.0023	0.0124	0.0147	<0.0020 BL	<0.0020 BL	<0.0020	0.0091	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0084	<0.0020 BL	0.0030
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	5.0	**5.4^{C}**	**5.3^{C}**	**6.9^{C}**	**5.2^{C}**	**9.1^{C}**	**7.6^{C}**	**24.2^{C}**	**17.8^{C}**	**17.0^{C}**	**5.9^{C}**	**6.1^{C}**	3.7	4.1	3.5
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	2000	2460	2470	2020	2020	3330	3200	271	249	346	299	465	2590	3320	2870
Fluoride	mg/L	1.5$_{b}^{A}$	n/v	1.5^{H}	0.138	0.27	0.28	0.133	0.130	<0.10 DM	<0.10 DM	0.035	0.032	<0.020	0.032	0.020	0.21	<0.40 GT	<0.10 GT
Hardness (as CaCO3)	mg/L	80-100^{D}	n/v	n/v	**1550^{D}**	**1840^{D}**	**1850^{D}**	**1310^{D}**	**1370^{D}**	**1410^{D}**	**1520^{D}**	**156^{D}**	**144^{D}**	**185^{D}**	**148^{D}**	**229^{D}**	**1820^{D}**	**2420^{D}**	**2020^{D}**
Ion Balance	%	n/v	n/v	n/v	7.4	0.8	0.8	<0.000	0.3	<0.000	0.0	5.1	6.8	2.5	1.8	<0.000	<0.000	3.7	3.8
Nitrate (as N)	mg/L	10.0$_{d}^{A}$	n/v	10^{H}	0.055	<0.20 GT	<0.20 GT	0.088	0.084	<0.10 DM	<0.10 DM	<0.020	<0.020	<0.020	<0.020	<0.020	<0.10 DM	<0.40 GT	<0.10 GT
Nitrite (as N)	mg/L	1.0$_{d}^{A}$	n/v	1^{H}	<0.020 GT	<0.10 GT	<0.10 GT	<0.020 DM	<0.020 DM	<0.050 DM	<0.050 DM	<0.010	<0.010	<0.010	<0.010	<0.010	<0.050 DM	<0.20 GT	<0.050 GT
pH	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.28	7.13	7.16	7.54	7.54	7.79	8.07	7.29	7.05	**6.80^{G}**	7.96	8.09	7.60	7.16	7.76
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.618	0.868	0.811	0.532	0.555	0.188	0.0302	0.020	0.068	0.020	0.0133	0.051	0.120	0.145	0.025
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.541	0.532	0.546	0.58	0.54	<0.0030	<0.0030	0.0193	0.0135	0.0206	0.0038	0.0042	0.0229	0.0262	0.0239
Sulfate	mg/L	500$_{h}^{C}$	n/v	≤500$_{j}^{G}$	**925^{CG}**	**1320^{CG}**	**1340^{CG}**	**924^{CG}**	**927^{CG}**	**1160^{CG}**	**1210^{CG}**	1.82	1.59	39.7	1.80	14.9	**1590^{CG}**	**1940^{CG}**	**1530^{CG}**
Total Dissolved Solids	mg/L	500^{C}	n/v	≤500^{G}	**1860^{CG}**	**2330^{CG}**	**2320^{CG}**	**1760^{CG}**	**1770^{CG}**	**2540^{CG}**	**2520^{CG}**	201	170	261	167	273	**2510^{CG}**	**3430^{CG}**	**2810^{CG}**
Total Organic Carbon	mg/L	n/v	n/v	n/v	4.8	5.5	5.2	6.0	6.2	10.0	7.6	23.0	18.5	16.8	6.5	12.2	3.7	4.6	3.1
Total Suspended Solids	mg/L	n/v	n/v	n/v	50.7	41.3	37.1	26.7	30.1	14.1	<2.0	4.5	7.3	2.8	4.4	51.7	13.2	58.9	11.2

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Sample Location					Historical Tailings H96-06B					Seeps SEEP 1		SEEP 3			SEEP 5		SEEP 6		
Sample Date					20-Jun-16	4-Aug-16	4-Aug-16	17-Oct-16	17-Oct-16	5-Aug-16	16-Oct-16	21-Jun-16	5-Aug-16	15-Oct-16	7-Aug-16	14-Oct-16	14-Jun-16	3-Aug-16	13-Oct-16
Sample ID					H96-06B	H96-06B	DUPLICATE 4	H96-06B	DUPLICATE 8	SEEP 1	SEEP 1	SEEP 3	SEEP 3	SEEP 3	SEEP 5	SEEP 5	SEEP 6	SEEP 6	SEEP 6
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786744	L1809307	L1809307	L1846519	L1846519	L1810001	L1844384	L1787602	L1810001	L1844417	L1810001	L1844412	L1783978	L1808958	L1843864
Laboratory Sample ID					L1786744-4	L1809307-2	L1809307-3	L1846519-6	L1846519-7	L1810001-11	L1844384-7	L1787602-7	L1810001-9	L1844417-7	L1810001-23	L1844412-12	L1783978-1	L1808958-9	L1843864-6
Sample Type	Units	ODWS	MOE APV	Health Canada			Field Duplicate		Field Duplicate										
Metals, Dissolved																			
Aluminum	μg/L	100[D]	n/v	<100/200$_a$[G]	<10 GT	<20 GT	<20 GT	<20 GT	<100 GT	<2	<2	11	6.4	5.2	2.5	<2	<20 GT	<20 GT	<20 GT
Antimony	μg/L	6[B]	1600[F]	6[H]	<0.5 GT	<1 GT	<1 GT	<1 GT	<5 GT	<0.1	<0.1	<0.5 DM	0.12	1.11	<0.1	<0.1	<1 GT	<1 GT	<1 GT
Arsenic	μg/L	25[B]	150[F]	10[H]	**25700[BFH]**	**14900[BFH]**	**14800[BFH]**	**23100[BFH]**	**23200[BFH]**	**1430[BFH]**	**294[BFH]**	**978[BFH]**	**479[BFH]**	**342[BFH]**	2.55	2.88	**3090[BFH]**	**3050[BFH]**	**1680[BFH]**
Barium	μg/L	1000[A]	2300[F]	1000[H]	11.9	17.6	17.3	11.4	15.1	42	33.5	15	16	16.6	16.2	21.3	25.9	47.3	16.2
Beryllium	μg/L	n/v	5.3[F]	n/v	<0.5 GT	<1 GT	<1 GT	<1 GT	<5 GT	<0.1	<0.1	<0.5 DM	<0.1	<0.1	<0.1	<0.1	<1 GT	<1 GT	<1 GT
Bismuth	μg/L	n/v	n/v	n/v	<0.25 GT	<0.5 GT	<0.5 GT	<0.5 GT	<2.5 GT	<0.05	<0.05	<0.25 DM	<0.05	<0.05	<0.05	<0.05	<0.5 GT	<0.5 GT	<0.5 GT
Boron	μg/L	5000[B]	3550[F]	5000[H]	119	100	110	110	<500 GT	90	51	<50 DM	<10	<10	<10	<10	180	270	140
Cadmium	μg/L	5[A]	0.21[F]	5[H]	<0.025 GT	<0.05 GT	<0.05 GT	<0.05 GT	***<0.25 GT***	<0.005	<0.005	<0.025 DM	<0.005	0.0083	<0.005	<0.005	<0.05 GT	<0.05 GT	<0.05
Calcium	mg/L	n/v	n/v	n/v	272	354	364	222	237	335	362	47.2	42.2	52.5	41.7	73.5	392	512	447
Cesium	μg/L	n/v	n/v	n/v	<0.05 GT	<0.1 GT	<0.1 GT	<0.1 GT	<0.5 GT	0.027	0.014	<0.05 DM	0.012	0.015	<0.01	<0.01	<0.1 GT	<0.1 GT	<0.1 GT
Chromium	μg/L	50[A]	64[F]	50[H]	<0.5 GT	<1 GT	<1 GT	<1 GT	<5 GT	0.24	0.12	<0.5 DM	0.22	<0.1	0.42	<0.1	<1 GT	<1 GT	<1 GT
Cobalt	μg/L	n/v	5.2[F]	n/v	1.93	1.9	1.9	1.7	<5 GT	0.87	0.98	0.75	0.27	0.43	<0.1	<0.1	4	**6[F]**	5.1
Copper	μg/L	1000[C]	6.9[F]	≤1000[G]	<1 GT	<2 GT	<2 GT	<2 GT	***<10 GT***	0.69	0.26	<1 DM	0.24	0.77	0.37	<0.2	<2 GT	<2 GT	<2 GT
Iron	μg/L	300[C]	n/v	≤300[G]	**3550[CG]**	**9300[CG]**	**9170[CG]**	**5820[CG]**	**5560[CG]**	29	19	**2230[CG]**	**1660[CG]**	**4490[CG]**	207	<10	**3230[CG]**	**5240[CG]**	**1480[CG]**
Lead	μg/L	10$_c$[A]	2[F]	10[H]	<0.25 GT	<0.5 GT	<0.5 GT	<0.5 GT	***<2.5 GT***	<0.05	<0.05	<0.25 DM	<0.05	<0.05	<0.05	<0.05	<0.5 GT	<0.5 GT	<0.5 GT
Lithium	μg/L	n/v	n/v	n/v	6.5	16	17	<10 GT	<50 GT	10.2	10.5	<5 DM	<1	1.3	<1	<1	29	30	22
Magnesium	mg/L	n/v	n/v	n/v	211	233	229	183	190	139	149	9.23	9.31	11.3	10.7	11.1	205	276	220
Manganese	μg/L	50[C]	n/v	≤50[G]	**447[CG]**	**653[CG]**	**651[CG]**	**392[CG]**	**384[CG]**	**150[CG]**	**97.1[CG]**	**119[CG]**	**119[CG]**	**97.9[CG]**	20.3	23.9	**180[CG]**	**458[CG]**	**417[CG]**
Mercury	μg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	μg/L	n/v	730[F]	n/v	3.96	2.49	2.45	3.51	3.5	0.107	0.151	<0.25 DM	0.134	0.344	0.357	0.181	5.14	6.51	2.72
Nickel	μg/L	n/v	39[F]	n/v	<2.5 GT	<5 GT	<5 GT	<5 GT	<25 GT	0.76	0.5	<2.5 DM	0.84	1.8	<0.5	<0.5	<5 GT	<5 GT	<5 GT
Phosphorus	μg/L	n/v	n/v	n/v	<250 GT	<500 GT	<500 GT	<500 GT	<2500 GT	<50	<50	<250 DM	<50	<50	<50	<50	<500 GT	<500 GT	<500 GT
Potassium	mg/L	n/v	n/v	n/v	3.10	3.59	3.56	3.03	3.2	18.3	25.3	0.91	0.599	0.383	0.503	1.30	49.0	62.2	44.1
Rubidium	μg/L	n/v	n/v	n/v	1.2	<2 GT	<2 GT	<2 GT	<10 GT	5.97	6.19	2.9	1.67	1.16	1.31	2.06	6.5	8.1	5.9
Selenium	μg/L	10[A]	5[F]	50[H]	<0.25 GT	<0.5 GT	<0.5 GT	<0.5 GT	<2.5 GT	<0.05	0.061	<0.25 DM	0.062	<0.05	<0.05	<0.05	<0.5 GT	<0.5 GT	<0.5 GT
Silicon	μg/L	n/v	n/v	n/v	12200	12700	12700	11700	11300	8560	7360	2780	2970	2490	1580	3280	7830	7980	7470
Silver	μg/L	n/v	0.12[F]	n/v	<0.05 GT	<0.1 GT	<0.1 GT	<0.1 GT	***<0.5 GT***	<0.01	<0.01	<0.05 DM	<0.01	<0.01	<0.01	<0.01	<0.1 GT	<0.1 GT	<0.1 GT
Sodium	mg/L	200$_g$[C] 20$_g$[E]	180[F]	≤200[G]	9.43	10.8	10.8	7.86	8.1	**251[CEFG]**	**230[CEFG]**	1.03	1.05	1.26	7.43	8.52	11.1	15.9	11.0
Strontium	μg/L	n/v	n/v	n/v	884	1140	1170	853	867	1980	1880	58	49.2	66.2	51.6	67.5	3640	5250	3410
Sulfur	μg/L	n/v	n/v	n/v	364000	459000	461000	338000	332000	423000	497000	<2500 DM	510	17700	<500	4830	583000	716000	621000
Tellurium	μg/L	n/v	n/v	n/v	<1 GT	<2 GT	<2 GT	<2 GT	<10 GT	<0.2	<0.2	<1 DM	<0.2	<0.2	<0.2	<0.2	<2 GT	<2 GT	<2 GT
Thallium	μg/L	n/v	40[F]	n/v	<0.05 GT	<0.1 GT	<0.1 GT	<0.1 GT	<0.5 GT	<0.01	<0.01	<0.05 DM	<0.01	<0.01	<0.01	<0.01	<0.1 GT	<0.1 GT	<0.1 GT
Thorium	μg/L	n/v	n/v	n/v	<0.5 GT	<1 GT	<1 GT	<1 GT	<5 GT	<0.1	<0.1	<0.5 DM	<0.1	<0.1	<0.1	<0.1	<1 GT	<1 GT	<1 GT
Tin	μg/L	n/v	n/v	n/v	<0.5 GT	<1 GT	<1 GT	<1 GT	<5 GT	0.39	<0.1	<0.5 DM	<0.1	<0.1	<0.1	<0.1	<1 GT	<1 GT	<1 GT
Titanium	μg/L	n/v	n/v	n/v	<1.5 GT	<3 GT	<3 GT	<3 GT	<15 GT	<0.3	<0.3	<1.5 DM	<0.3	<0.3	<0.3	<0.3	<3 GT	<3 GT	<3 GT
Tungsten	μg/L	n/v	n/v	n/v	<0.5 GT	<1 GT	<1 GT	<1 GT	<5 GT	<0.1	0.13	<0.5 DM	<0.1	<0.1	0.25	0.16	<1 GT	<1 GT	<1 GT
Uranium	μg/L	20[A]	33[F]	20[H]	0.301	0.15	0.15	0.34	<0.5 GT	0.174	0.284	0.076	0.109	0.037	0.093	0.064	0.7	0.63	0.69
Vanadium	μg/L	n/v	20[F]	n/v	<2.5 GT	<5 GT	<5 GT	<5 GT	***<25 GT***	<0.5	<0.5	<2.5 DM	<0.5	<0.5	<0.5	<0.5	<5 GT	<5 GT	<5 GT
Zinc	μg/L	5000[C]	89[F]	≤5000[G]	<5 GT	<10 GT	<10 GT	<10 GT	<50 GT	9	1.1	<5 DM	1.3	4.2	3	<1	<10 GT	<10 GT	<10 GT
Zirconium	μg/L	n/v	n/v	n/v	<1.5 GT	<3 GT	<3 GT	<3 GT	<15 GT	<0.3	<0.3	<1.5 DM	<0.3	<0.3	<0.3	<0.3	<3 GT	<3 GT	<3 GT

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

	Units	ODWS	MOE APV	Health Canada	Historical Tailings					Seeps									
Sample Location					H96-06B					SEEP 1		SEEP 3			SEEP 5		SEEP 6		
Sample Date					20-Jun-16	4-Aug-16	4-Aug-16	17-Oct-16	17-Oct-16	5-Aug-16	16-Oct-16	21-Jun-16	5-Aug-16	15-Oct-16	7-Aug-16	14-Oct-16	14-Jun-16	3-Aug-16	13-Oct-16
Sample ID					H96-06B	H96-06B	DUPLICATE 4	H96-06B	DUPLICATE 8	SEEP 1	SEEP 1	SEEP 3	SEEP 3	SEEP 3	SEEP 5	SEEP 5	SEEP 6	SEEP 6	SEEP 6
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1786744	L1809307	L1809307	L1846519	L1846519	L1810001	L1844384	L1787602	L1810001	L1844417	L1810001	L1844412	L1783978	L1808958	L1843864
Laboratory Sample ID					L1786744-4	L1809307-2	L1809307-3	L1846519-6	L1846519-7	L1810001-11	L1844384-7	L1787602-7	L1810001-9	L1844417-7	L1810001-23	L1844412-12	L1783978-1	L1808958-9	L1843864-6
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**			Field Duplicate		Field Duplicate										
Metals, Total																			
Aluminum	µg/L	100^{D}	n/v	<100/200$_{a}$^{G}	**154^{DG}**	**271^{DG}**	**293^{DG}**	89	86	4.5	19.8	15.8	99.6	7.9	12.8	31.7	5.9	<30 GT	<30 GT
Antimony	µg/L	6^{B}	1600^{F}	6^{H}	<1 GT	<1 GT	<1 GT	<1 GT	<1 GT	<0.1	<0.1	0.2	0.16	1.15	<0.1	<0.1	<0.1	<1 GT	<1 GT
Arsenic	µg/L	25^{B}	150^{F}	10^{H}	**28500^{BFH}**	**15800^{BFH}**	**16800^{BFH}**	**26600^{BFH}**	**24600^{BFH}**	**1790^{BFH}**	**348^{BFH}**	**1050^{BFH}**	**644^{BFH}**	**457^{BFH}**	3.32	7.73	**2620^{BFH}**	**8280^{BFH}**	**2650^{BFH}**
Barium	µg/L	1000^{A}	2300^{F}	1000^{H}	14.6	18.3	19	12.4	12	43.8	35.1	16.8	16.5	15.6	16.3	133	24.9	55.1	18
Beryllium	µg/L	n/v	5.3^{F}	n/v	<1 GT	<1 GT	<1 GT	<1 GT	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<1 GT
Bismuth	µg/L	n/v	n/v	n/v	<0.5 GT	<0.5 GT	<0.5 GT	<0.5 GT	<0.5 GT	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5 GT	<0.5 GT
Boron	µg/L	5000^{B}	3550^{F}	5000^{H}	120	<100 GT	100	110	120	75	57	<10	<10	<10	<10	<10	160	260	170
Cadmium	µg/L	5^{A}	0.21^{F}	5^{H}	<0.05 GT	<0.05 GT	<0.05 GT	<0.05 GT	<0.05 GT	<0.005	<0.005	0.0058	0.0151	0.0095	<0.005	0.0052	<0.005	<0.05 GT	<0.05 GT
Calcium	mg/L	n/v	n/v	n/v	255	351	356	232	236	376	377	50.7	40.7	54.5	39.0	80.6	436	525	460
Cesium	µg/L	n/v	n/v	n/v	<0.1 GT	<0.1 GT	<0.1 GT	<0.1 GT	<0.1 GT	0.027	0.017	0.02	0.03	0.017	<0.01	0.011	0.019	<0.1 GT	<0.1 GT
Chromium	µg/L	50^{A}	64^{F}	50^{H}	<1 GT	<1 GT	<1 GT	<1 GT	<1 GT	0.15	0.23	0.14	0.36	<0.1	0.12	0.25	<0.1	<1 GT	<1 GT
Cobalt	µg/L	n/v	5.2^{F}	n/v	2	2.1	2.1	1.7	1.8	0.94	1.02	0.8	0.39	0.43	<0.1	0.35	3.81	**6.6^{F}**	5.2
Copper	µg/L	1000^{C}	6.9^{F}	≤1000^{G}	<5 GT	<5 GT	<5 GT	<5 GT	<5 GT	0.79	0.92	0.58	1.42	1.24	0.56	<0.5	<0.5	<5 GT	<5 GT
Iron	µg/L	300^{C}	n/v	≤300^{G}	**7460^{CG}**	**9790^{CG}**	**10200^{CG}**	**5710^{CG}**	**5890^{CG}**	**735^{CG}**	229	**2570^{CG}**	**3400^{CG}**	**4810^{CG}**	**579^{CG}**	**1420^{CG}**	**2450^{CG}**	**17400^{CG}**	**3650^{CG}**
Lead	µg/L	10$_{c}$^{A}	2^{F}	10^{H}	<0.5 GT	<0.5 GT	<0.5 GT	<0.5 GT	<0.5 GT	<0.05	0.053	0.087	0.339	0.052	<0.05	<0.05	<0.05	<0.5 GT	<0.5 GT
Lithium	µg/L	n/v	n/v	n/v	<10 GT	<10 GT	<10 GT	<10 GT	<10 GT	9.6	11.4	<1	<1	1.3	<1	<1	24.4	36	27
Magnesium	mg/L	n/v	n/v	n/v	204	230	237	186	181	156	167	10.6	8.96	11.9	10.3	11.7	203	302	227
Manganese	µg/L	50^{C}	n/v	≤50^{G}	**464^{CG}**	**667^{CG}**	**681^{CG}**	**405^{CG}**	**381^{CG}**	**178^{CG}**	**101^{CG}**	**123^{CG}**	**119^{CG}**	**92.8^{CG}**	31.6	**229^{CG}**	**166^{CG}**	**506^{CG}**	**440^{CG}**
Mercury	µg/L	1^{A}	0.77^{F}	1^{H}	0.0062	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730^{F}	n/v	4.25	2.38	2.55	3.45	3.77	0.111	0.161	0.24	0.155	0.36	0.329	0.322	5.05	6.04	2.82
Nickel	µg/L	n/v	39^{F}	n/v	<5 GT	<5 GT	<5 GT	<5 GT	<5 GT	0.63	0.58	1.83	1.29	1.44	<0.5	<0.5	4.52	<5 GT	<5 GT
Phosphorus	µg/L	n/v	n/v	n/v	<500 GT	<500 GT	<500 GT	<500 GT	<500 GT	<50	<50	<50	<50	<50	<50	72	<50	<500 GT	<500 GT
Potassium	mg/L	n/v	n/v	n/v	3.08	3.56	3.68	3.35	3.20	19.5	25.3	1.07	0.600	0.390	0.489	1.51	47.0	63.4	44.8
Rubidium	µg/L	n/v	n/v	n/v	<2 GT	<2 GT	<2 GT	<2 GT	<2 GT	6.11	6.68	3.26	1.79	1.12	1.31	2.38	6.89	8.7	6.2
Selenium	µg/L	10^{A}	5^{F}	50^{H}	<0.5 GT	<0.5 GT	<0.5 GT	<0.5 GT	<0.5 GT	0.057	0.06	0.088	0.089	<0.05	<0.05	<0.05	<0.05	<0.5 GT	<0.5 GT
Silicon	µg/L	n/v	n/v	n/v	12400	13600	13800	11600	11600	8890	7490	3290	3030	2440	1610	3620	9060	9230	7940
Silver	µg/L	n/v	0.12^{F}	n/v	<0.1 GT	<0.1 GT	<0.1 GT	<0.1 GT	<0.1 GT	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 GT	<0.1 GT
Sodium	mg/L	200$_{g}$^{C} 20$_{g}$^{E}	180^{F}	≤200^{G}	8.96	11.8	12.3	8.43	8.39	**275^{CEFG}**	**241^{CEFG}**	1.19	1.05	1.28	7.58	8.76	10.3	17.8	11.0
Strontium	µg/L	n/v	n/v	n/v	939	1140	1200	804	790	2080	2030	63.1	46.5	69.1	47.5	75.7	3860	5040	3450
Sulfur	µg/L	n/v	n/v	n/v	367000	438000	462000	314000	306000	462000	436000	850	550	16300	<500	5070	525000	771000	652000
Tellurium	µg/L	n/v	n/v	n/v	<2 GT	<2 GT	<2 GT	<2 GT	<2 GT	0.31	0.28	<0.2	<0.2	<0.2	<0.2	<0.2	0.72	<2 GT	<2 GT
Thallium	µg/L	n/v	40^{F}	n/v	<0.1 GT	<0.1 GT	<0.1 GT	<0.1 GT	<0.1 GT	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1 GT	0.13
Thorium	µg/L	n/v	n/v	n/v	<1 GT	<1 GT	<1 GT	<1 GT	<1 GT	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<1 GT
Tin	µg/L	n/v	n/v	n/v	<1 GT	<1 GT	<1 GT	<1 GT	<1 GT	0.13	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1 GT	<1 GT
Titanium	µg/L	n/v	n/v	n/v	11.9	19.1	21.5	7.5	6.8	<0.3	<1.6 DM	0.41	3.36	<0.3	0.49	1.64	<0.3	<3 GT	<3 GT
Tungsten	µg/L	n/v	n/v	n/v	<1 GT	<1 GT	<1	<1 GT	<1 GT	<0.1	0.13	<0.1	<0.1	<0.1	0.26	0.57	0.19	<1 GT	<1 GT
Uranium	µg/L	20^{A}	33^{F}	20^{H}	0.36	0.17	0.16	0.35	0.36	0.183	0.298	0.083	0.174	0.041	0.091	0.075	0.771	0.6	0.68
Vanadium	µg/L	n/v	20^{F}	n/v	<5 GT	<5 GT	<5 GT	<5 GT	<5 GT	<0.5	<0.5	<0.5	0.57	<0.5	<0.5	<0.5	<0.5	<5 GT	<5 GT
Zinc	µg/L	5000^{C}	89^{F}	≤5000^{G}	<30 GT	<30 GT	<30 GT	<30 GT	<30 GT	<3	<3	<3	3.7	<3	<3	<3	<3	<30 GT	<30 GT
Zirconium	µg/L	n/v	n/v	n/v	<3 GT	<3 GT	<3 GT	<3 GT	<3 GT	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<3 GT	<3 GT

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Seeps										Underground Workings		
Sample Location					SEEP 7			SEEP 8		SEEP 9			SEEP 10		HARDROCK SHAFT	HARDROCK SHAFT 1	
Sample Date					14-Jun-16	3-Aug-16	13-Oct-16	14-Jun-16	3-Aug-16	4-Aug-16	13-Oct-16	16-Oct-16	5-Aug-16	16-Oct-16	16-Oct-16	21-Jun-16	5-Aug-16
Sample ID					SEEP 7	SEEP 7	SEEP 7	SEEP 8	SEEP 8	SEEP 9	SEEP 9	SEEP 9	SEEP 10	SEEP 10	HARDROCK SHAFT	HARDROCK SHAFT 1	HARD ROCK SHAFT 1
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1783978	L1808958	L1843864	L1783978	L1808958	L1809307	L1843864	L1844384	L1810001	L1844384	L1844384	L1787602	L1810001
Laboratory Sample ID					L1783978-2	L1808958-10	L1843864-7	L1783978-3	L1808958-11	L1809307-8	L1843864-8	L1844384-9	L1810001-8	L1844384-8	L1844384-6	L1787602-8	L1810001-10
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**													
Field Parameters																	
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	2.52	1.11	0.29	6.62	5.1	2.56	-	5.25	9.08	6.34	1.22	0.23	0.43
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	2864	2963	2760	2807	2979	4162	-	3747	1696	11179	1793	1479	13.52
pH, Field	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	**6.89**^{G}	**6.73**^{G}	7.13	**6.86**^{G}	7.1	**6.94**^{G}	-	7.2	7.96	7.96	7.05	**6.83**^{G}	**6.97**^{G}
Temperature, Field	deg C	15^{C}	n/v	≤15^{G}	**23.34**^{CG}	**18.06**^{CG}	6.51	**27.34**^{CG}	**32.5**^{CG}	**18.71**^{CG}	-	6.26	**24.6**^{CG}	6.85	3.3	4.16	5.85
General Chemistry																	
Acidity as CaCO3	mg/L	n/v	n/v	n/v	23.3	54.6	38.8	40.1	37.9	41.9	47.9	31.7	2.5	3.2	40.3	18.2	26.5
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	338	-	363	358	-	332	380	337	257	202	289	233	242
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500^{D}	n/v	n/v	338	400	363	358	374	332	380	337	257	202	289	233	242
Ammonia (as N)	mg/L	n/v	n/v	n/v	0.201	0.090	0.470	0.240	0.658	0.679	0.343	0.540	<0.020	0.063	0.206	0.045	0.201
Anion Sum	meq/L	n/v	n/v	n/v	32.1	47.1	47.3	37.0	47.4	56.9	47.1	46.5	19.7	43.8	21.3	15.0	17.4
Cation Sum	meq/L	n/v	n/v	n/v	36.4	51.4	45.4	39.1	50.7	55.9	46.1	48.8	19.7	58.0	20.7	16.2	19.0
Chloride	mg/L	250^{C}	180^{F}	≤250^{G}	5.02	4.8	5.4	4.46	3.6	172	5.4	70.6	**517**^{CFG}	**1380**^{CFG}	128	138	144
Color, True	TCU	5^{C}	n/v	n/v	4.5	4.5	<2.0	4.1	3.6	3.0	<2.0	**9.9**^{C}	**91.2**^{C}	**188**^{C}	**8.9**^{C}	**5.7**^{C}	4.2
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	**0.0143**^{F}	**0.0117**^{F}	**0.0121**^{F}	**0.0104**^{F}	**0.0111**^{F}	**0.0061**^{F}	**0.0116**^{F}	**0.0087**^{F}	<0.0020	0.0027	0.0022	0.0030	0.0023
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	0.0104	0.0085	<0.0050 BL	<0.0050 BL	0.0080	<0.0050 BL	<0.0050 BL	<0.0050 BL	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	0.0122	0.0098	<0.0020 BL	0.0051	0.0092	0.0021	<0.0020 BL	0.0047	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	3.9	4.2	2.8	3.9	4.4	3.7	2.9	4.8	**34.6**^{C}	**28.1**^{C}	**5.6**^{C}	**5.5**^{C}	4.2
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	2550	3190	3030	2720	3260	3680	3060	3300	2000	5710	1690	1480	1600
Fluoride	mg/L	1.5_{b}^{A}	n/v	1.5^{H}	0.16	<0.40 GT	<0.40 GT	0.18	<0.40 GT	<0.20 GT	<0.40 GT	<0.20 DM	<0.20 DM	<0.20 DM	<0.20 DM	0.057	0.064
Hardness (as CaCO3)	mg/L	80-100^{D}	n/v	n/v	**1750**^{D}	**2480**^{D}	**2140**^{D}	**1880**^{D}	**2460**^{D}	**2480**^{D}	**2210**^{D}	**2250**^{D}	**273**^{D}	**611**^{D}	**830**^{D}	**609**^{D}	**741**^{D}
Ion Balance	%	n/v	n/v	n/v	6.3	4.4	<0.000	2.7	3.3	<0.000	<0.000	2.5	<0.000	13.9 BR	<0.000	4.0	4.5
Nitrate (as N)	mg/L	10.0_{d}^{A}	n/v	10^{H}	<0.10 DM	<0.40 GT	<0.40 GT	<0.10 DM	<0.40 GT	<0.20 GT	<0.40 GT	<0.20 DM	0.059	2.44	<0.20 DM	0.062	<0.040 DM
Nitrite (as N)	mg/L	1.0_{d}^{A}	n/v	1^{H}	<0.050 DM	<0.20 GT	<0.20 GT	<0.050 DM	<0.20 GT	<0.10 GT	<0.20 GT	<0.10 DM	<0.10 DM	<0.10 DM	<0.10 DM	<0.010	<0.020 DM
pH	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.62	7.35	7.49	7.33	7.61	7.19	7.38	7.57	7.95	8.17	7.21	7.36	7.13
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0557	0.035	0.061	0.050	0.139	0.198	0.041	0.044	0.066	0.056	0.0298	0.0035	0.0038
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0104	0.0055	0.197	0.0115	<0.0060 DM	0.0331	0.0556	0.0507	0.0206	0.0518	0.0094	<0.0030	<0.0030
Sulfate	mg/L	500_{h}^{C}	n/v	$≤500_{j}^{G}$	**1210**^{CG}	**1870**^{CG}	**1920**^{CG}	**1430**^{CG}	**1910**^{CG}	**2180**^{CG}	**1890**^{CG}	**1810**^{CG}	<3.0 DM	28.9	**572**^{CG}	308	408
Total Dissolved Solids	mg/L	500^{C}	n/v	≤500^{G}	**2440**^{CG}	**3200**^{CG}	**2990**^{CG}	**2650**^{CG}	**3350**^{CG}	**3650**^{CG}	**3080**^{CG}	**3260**^{CG}	**1080**^{CG}	**3300**^{CG}	**1230**^{CG}	**1020**^{CG}	**1090**^{CG}
Total Organic Carbon	mg/L	n/v	n/v	n/v	3.9	4.1	2.7	3.7	3.8	4.1	2.5	4.0	36.9	27.4	5.0	5.4	4.1
Total Suspended Solids	mg/L	n/v	n/v	n/v	15.4	48.1	48.4	66.1	129	52.0	48.9	31.7	16.1	4.7	30.5	<2.0	8.9

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Seeps										Underground Workings		
Sample Location					SEEP 7	SEEP 7	SEEP 7	SEEP 8	SEEP 8	SEEP 9	SEEP 9	SEEP 9	SEEP 10	SEEP 10	HARDROCK SHAFT	HARDROCK SHAFT 1	HARDROCK SHAFT 1
Sample Date					14-Jun-16	3-Aug-16	13-Oct-16	14-Jun-16	3-Aug-16	4-Aug-16	13-Oct-16	16-Oct-16	5-Aug-16	16-Oct-16	16-Oct-16	21-Jun-16	5-Aug-16
Sample ID					SEEP 7	SEEP 7	SEEP 7	SEEP 8	SEEP 8	SEEP 9	SEEP 9	SEEP 9	SEEP 10	SEEP 10	HARDROCK SHAFT	HARDROCK SHAFT 1	HARD ROCK SHAFT 1
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1783978	L1808958	L1843864	L1783978	L1808958	L1809307	L1843864	L1844384	L1810001	L1844384	L1844384	L1787602	L1810001
Laboratory Sample ID					L1783978-2	L1808958-10	L1843864-7	L1783978-3	L1808958-11	L1809307-8	L1843864-8	L1844384-9	L1810001-8	L1844384-8	L1844384-6	L1787602-8	L1810001-10
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**													
Metals, Dissolved																	
Aluminum	µg/L	100[D]	n/v	<100/200$_a$[G]	<20 GT	<20 IF	<20 GT	<20 GT	<20 DM	<20 GT	<20 GT	<2	22.3	45	<2	<2	<2
Antimony	µg/L	6[B]	1600[F]	6[H]	<1 GT	<1 IF	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<0.1	0.51	1.1	0.19	0.31	0.25
Arsenic	µg/L	25[B]	150[F]	10[H]	**1050[BFH]**	**550[BFH]**	**7990[BFH]**	**858[BFH]**	**298[BFH]**	**4510[BFH]**	**3800[BFH]**	**4770[BFH]**	**243[BFH]**	**116[BH]**	**316[BFH]**	5.16	**11.6[H]**
Barium	µg/L	1000[A]	2300[F]	1000[H]	20.7	30	21.4	24.8	18.8	14.5	24.7	15	35.7	125	31.2	26.6	28.1
Beryllium	µg/L	n/v	5.3[F]	n/v	<1 GT	<1 IF	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.5 GT	<0.5 IF	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 GT	<0.5 GT	<0.05	<0.05	<0.5 GT	<0.05	<0.05	<0.05
Boron	µg/L	5000[B]	3550[F]	5000[H]	170	200	130	180	130	160	100	84	15	<100 GT	81	45	65
Cadmium	µg/L	5[A]	0.21[F]	5[H]	<0.05 GT	<0.05 IF	<0.05 GT	<0.05 GT	<0.05 DM	<0.05 GT	<0.05 GT	<0.005	<0.005	0.051	<0.005	<0.005	<0.005
Calcium	mg/L	n/v	n/v	n/v	388	554	482	418	575	527	493	496	89.8	199	223	166	197
Cesium	µg/L	n/v	n/v	n/v	<0.1 GT	<0.1 IF	<0.1 GT	<0.1 GT	<0.1 DM	<0.1 GT	<0.1 GT	0.072	<0.01	<0.1 GT	0.34	0.36	0.369
Chromium	µg/L	50[A]	64[F]	50[H]	<1 GT	<1 IF	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<0.1	0.58	1.1	0.17	<0.1	<0.1
Cobalt	µg/L	n/v	5.2[F]	n/v	3.8	**5.8[F]**	**6.1[F]**	3.9	**7[F]**	3.9	**6.8[F]**	4.31	0.41	<1 GT	2.69	1.29	1.93
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	<2 GT	<2 IF	<2 GT	<2 GT	<2 DM	<2 GT	<2 GT	0.22	1.88	**13[F]**	<0.2	0.4	0.21
Iron	µg/L	300[C]	n/v	≤300[G]	**1990[CG]**	**860[CG]**	**20500[CG]**	**1760[CG]**	<100 DM	**9940[CG]**	**13700[CG]**	**7800[CG]**	186	120	**13700[CG]**	<10	**4180[CG]**
Lead	µg/L	10$_c$[A]	2[F]	10[H]	<0.5 GT	<0.5 IF	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 GT	<0.5 GT	<0.05	0.062	0.57	<0.05	<0.05	<0.05
Lithium	µg/L	n/v	n/v	n/v	23	30	25	23	23	20	20	14.5	1.3	<10 GT	6.9	4.6	5.7
Magnesium	mg/L	n/v	n/v	n/v	189	267	228	203	249	283	237	245	11.8	27.9	66.6	47.1	60.5
Manganese	µg/L	50[C]	n/v	≤50[G]	**189[CG]**	**363[CG]**	**421[CG]**	**192[CG]**	**631[CG]**	**413[CG]**	**553[CG]**	**447[CG]**	**129[CG]**	17.6	**667[CG]**	**228[CG]**	**389[CG]**
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0113	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	3.36	2.29	2.89	3.21	4.21	1.11	2.09	0.936	0.514	1.87	0.495	0.338	0.398
Nickel	µg/L	n/v	39[F]	n/v	<5 GT	<5 IF	<5 GT	5.2	8.7	<5 GT	7.1	3.33	2.72	<5 GT	8.57	4.25	6.82
Phosphorus	µg/L	n/v	n/v	n/v	<500 GT	<500 IF	<500 GT	<500 GT	<500 DM	<500 GT	<500 GT	<50	<50	<500 GT	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	41.3	49.7	43.2	43.1	42.8	41.9	34.9	38.4	3.37	5.47	6.52	5.63	6.18
Rubidium	µg/L	n/v	n/v	n/v	5.3	7.7	5.6	5.6	6.9	8.4	5	8.19	2.41	<2 GT	8.69	6.91	7.69
Selenium	µg/L	10[A]	5[F]	50[H]	<0.5 GT	<0.5 IF	<0.5 GT	<0.5 GT	<0.5 DM	<0.5 GT	<0.5 GT	<0.05	0.135	<0.5 GT	<0.05	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	7520	8850	9080	8720	10700	9580	7970	8700	973	710	5240	3710	4590
Silver	µg/L	n/v	0.12[F]	n/v	<0.1 GT	<0.1 IF	<0.1 GT	<0.1 GT	<0.1 DM	<0.1 GT	<0.1 GT	<0.01	<0.01	<0.1 GT	<0.01	<0.01	<0.01
Sodium	mg/L	200$_g$[C] 20$_g$[E]	180[F]	≤200[G]	8.93	11.6	9.74	8.69	9.41	**108[E]**	8.76	**56.4[E]**	**324[CEFG]**	**1050[CEFG]**	**72.9[E]**	**90.1[E]**	**87.3[E]**
Strontium	µg/L	n/v	n/v	n/v	3300	4470	3610	3730	4460	3730	3480	3190	167	380	1800	1170	1420
Sulfur	µg/L	n/v	n/v	n/v	559000	723000	666000	602000	745000	738000	653000	694000	1900	16600	207000	125000	162000
Tellurium	µg/L	n/v	n/v	n/v	<2 GT	<2 IF	<2 GT	<2 GT	<2 DM	<2 GT	<2 GT	<0.2	<0.2	<2 GT	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40[F]	n/v	<0.1 GT	<0.1 IF	<0.1 GT	<0.1 GT	<0.1 DM	<0.1 GT	<0.1 GT	<0.01	<0.01	<0.1 GT	<0.01	<0.01	<0.01
Thorium	µg/L	n/v	n/v	n/v	<1 GT	<1 IF	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	<1 GT	<1 IF	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<0.1	<0.1	<1 GT	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	<3 GT	<3 IF	<3 GT	<3 GT	<3 DM	<3 GT	<3 GT	<0.3	0.56	<3 GT	<0.3	<0.3	<0.3
Tungsten	µg/L	n/v	n/v	n/v	<1 GT	<1 IF	<1 GT	<1 GT	<1 DM	<1 GT	<1 GT	<0.1	0.58	1.9	0.19	<0.1	<0.1
Uranium	µg/L	20[A]	33[F]	20[H]	0.73	0.72	0.73	0.79	1.03	0.62	1.02	0.633	0.478	1.07	2.26	1.06	1.55
Vanadium	µg/L	n/v	20[F]	n/v	<5 GT	<5 IF	<5 GT	<5 GT	<5 DM	<5 GT	<5 GT	<0.5	0.58	<5 GT	<0.5	<0.5	<0.5
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	<10 GT	<10 IF	<10 GT	<10 GT	<10 DM	<10 GT	<10 GT	1.4	2.7	<10 GT	3.2	1.4	1.3
Zirconium	µg/L	n/v	n/v	n/v	<3 GT	<3 IF	<3 GT	<3 GT	<3 DM	<3 GT	<3 GT	<0.3	<0.3	<3 GT	<0.3	<0.3	<0.3

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Seeps										Underground Workings		
Sample Location					SEEP 7			SEEP 8		SEEP 9			SEEP 10		HARDROCK SHAFT	HARDROCK SHAFT 1	
Sample Date					14-Jun-16	3-Aug-16	13-Oct-16	14-Jun-16	3-Aug-16	4-Aug-16	13-Oct-16	16-Oct-16	5-Aug-16	16-Oct-16	16-Oct-16	21-Jun-16	5-Aug-16
Sample ID					SEEP 7	SEEP 7	SEEP 7	SEEP 8	SEEP 8	SEEP 9	SEEP 9	SEEP 9	SEEP 10	SEEP 10	HARDROCK SHAFT	HARDROCK SHAFT 1	HARD ROCK SHAFT 1
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1783978	L1808958	L1843864	L1783978	L1808958	L1809307	L1843864	L1844384	L1810001	L1844384	L1844384	L1787602	L1810001
Laboratory Sample ID					L1783978-2	L1808958-10	L1843864-7	L1783978-3	L1808958-11	L1809307-8	L1843864-8	L1844384-9	L1810001-8	L1844384-8	L1844384-6	L1787602-8	L1810001-10
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**													
Metals, Total																	
Aluminum	µg/L	100[D]	n/v	<100/200a[G]	<3	<30 GT	<30 GT	<3	<30 GT	<30 GT	<30 GT	3.1	**235[DG]**	**439[DG]**	<3	<3	<3
Antimony	µg/L	6[B]	1600[F]	6[H]	<0.1	<1 GT	<1 GT	0.1	<1 GT	<1 GT	<1 GT	0.1	0.52	1.1	0.2	0.35	0.29
Arsenic	µg/L	25[B]	150[F]	10[H]	**2640[BFH]**	**2280[BFH]**	**7650[BFH]**	**3280[BFH]**	**1850[BFH]**	**9530[BFH]**	**5600[BFH]**	**5060[BFH]**	**335[BFH]**	**125[BH]**	**366[BFH]**	**45.9[BH]**	**73.9[BH]**
Barium	µg/L	1000[A]	2300[F]	1000[H]	20.3	30.7	21.6	26.4	20.7	17.8	27.6	12.4	39.9	131	33	27.6	26.4
Beryllium	µg/L	n/v	5.3[F]	n/v	<0.1	<1 GT	<1 GT	<0.1	<1 GT	<1 GT	<1 GT	<0.1	<0.1	<1 DM	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.5 GT	<0.5 GT	<0.05	<0.5 GT	<0.5 GT	<0.5 GT	<0.05	<0.05	<0.5 DM	<0.05	<0.05	<0.05
Boron	µg/L	5000[B]	3550[F]	5000[H]	149	190	130	169	120	140	110	116	13	<100 DM	92	58	57
Cadmium	µg/L	5[A]	0.21[F]	5[H]	<0.005	<0.05 GT	<0.05 GT	<0.005	<0.05 GT	<0.05 GT	<0.05 GT	<0.005	0.0122	0.078	<0.005	<0.005	<0.005
Calcium	mg/L	n/v	n/v	n/v	436	498	497	488	542	517	491	494	84.7	213	216	177	183
Cesium	µg/L	n/v	n/v	n/v	0.02	<0.1 GT	<0.1 GT	0.027	<0.1 GT	<0.1 GT	<0.1 GT	0.041	0.019	<0.1 DM	0.36	0.396	0.371
Chromium	µg/L	50[A]	64[F]	50[H]	<0.1	<1 GT	<1 GT	<0.1	<1 GT	<1 GT	<1 GT	<0.1	0.79	1.9	<0.1	<0.1	<0.1
Cobalt	µg/L	n/v	5.2[F]	n/v	4.05	**6.1[F]**	**6.2[F]**	4.13	**7.3[F]**	4.4	**6.8[F]**	3.99	0.55	<1 DM	2.8	1.43	1.88
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	<0.5	<5 GT	<5 GT	<0.5	<5 GT	<5 GT	<5 GT	<0.5	2.65	**16.2[F]**	<0.5	0.57	1.01
Iron	µg/L	300[C]	n/v	≤300[G]	**5240[CG]**	**7170[CG]**	**20600[CG]**	**6110[CG]**	**8490[CG]**	**23000[CG]**	**20100[CG]**	**10300[CG]**	**1070[CG]**	**560[CG]**	**14100[CG]**	**614[CG]**	**4810[CG]**
Lead	µg/L	10c[A]	2[F]	10[H]	<0.05	<0.5 GT	<0.5 GT	<0.05	<0.5 GT	<0.5 GT	<0.5 GT	<0.05	0.511	1.72	<0.05	<0.05	<0.05
Lithium	µg/L	n/v	n/v	n/v	22.3	28	25	23.2	23	17	22	17.6	1.4	<10 DM	7.5	4.4	5.1
Magnesium	mg/L	n/v	n/v	n/v	187	252	232	204	254	305	246	273	12.7	29.9	67.9	50.2	56.5
Manganese	µg/L	50[C]	n/v	≤50[G]	**197[CG]**	**367[CG]**	**420[CG]**	**205[CG]**	**675[CG]**	**469[CG]**	**569[CG]**	**444[CG]**	**153[CG]**	27.6	**686[CG]**	**237[CG]**	**375[CG]**
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0115	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	3.59	2.05	2.9	3.67	3.79	1.06	2.15	0.95	0.544	2.02	0.517	0.371	0.381
Nickel	µg/L	n/v	39[F]	n/v	3.93	<5 GT	5.3	4.68	9.6	<5 GT	6.9	2.91	3.12	<5 DM	8.88	4.68	6.37
Phosphorus	µg/L	n/v	n/v	n/v	<50	<500 GT	<500 GT	<50	<500 GT	<500 GT	<500 GT	<50	74	<500 DM	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	40.8	47.3	39.9	45.9	43.3	43.3	38.1	37.6	3.57	5.84	6.69	5.82	5.84
Rubidium	µg/L	n/v	n/v	n/v	5.94	7.3	5.5	6.99	6.2	8.3	5.6	8.3	2.69	<2 DM	8.99	7.35	7.48
Selenium	µg/L	10[A]	5[F]	50[H]	<0.05	<0.5 GT	<0.5 GT	<0.05	<0.5 GT	<0.5 GT	<0.5 GT	0.059	0.16	<0.5 DM	<0.05	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	8800	9080	8770	10400	10500	10500	8520	9150	1340	1430	5220	4240	4480
Silver	µg/L	n/v	0.12[F]	n/v	<0.01	<0.1 GT	<0.1 GT	<0.01	<0.1 GT	<0.1 GT	<0.1 GT	<0.01	<0.01	<0.1 DM	<0.01	<0.01	<0.01
Sodium	mg/L	200g[C] 20g[E]	180[F]	≤200[G]	8.83	11.5	9.46	8.75	9.39	**116[E]**	9.16	**57.7[E]**	**351[CEFG]**	**1110[CEFG]**	**79.0[E]**	**92.6[E]**	**87.8[E]**
Strontium	µg/L	n/v	n/v	n/v	3490	4030	3640	4150	4000	3590	3510	3530	167	379	1930	1230	1300
Sulfur	µg/L	n/v	n/v	n/v	498000	697000	677000	562000	729000	771000	690000	692000	1930	18900	206000	144000	159000
Tellurium	µg/L	n/v	n/v	n/v	0.7	<2 GT	<2 GT	0.82	<2 GT	<2 GT	<2 GT	0.45	<0.2	<2 DM	0.28	0.24	0.21
Thallium	µg/L	n/v	40[F]	n/v	<0.01	<0.1 GT	<0.1 GT	<0.01	<0.1 GT	<0.1 GT	<0.1 GT	<0.01	<0.01	<0.1 DM	<0.01	<0.01	<0.01
Thorium	µg/L	n/v	n/v	n/v	<0.1	<1 GT	<1 GT	<0.1	<1 GT	<1 GT	<1 GT	<0.1	<0.1	<1 DM	<0.1	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	<0.1	<1 GT	<1 GT	<0.1	<1 GT	<1 GT	<1 GT	<0.1	<0.1	<1 DM	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	<0.3	<3 GT	<3 GT	<0.3	<3 GT	<3 GT	<3 GT	<0.3	8.8	15.1	<0.3	<0.3	<0.3
Tungsten	µg/L	n/v	n/v	n/v	0.27	<1 GT	<1 GT	0.13	<1 GT	<1 GT	<1 GT	0.12	0.64	2	0.19	<0.1	<0.1
Uranium	µg/L	20[A]	33[F]	20[H]	0.755	0.71	0.74	0.828	1.03	0.62	1.07	0.781	0.498	1.18	2.23	1.21	1.55
Vanadium	µg/L	n/v	20[F]	n/v	<0.5	<5 GT	<5 GT	<0.5	<5 GT	<5 GT	<5 GT	<0.5	1.2	<5 DM	<0.5	<0.5	<0.5
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	<3	<30 GT	<30 GT	<3	<30 GT	<30 GT	<30 GT	<3	3.6	<30 DM	<3	<3	<3
Zirconium	µg/L	n/v	n/v	n/v	<0.3	<3 GT	<3 GT	<0.3	<3 GT	<3 GT	<3 GT	<0.3	<0.3	<3 DM	0.37	<0.3	<0.3

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Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

					Underground Workings					Blanks							
Sample Location					MOSHER SHAFT 1					EQUIPMENT BLANK	Field Blank					Trip Blank	
Sample Date					7-Oct-16	7-Oct-16	7-Oct-16	7-Oct-16	7-Oct-16	18-Oct-16	15-Jun-16	4-Aug-16	7-Aug-16	15-Oct-16	17-Oct-16	4-Aug-16	16-Oct-16
Sample ID					MOSHER SHAFT 122 M	MOSHER SHAFT 21 M	MOSHER SHAFT 244 M	MOSHER SHAFT 396 M	MOSHER SHAFT 512 M	EQUIPMENT BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK 2	FIELD BLANK	FIELD BLANK	TRAVEL BLANK	TRAVEL BLANK
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1840986	L1840986	L1840986	L1840986	L1840986	L1846519	L1784595	L1809307	L1810001	L1844417	L1846519	L1809307	L1844384
Laboratory Sample ID					L1840986-2	L1840986-1	L1840986-3	L1840986-4	L1840986-5	L1846519-10	L1784595-11	L1809307-16	L1810001-24	L1844417-10	L1846519-4	L1809307-17	L1844384-13
Sample Type	**Units**	**ODWS**	**MOE APV**	**Health Canada**						Equipment Blank	Field Blank	Field Blank	Field Blank	Field Blank	Field Blank	Trip Blank	Trip Blank
Field Parameters																	
Dissolved oxygen, Field	mg/L	n/v	n/v	n/v	-	-	-	-	-	-	-	-	-	-	-	-	-
Electrical Conductivity, Field	µS/cm	n/v	n/v	n/v	-	-	-	-	-	-	-	-	-	-	-	-	-
pH, Field	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	-	-	-	-	-	-	-	-	-	-	-	-	-
Temperature, Field	deg C	15^{C}	n/v	≤15^{G}	-	-	-	-	-	-	-	-	-	-	-	-	-
General Chemistry																	
Acidity as CaCO3	mg/L	n/v	n/v	n/v	13.2	17.8	14.4	13.6	15.5	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	n/v	n/v	253	254	254	259	258	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	n/v	n/v	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3)	mg/L	30-500^{D}	n/v	n/v	253	254	254	259	258	***<2.0***	***<2.0***	***<2.0***	***<2.0***	***<2.0***	***<2.0***	***<2.0***	***<2.0***
Ammonia (as N)	mg/L	n/v	n/v	n/v	<0.020	<0.020	0.046	0.055	0.072	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Anion Sum	meq/L	n/v	n/v	n/v	5.73	5.74	5.73	5.88	5.87	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0
Cation Sum	meq/L	n/v	n/v	n/v	5.62	5.39	5.58	5.73	5.54	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0
Chloride	mg/L	250^{C}	180^{F}	≤250^{G}	1.58	1.33	1.77	1.53	1.67	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Color, True	TCU	5^{C}	n/v	n/v	**10.4^{C}**	4.8	**11.3^{C}**	**7.4^{C}**	**10.4^{C}**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Cyanide	mg/L	n/v	0.0052^{F}	0.2^{H}	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (Free)	mg/L	0.2^{A}	n/v	0.2^{H}	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide (Weak Acid Dissociable)	mg/L	n/v	n/v	n/v	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Dissolved Organic Carbon (DOC)	mg/L	5^{C}	n/v	n/v	4.9	4.8	4.9	**5.2^{C}**	5.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Electrical Conductivity, Lab	µmhos/cm	n/v	n/v	n/v	442	451	449	446	449	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Fluoride	mg/L	1.5_{b}^{A}	n/v	1.5^{H}	0.033	0.030	0.032	0.032	0.035	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Hardness (as CaCO3)	mg/L	80-100^{D}	n/v	n/v	**265^{D}**	**259^{D}**	**263^{D}**	**267^{D}**	**261^{D}**	***<0.50***	***<0.50***	***<0.50***	***<0.50***	***<0.50***	***<0.50***	***<0.50***	***<0.50***
Ion Balance	%	n/v	n/v	n/v	<0.000	<0.000	<0.000	<0.000	<0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrate (as N)	mg/L	10.0_{d}^{A}	n/v	10^{H}	0.033	0.055	0.028	0.025	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	1.0_{d}^{A}	n/v	1^{H}	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5^{D}	n/v	7.0-10.5^{G}	7.71	7.59	7.67	7.69	7.64	**5.85^{DG}**	**6.21^{DG}**	**6.00^{DG}**	**5.91^{DG}**	**6.96^{G}**	7.04	**5.77^{DG}**	**5.67^{DG}**
Phosphorus, Total	mg/L	n/v	n/v	n/v	0.0127	0.0048	0.0056	0.0083	0.0069	0.0031	0.0010	<0.0010	<0.0010	0.0011	0.0035	<0.0010	0.0021
Phosphorus, Total	mg/L	n/v	n/v	n/v	<0.0030	0.0045	0.0066	0.0048	0.0033	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0042
Sulfate	mg/L	500_{h}^{C}	n/v	$≤500_{j}^{G}$	30.7	30.0	29.2	31.8	32.1	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Total Dissolved Solids	mg/L	500^{C}	n/v	≤500^{G}	287	286	301	298	291	<10	<10	<10	<10	<10	<10	<10	<10
Total Organic Carbon	mg/L	n/v	n/v	n/v	4.6	4.3	5.0	4.9	5.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Suspended Solids	mg/L	n/v	n/v	n/v	6.4	<2.0	8.9	8.5	7.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

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Table 1
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Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Sample Location					Underground Workings MOSHER SHAFT 1					EQUIPMENT BLANK	Blanks Field Blank					Trip Blank	
Sample Date					7-Oct-16	7-Oct-16	7-Oct-16	7-Oct-16	7-Oct-16	18-Oct-16	15-Jun-16	4-Aug-16	7-Aug-16	15-Oct-16	17-Oct-16	4-Aug-16	16-Oct-16
Sample ID					MOSHER SHAFT 122 M	MOSHER SHAFT 21 M	MOSHER SHAFT 244 M	MOSHER SHAFT 396 M	MOSHER SHAFT 512 M	EQUIPMENT BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK 2	FIELD BLANK	FIELD BLANK	TRAVEL BLANK	TRAVEL BLANK
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1840986	L1840986	L1840986	L1840986	L1840986	L1846519	L1784595	L1809307	L1810001	L1844417	L1846519	L1809307	L1844384
Laboratory Sample ID					L1840986-2	L1840986-1	L1840986-3	L1840986-4	L1840986-5	L1846519-10	L1784595-11	L1809307-16	L1810001-24	L1844417-10	L1846519-4	L1809307-17	L1844384-13
Sample Type	Units	ODWS	MOE APV	Health Canada						Equipment Blank	Field Blank	Field Blank	Field Blank	Field Blank	Field Blank	Trip Blank	Trip Blank
Metals, Dissolved																	
Aluminum	µg/L	100[D]	n/v	<100/200$_{a}$[G]	2.1	3.6	2.2	2.4	2	4.9	<2	<2	<2	<2	<2	<2	<2
Antimony	µg/L	6[B]	1600[F]	6[H]	0.27	0.39	0.26	0.19	0.26	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	µg/L	25[B]	150[F]	10[H]	**18.6[H]**	6.59	**18[H]**	**26.9[BH]**	**19.3[H]**	0.19	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Barium	µg/L	1000[A]	2300[F]	1000[H]	100	83.5	101	118	104	0.135	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Beryllium	µg/L	n/v	5.3[F]	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000[B]	3550[F]	5000[H]	12	22	11	11	12	<10	<10	<10	<10	<10	<10	<10	<10
Cadmium	µg/L	5[A]	0.21[F]	5[H]	0.0052	0.0137	0.0054	<0.005	0.0072	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/L	n/v	n/v	n/v	82.3	80.8	81.8	82.9	80.4	0.117	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cesium	µg/L	n/v	n/v	n/v	0.051	0.077	0.051	0.037	0.051	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	µg/L	50[A]	64[F]	50[H]	<0.1	0.13	0.21	0.19	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	µg/L	n/v	5.2[F]	n/v	0.16	0.12	0.18	0.2	0.17	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	0.96	1.75	0.86	0.44	0.79	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Iron	µg/L	300[C]	n/v	≤300[G]	**1270[CG]**	13	**1190[CG]**	**2180[CG]**	**1340[CG]**	<10	<10	<10	<10	<10	<10	<10	<10
Lead	µg/L	10$_{c}$[A]	2[F]	10[H]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	n/v	n/v	n/v	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium	mg/L	n/v	n/v	n/v	14.4	13.8	14.3	14.6	14.5	0.0327	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Manganese	µg/L	50[C]	n/v	≤50[G]	49.2	6.41	46.9	**76.7[CG]**	**50.4[CG]**	0.33	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	0.328	0.381	0.347	0.283	0.323	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	µg/L	n/v	39[F]	n/v	1.17	1.46	1.21	0.95	1.11	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	2.71	2.48	2.64	2.73	2.62	0.058	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Rubidium	µg/L	n/v	n/v	n/v	1.86	1.69	1.79	1.85	1.81	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	µg/L	10[A]	5[F]	50[H]	<0.05	0.102	0.055	0.448	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	4800	4610	4810	4830	4790	54	<50	<50	<50	<50	<50	<50	<50
Silver	µg/L	n/v	0.12[F]	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L	200$_{g}$[C] 20$_{g}$[E]	180[F]	≤200[G]	4.25	3.55	4.16	4.65	4.23	0.055	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Strontium	µg/L	n/v	n/v	n/v	338	304	330	374	334	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sulfur	µg/L	n/v	n/v	n/v	9790	10500	10500	9190	10100	<500	<500	<500	<500	<500	<500	<500	<500
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40[F]	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.16	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<0.3	<0.3	0.31	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Tungsten	µg/L	n/v	n/v	n/v	0.63	0.5	0.65	0.73	0.64	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	20[A]	33[F]	20[H]	1.04	1.2	1.11	0.985	1.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	µg/L	n/v	20[F]	n/v	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	24	39.5	21.8	12.6	20.8	<1	<1	<1	<1	<1	<1	1.3	<1
Zirconium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3

See notes on last page

Table 1
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Sample Location					Underground Workings MOSHER SHAFT 1					EQUIPMENT BLANK	Blanks Field Blank					Trip Blank	
Sample Date					7-Oct-16	7-Oct-16	7-Oct-16	7-Oct-16	7-Oct-16	18-Oct-16	15-Jun-16	4-Aug-16	7-Aug-16	15-Oct-16	17-Oct-16	4-Aug-16	16-Oct-16
Sample ID					MOSHER SHAFT 122 M	MOSHER SHAFT 21 M	MOSHER SHAFT 244 M	MOSHER SHAFT 396 M	MOSHER SHAFT 512 M	EQUIPMENT BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK 2	FIELD BLANK	FIELD BLANK	TRAVEL BLANK	TRAVEL BLANK
Sampling Company					GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM	GGM
Laboratory					ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM	ALS-EDM
Laboratory Work Order					L1840986	L1840986	L1840986	L1840986	L1840986	L1846519	L1784595	L1809307	L1810001	L1844417	L1846519	L1809307	L1844384
Laboratory Sample ID					L1840986-2	L1840986-1	L1840986-3	L1840986-4	L1840986-5	L1846519-10	L1784595-11	L1809307-16	L1810001-24	L1844417-10	L1846519-4	L1809307-17	L1844384-13
Sample Type	Units	ODWS	MOE APV	Health Canada						Equipment Blank	Field Blank	Field Blank	Field Blank	Field Blank	Field Blank	Trip Blank	Trip Blank
Metals, Total																	
Aluminum	µg/L	100[D]	n/v	<100/200$_{a}$[G]	4.6	6.2	5.8	5.3	19.5	10.8	<3	<3	<3	<3	<3	6.7	<3
Antimony	µg/L	6[B]	1600[F]	6[H]	0.16	0.41	<0.1	0.12	0.11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	µg/L	25[B]	150[F]	10[H]	**33.6[BH]**	7	**46.3[BH]**	**40.5[BH]**	**49.6[BH]**	0.21	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Barium	µg/L	1000[A]	2300[F]	1000[H]	117	81.2	132	128	139	0.186	<0.05	<0.05	0.086	<0.05	<0.05	<0.05	<0.05
Beryllium	µg/L	n/v	5.3[F]	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	n/v	n/v	n/v	<0.05	0.051	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	5000[B]	3550[F]	5000[H]	13	12	14	13	13	<10	<10	<10	<10	<10	<10	<10	<10
Cadmium	µg/L	5[A]	0.21[F]	5[H]	0.0075	0.0118	0.0404	0.0191	0.0094	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/L	n/v	n/v	n/v	80.1	80.8	83.3	81.2	82.3	0.134	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cesium	µg/L	n/v	n/v	n/v	0.029	0.081	0.02	0.027	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	µg/L	50[A]	64[F]	50[H]	0.11	0.17	0.2	0.15	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	µg/L	n/v	5.2[F]	n/v	0.22	0.2	0.21	0.22	1.08	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	µg/L	1000[C]	6.9[F]	≤1000[G]	1.02	1.95	0.56	0.7	0.97	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	µg/L	300[C]	n/v	≤300[G]	**2770[CG]**	42	**4150[CG]**	**3640[CG]**	**5030[CG]**	15	<10	<10	<10	<10	<10	<10	<10
Lead	µg/L	10$_{c}$[A]	2[F]	10[H]	0.365	0.092	0.302	0.467	0.389	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	n/v	n/v	n/v	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium	mg/L	n/v	n/v	n/v	14.8	14.4	15.2	15.0	15.1	0.0342	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Manganese	µg/L	50[C]	n/v	≤50[G]	**101[CG]**	13.4	**141[CG]**	**123[CG]**	**136[CG]**	0.36	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mercury	µg/L	1[A]	0.77[F]	1[H]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	n/v	730[F]	n/v	0.258	0.438	0.18	0.21	0.191	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	µg/L	n/v	39[F]	n/v	1.04	1.49	0.61	0.78	1.17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phosphorus	µg/L	n/v	n/v	n/v	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	mg/L	n/v	n/v	n/v	2.81	2.44	2.85	2.86	2.88	0.058	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Rubidium	µg/L	n/v	n/v	n/v	1.97	1.66	2.01	2.06	2.09	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	µg/L	10[A]	5[F]	50[H]	<0.05	0.083	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	µg/L	n/v	n/v	n/v	5090	4730	5240	5040	5160	56	<50	<50	<50	<50	<50	<50	<50
Silver	µg/L	n/v	0.12[F]	n/v	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L	200$_{g}$[C] 20$_{g}$[E]	180[F]	≤200[G]	4.68	3.64	5.03	4.96	5.06	0.055	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Strontium	µg/L	n/v	n/v	n/v	375	298	411	394	410	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sulfur	µg/L	n/v	n/v	n/v	8740	10500	6380	7140	7280	<500	<500	<500	<500	<500	<500	<500	<500
Tellurium	µg/L	n/v	n/v	n/v	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	n/v	40[F]	n/v	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	n/v	n/v	n/v	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	n/v	n/v	n/v	<0.1	<0.1	0.12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	n/v	n/v	n/v	<0.3	<0.3	0.37	<0.3	0.34	0.68	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Tungsten	µg/L	n/v	n/v	n/v	0.79	0.53	0.88	0.83	0.84	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	20[A]	33[F]	20[H]	0.934	1.35	0.72	0.831	0.75	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	µg/L	n/v	20[F]	n/v	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	5000[C]	89[F]	≤5000[G]	29.9	38	26.7	28	86.4	<3	<3	3.3	<3	<3	<3	<3	<3
Zirconium	µg/L	n/v	n/v	n/v	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3

See notes on last page

Table
Summary of Groundwater Analytical Results - 2016
Hardrock Environmental Baseline Study
Greenstone Gold Mine LP Inc.

Notes:

ODWS	Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (MOE, 2006, revised January 2017)
A	ODWS Table 2 - Chemical Standards, Maximum Acceptable Concentration
B	ODWS Table 2 - Chemical Standards, Interim Maximum Acceptable Concentration
C	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Aesthetic Objectives
D	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Operational Guidelines
E	ODWS Table 4 - Medical Officer of Health Reporting Limit
MOE APV	MOE - Aquatic Protection Values (APV) to Protect Aquatic Biota Exposed to Contaminants from Migration of Contaminated Groundwater to Surface Water.
F	Aquatic Toxicity Data Screening - Table 3.1 - Aquatic Protection Values
Health Canada	Health Canada (2017). Guidelines for Canadian Drinking Water Quality—Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.
G	Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives/ Operational Guidelines
H	Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentration
6.5^A	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
<0.50	Laboratory reporting limit was greater than the applicable standard.
<0.03	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
a	This is an operational guidance value, designed to apply only to drinking water treatment plants using aluminum-based coagulants; it does not apply to naturally occuring aluminum found in groundwater. The operational guidance values of 0.1 mg/L applies to conventional treatment plants, and 0.2 mg/L applies to other types of treatment systems.
b	Where fluoride is added to drinking water, it is recommended that the concentration be adjusted to 0.5 - 0.8 mg/L the optimum level for control of tooth decay. Where supplies contain naturally occurring fluoride at levels higher than 1.5 mg/L but lower than 2.4 mg/L the Ministry of Health and Long Term Care recommends an approach through local boards of health to raise public and professional awareness to control excessive exposure to fluoride from other sources.
c	This standard applies to water at the point of consumption. Since lead is a component in some plumbing systems, first flush water may contain higher concentrations of lead than water that has been flushed for five minutes.
d	Where both nitrate and nitrite are present, the total of the two should not exceed 10 mg/L (as nitrogen).
g^{CE}	The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.
h	When sulfate levels exceed 500 mg/L, water may have a laxative effect on some people.
j	High levels (above 500 mg/L) can cause physiological effects such as diarrhoea or dehyrdration.
BL	Results may be biased low.
BR	Balance Reviewed: Interference Or Non-Measured Component
DM	Detection limit adjusted due to sample matrix effects.
GT	Elevated detection limit because of dilution required due to high target analyte concentration.
IF	RDL raised due to sample matrix interference sample dilution required
LH	Detection limits were adjusted for high moisture content
RW	Result Revised from previous report.
XH	Dissolved concentration exceeds total. Results were confirmed by re-analysis.

ATTACHMENT C:
LETTER FROM THE MUNICIPALITY OF GREENSTONE DATED JANUARY 11, 2018

ADMINISTRATION OFFICE
1800 Main Street, P.O. Box 70
GERALDTON, ON P0T 1M0

GREENSTONE

P: 807-854-1100 F: 807-854-1947
E: administration@greenstone.ca
www.greenstone.ca

January 11, 2018

To Whom It May Concern

The Municipality of Greenstone manages all municipal infrastructure in the Ward of Geraldton. Development of the Greenstone Gold Mines - Hardrock Project will provide significant benefits to the Municipality and surrounding areas through the life of the Project. In support of the Project, the Municipality has agreed in principle, subject to financing, to expand the collection of municipal sewage to include the area south of Barton Bay which will include the temporary construction camp required for the Hardrock Project.

The design capacity of the existing municipal sewage collection system and treatment plant is adequate to accept the expected quantity of sewage from this expanded catchment area. Upgrades to the sewage treatment plant to achieve design capacity rates of treatment have been identified and will be implemented to maintain operational compliance of the facility and are planned to be in place in time for the Project's temporary construction camp. These upgrades include reduction in phosphorus loading of discharge stream and improvements to flow rates for potential future needs.

The Municipality of Greenstone is supportive of the Greenstone Gold Mines - Hardrock Project and is preparing for increases in population, tax base and business activity. This includes improvements to community services and infrastructure to coincide with the Project development.

Regards

<Original signed by>

CAO

Update to: Mass Balance Modelling of Arsenic Concentrations in Water and Sediment of Kenogamisis Lake, Geraldton, Ontario

Greenstone Gold Mines GP Inc.

Prepared for:
Greenstone Gold Mines GP Inc.
365 Bay Street
Suite 500
Toronto ON,
Canada

Prepared by:
Stantec Consulting Ltd.
845 Prospect Street
Fredericton, NB
E3B 2T7

Project No.: 16091223
February 1, 2018

EXECUTIVE SUMMARY

Greenstone Gold Mines GP Inc. (GGM) proposes the construction, operation, and closure of an open pit gold mine, process plant and associated ancillary facilities, collectively known as the Hardrock Project (the Project). The Project is located in northwestern Ontario, approximately 275 km northeast of Thunder Bay, in the Municipality of Greenstone, Ward of Geraldton. The Project is generally centred at the intersection of Highway 11 and Michael Power Boulevard. Highway 11 currently traverses the Project property in an east-west direction.

The Project is partially situated within a historical mine site that was actively mined between the 1930s and 1970s, and in later years was known as the MacLeod-Mosher complex. The historical MacLeod high and low tailings areas are mostly situated north of Highway 11 near Barton Bay (part of Kenogamisis Lake), and the historical Hardrock tailings area is south of Highway 11, near the Central Basin of Kenogamisis Lake.

As a result of historical mining activity, arsenic is a parameter of particular interest within Kenogamisis Lake. An integrated mass balance model of lake water and sediment was developed to support prediction of arsenic concentrations in water and sediment of Kenogamisis Lake, and implemented in the STELLA™ modelling framework. The lake water model was based on Bird et al. (1993), and the lake sediment model was based on Kansanen and Seppala (1992). Both of these source models originate from peer-reviewed primary scientific literature, were validated as part of their development processes, and are applicable to the Precambrian Shield lakes of the Project area, including Kenogamisis Lake. The integrated mass balance model incorporates in-lake processes related to sedimentation and release of arsenic from sediment to the water column, as well as seasonal variations related to monthly variations in water flow and external arsenic loadings.

The model development and results presented in this report bring together information previously presented in individual memoranda, as well as new information, and was informed by review comments and information requests provided by the Ontario Ministry of the Environment and Climate Change (MOECC), and the Métis Nation of Ontario (MNO). While the findings remain consistent, the memoranda that are rescinded and replaced by this updated report include:

- Mass Balance Modelling of Arsenic Concentrations in Water and Sediment of Kenogamisis Lake, Geraldton, Ontario. Memorandum to Steve Lines (GGM) from Paul Mazzocco and Malcolm Stephenson (Stantec), dated April 7, 2017.
- Response to MOECC Comments on "Mass Balance Modelling of Arsenic Concentrations in Water and Sediment of Kenogamisis Lake, Geraldton, Ontario". Memorandum to Steve Lines (GGM) from Paul Mazzocco and Malcolm Stephenson (Stantec), dated October 6, 2017.

The objectives of the modelling were to:

- Develop and perform an initial calibration of the model by evaluating historical arsenic loading based on arsenic concentrations in water and sediment in the various sub-basins of Kenogamisis Lake.

- Conduct a sensitivity analysis on the initial model calibration to demonstrate the sensitivity of the overall model to certain key parameter values.

- Perform a detailed calibration of the model by simulating arsenic concentrations measured in lake water (2001 – 2011 data) and sediment (2011 data) as reported by Parks Environmental Inc. (2011, 2012).

- Validate the calibrated model by simulating arsenic concentrations in lake water (2013 – 2017 data) and sediment (2013 – 2016 data) as reported by Stantec (2017).

- Provide estimates of future arsenic concentrations in the lake water, based on the mine development plan, to support a human health risk assessment for the Project.

- Evaluate present day and expected future fluxes of arsenic between sub-basins, and between water and sediment, to provide further insight into the behavior of arsenic within the lake.

- Evaluate the potential effects of changing precipitation patterns between 2020 and 2100, resulting from a climate change scenario, on predicted future arsenic concentrations in lake water and sediment.

The model of arsenic fate and cycling in Kenogamisis Lake is informed by estimates of total arsenic loading from historical tailings, based on detailed studies carried out since 2013; by multi-year measurements of total arsenic inputs to and aqueous concentrations in the six lake sub-basins; and by measurements of total arsenic concentrations and profiles in lake sediments. The overall hydrology of the lake (with flushing rate as a primary determinant of arsenic concentration in the lake water) is also well known, and subject to annual and seasonal variation. The calibrated values of the parameters responsible for total arsenic deposition to sediment, as well as the diffusive flux from sediment to water, are consistent with information obtained from other studies (e.g., Cornett et al. 1992, Fabian et al. 2003, Kuhn and Sigg 1993).

The model reproduces the seasonal cycle of arsenic concentrations in water, as well as historical accumulation of arsenic in sediment. The expected future reductions in arsenic loading to Kenogamisis Lake are of sufficient magnitude that the model predictions are reliable indicators of the relative magnitude of future arsenic concentrations in water and sediment.

A climate change scenario was developed to evaluate the effects of the expected milder and wetter winter seasons that are expected to develop in northwestern Ontario between the present day and 2100. The results of this scenario suggest that total arsenic concentrations in lake water and sediment would not be markedly affected by the anticipated climate change.

Without changes due to the Project, arsenic concentrations in water and sediment can be expected to remain similar to concentrations that have been observed over the past decade. With the Project plan, there would be a significant overall reduction in arsenic loading to Kenogamisis Lake. When compared with present day baseline conditions, arsenic concentrations in the water of the Southwest Arm would increase slightly during Operation (2018 to 2033), returning to near baseline thereafter. This slight increase would be more than offset by substantial decreases in total arsenic concentrations in the waters of Barton Bay East, the Central Basin, and the Outflow Basin during operation, and continuing through Post-Closure. The significant net positive effect that is predicted can be attributed to Project design measures addressing historical tailings in the Project Development Area, thereby meeting the intent of the MOECC Policy 2 designation for Kenogamisis Lake.

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1.0 INTRODUCTION

Greenstone Gold Mines GP Inc. (GGM) proposes the construction, operation, and closure of an open pit gold mine, process plant and associated ancillary facilities, collectively known as the Hardrock Project (the Project). The Project is located in northwestern Ontario, approximately 275 km northeast of Thunder Bay, in the Municipality of Greenstone, Ward of Geraldton. The Project is generally centred at the intersection of Highway 11 and Michael Power Boulevard. Highway 11 currently traverses the Project property in an east-west direction.

The Project is partially situated within a historical mine site that was actively mined between the 1930s and 1970s, and in later years was known as the MacLeod-Mosher complex. The historical underground operations include the MacLeod-Mosher Mine and the Hardrock Mine. Premier (2011) reported that historical mining activities associated with the Project affected approximately 100 hectares (ha) of land, including tailings facilities referred to as the historical MacLeod high tailings and historical MacLeod low tailings. The historical MacLeod high and low tailings areas are mostly situated north of Highway 11 near Barton Bay (East), and the historical Hardrock tailings area is south of Highway 11 (Figure 1). Further details of historical mining operations and historical water quality are provided in "Environmental Conditions – Hardrock Project: Historical Mining and Lake Water Quality" (Stantec 2016b).

The overall Project development schedule will consist of the following key phases during which various Project activities will be completed that have the potential to effect water quality. The Project development schedule for the key Project phases is summarized below:

- 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 and beyond, 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.

For the purposes of this modelling effort, it is assumed that Year 1 of operation corresponds to calendar year 2018, with the operation phase extending to calendar year 2033. In the model the closure phase begins in calendar year 2034 with the open pit filled and beginning to discharge to Kenogamisis Lake in the 2050's. The modelling extends to the year 2100.

Arsenic was determined to be a primary parameter of potential concern within Kenogamisis Lake, and as a result the mass balance modelling approach described in this report was adopted for arsenic. The mass balance model incorporates in-lake processes related to sedimentation and release of arsenic from sediment to the water column, as well as seasonal variations related to monthly variations in water flow and external arsenic loadings. The objectives of the modelling were to:

- Develop and preform an initial calibration of the model by evaluating historical arsenic loading based on arsenic concentrations in water and sediment in the various sub-basins of Kenogamisis Lake.
- Conduct a sensitivity analysis on the initial model calibration to demonstrate the sensitivity of the overall model to certain key parameter values.
- Perform a detailed calibration of the model by simulating arsenic concentrations measured in lake water (2001 – 2011 data) and sediment (2011 data) as reported by Parks Environmental Inc. (2011, 2012).
- Validate the calibrated model by simulating arsenic concentrations in lake water (2013 – 2017 data) and sediment (2013 – 2016 data) as reported by Stantec (2017).
- Provide estimates of future arsenic concentrations in the lake water during Operations, Active Closure and Post-Closure phases of the mine life, based on the mine development plan, to support a human health risk assessment for the Project.
- Evaluate present day and expected future fluxes of arsenic between sub-basins, and between water and sediment, to provide further insight into the behavior of arsenic within the lake.
- Evaluate the potential effects of changing precipitation patterns between 2020 and 2100, as a result of a climate change scenario, on predicted future arsenic concentrations in lake water and sediment.

The model development and results presented in this report bring together information previously presented in individual memoranda, as well as new information, and was informed by review comments and information requests provided by the Ontario Ministry of the Environment and Climate Change (MOECC), and the Métis Nation of Ontario (MNO). While the findings remain consistent, the memoranda that are rescinded and replaced by this updated report include:

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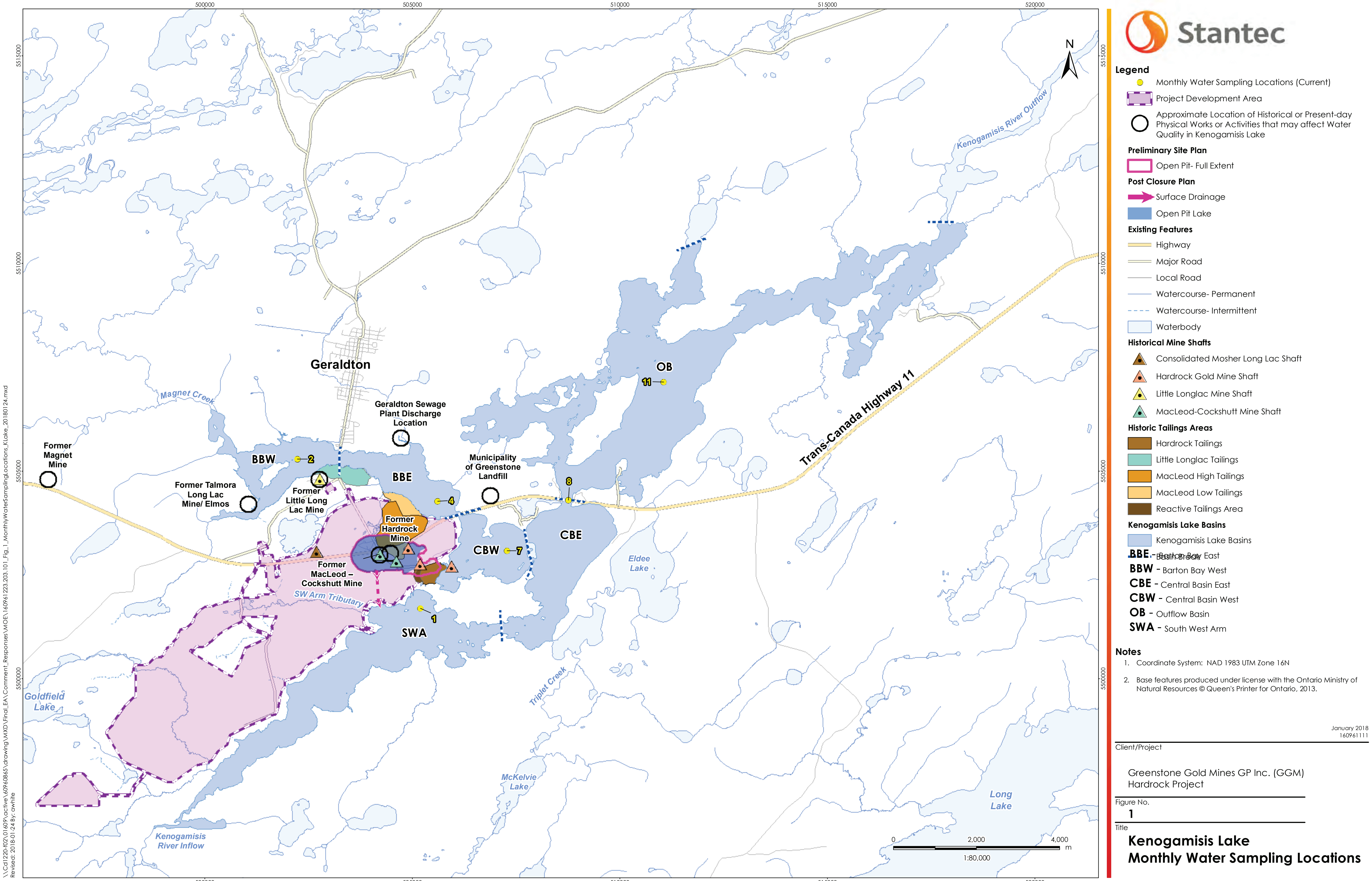
1.1 KENOGAMISIS LAKE

Both the Project and the historical mines are located within the catchment area of Kenogamisis Lake (Figure 1). The lake comprises several individual sub-basins, which have differing histories of exposure to historical mining activity, as well as to proposed future mining activities associated with the Project. Generally, surface water enters Kenogamisis Lake from the north (via Barton Bay), south (via the Kenogamisis River which flows into the Southwest Arm), and east (via McKelvie Creek which flows into the Central Basin). Water flow exits the Central Basin via a “narrows” at the Highway 11 bridge, to the Outflow Basin, and eventually to the Kenogamisis River outflow. Surface runoff from the historical MacLeod high tailings area reports to Barton Bay, which is the basin most affected by historical mining activities.



Stantec
Legend
Monthly Water Sampling Locations (Current)
Project Development Area
Approximate Location of Historical or Present-day Physical Works or Activities that may affect Water Quality in Kenogamisis Lake
Preliminary Site Plan
Open Pit- Full Extent
Post Closure Plan
Surface Drainage
Open Pit Lake
Existing Features
Highway
Major Road
Local Road
Watercourse- Permanent
Watercourse- Intermittent
Waterbody
Historical Mine Shafts
Consolidated Mosher Long Lac Shaft
Hardrock Gold Mine Shaft
Little Longlac Mine Shaft
MacLeod-Cockshutt Mine Shaft
Historic Tailings Areas
Hardrock Tailings
Little Longlac Tailings
MacLeod High Tailings
MacLeod Low Tailings
Reactive Tailings Area
Kenogamisis Lake Basins
Kenogamisis Lake Basins
BBE - Barton Bay East
BBW - Barton Bay West
CBE - Central Basin East
CBW - Central Basin West
OB - Outflow Basin
SWA - South West Arm
Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
January 2018
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Client/Project
Greenstone Gold Mines GP Inc. (GGM)
Hardrock Project
Figure No.
1
Title
Kenogamisis Lake
Monthly Water Sampling Locations
Geraldton
Magnet Creek
Former Magnet Mine
Former Talmora Long Lac Mine/ Elmos
Former Little Long Lac Mine
Geraldton Sewage Plant Discharge Location
Municipality of Greenstone Landfill
Former Hardrock Mine
Former MacLeod – Cockshutt Mine
SW Arm Tributary
BBW
BBE
CBW
CBE
OB
SWA
1
2
4
7
8
11
Trans-Canada Highway 11
Kenogamisis River Outflow
Kenogamisis River Inflow
Goldfield Lake
Eldee Lake
McKelvie Lake
Long Lake
Triplet Creek
N
0
2,000
4,000
m
1:80,000
500000
505000
510000
515000
520000
5515000
5510000
5505000
5500000

Kenogamisis Lake has a surface area of 39.68 square kilometres (km^2) as measured by Stantec, and setting limits on the Outflow Basin where railway embankments create narrows where water flows can be expected to be largely unidirectional and free from anthropogenic contamination (Figure 1). This value is consistent with official estimates of the lake area (e.g., Ministry of Natural Resources mapping dated 1974 giving a lake surface area of 41.7 km^2, and Land Inventory Ontario, Ontario Hydrological Network Waterbody Mapping produced by the Ministry of Natural Resources and Forestry giving a lake surface area of 42.2 km^2). However, these two estimates include portions of the Outflow Basin that were not considered germane to modelling arsenic in the lake water or sediments. Other reports (e.g., Parks Environmental Inc., 2012 referencing Ontario Ministry of the Environment 1982) have reported a seemingly erroneous area for the lake (25.43 km^2). It is unclear why the lake area stated in the Ontario Ministry of the Environment (1982) report differs from the official (i.e., Land Inventory Ontario) value.

The Kenogamisis River, which enters the Southwest Arm, provides approximately 62 percent of inflowing water to the lake. Secondary sources of water (i.e., smaller streams, non-point source overland flows, and groundwater) enter the various sub-basins. Of these, Magnet Creek which enters Barton Bay, and McKelvie Creek which enters the Central Basin, are most notable. The McKelvie Creek watershed is a special case, in that the overall watershed appears to have historically had two outlets: one to the Central Basin via an un-named pond, and one to the Outflow Basin via Eldee Lake. Investigation shows that the outlet to the Outflow Basin was blocked by Highway 11. Therefore, all of the flow (and associated natural arsenic loading) from the McKelvie Lake watershed is assumed to enter the Central Basin. Water levels in the lake are regulated by the Kenogamisis River Dam located about 18 km downstream of the Highway 11 bridge. The Kenogamisis River continues downstream of the dam.

For the purposes of this report, Kenogamisis Lake is divided into six sub-basins, which have varying degrees of hydraulic separation due to natural narrows, shoals, or artificial constrictions (e.g., highway causeways and bridges). The six sub-basins include:

- Barton Bay West (BBW)
- Barton Bay East (BBE)
- Central Basin West (CBW)
- Central Basin East (CBE)
- Southwest Arm (SWA)
- Outflow Basin (OB)

The model structure assumes that the individual sub-basins of Kenogamisis Lake act as effective sediment traps, and that inter-basin transport of bed sediment is a minor process. This assumption is supported by the following lines of evidence:

- Total suspended sediment concentrations in the lake, which include biogenic matter such as phytoplankton and zooplankton, as well as dust fall and organic debris of terrestrial origin, in addition to potentially re-suspended bed sediments, are generally low (<2 mg/L).
- Total arsenic concentrations in the lake water are dominated by dissolved species, with particle-bound arsenic (including phytoplankton and zooplankton in addition to potentially re-suspended bed sediments) typically comprising no more than 10% of the total (Parks Environmental Inc., 2011).

- Concentrations of trace elements in the sediments of the various sub-basins of Kenogamisis Lake are quite distinct. For example, Parks Environmental Inc. (2012) noted that the mercury concentration in the sediments of BBE are substantially higher than in BBW and other sub-basins. Similarly, the arsenic concentrations in the sediments of BBE are substantially higher than in CBW and other sub-basins. In addition, localized "hotspots" of arsenic accumulation in sediment are noted in the sediments near tailings deposits. If there was substantial post-depositional resuspension and lateral transport of bed sediments, these features would not persist.

Notwithstanding the above points, the STELLA™ model implicitly simulates inter-basin transport of arsenic, including arsenic that may be bound to particulate matter in the water column, by allowing arsenic to be exported from upstream sub-basins to downstream sub-basins at rates determined by total arsenic concentrations in the water column, and hydraulic water flows.

In the model, mass transfers of arsenic are described as loadings or fluxes. For the purposes of this report, the terms "load" and "loading" (with units of kilograms per year, kg/y) will refer to quantities of arsenic that are estimated to directly enter individual sub-basins of the lake as a result of natural processes or human activities. The loadings have historically been estimated on the basis of seasonal measurements of surface water and groundwater flow, and associated arsenic concentrations. The terms "flux" and "fluxes" (kg/y) will refer to quantities of arsenic moving within (e.g., from water to sediment and vice versa) or between the sub-basins, that have been estimated using the current mass balance model. The purpose of this terminology is to help differentiate between values that have been derived from measurement or other models, and values that have been internally derived or estimated using the water and sediment quality model described here.

2.0 MODELLING APPROACH

The approach to this work began with the selection of appropriate (published, peer-reviewed, validated) mass balance models of water and sediment quality in Canadian Shield or similar lakes, followed by their implementation in the STELLA™ modelling framework. Once this was complete, the conditions of Kenogamisis Lake were simulated for the period of 1920 to 2018. This effort was supported by existing work carried out to estimate arsenic loadings to the lake under present day conditions. In addition, a simplified history of arsenic loadings to the lake between 1920 and 2000 was hindcast using arsenic concentrations in lake sediment (i.e., sediment cores to establish historical arsenic concentrations, and surface grab samples to establish present day arsenic concentrations).

Seasonal observations of arsenic concentrations in lake water between 2001 and 2011 (Parks Environmental Inc. 2011, 2012) were used to support model calibration. Water and sediment quality data collected between 2013 and 2016 (Stantec 2017) were reserved for use in model validation. From this foundation (i.e., the calibrated and validated models as implemented in the STELLA™ modelling framework), expected future arsenic concentrations in lake water and sediment were simulated using predicted future arsenic loadings to the lake, based on present day existing conditions, and predicted changes to surface water and groundwater arsenic loadings during the operational and closure phases of the Project.

2.1 SELECTION OF MODEL AND ASSUMPTIONS

The work was completed using integrated lake water and sediment quality models implemented in the STELLA™ modelling framework. The lake water model was based on the model of Bird et al. (1993). This model was specifically developed to simulate contaminant concentrations in the water of Canadian Shield lakes. The lake sediment model was based on the model of Kansanen and Seppala (1992), which was developed to simulate the behavior of contaminants in the sediments of small lakes in southern Finland, which are similar to Canadian Shield lakes in terms of climate, geology, water chemistry, trophic state, basin morphometry, and ecological conditions. As implemented in the STELLA™ modelling framework, these two models (lake water model and lake sediment model) will be referred to as the "surface water sub-model" and the "sediment sub-model", respectively. Both models (i.e., Bird et al. 1993 and Kansanen and Seppala 1992) were described in peer-reviewed primary scientific journals, and both included validation exercises based on real lakes on Precambrian Shield terrain.

The surface water sub-model, adapted from Bird et al. (1993), is a time-dependent, mass balance model of a lake that can be used to calculate trace element concentrations in lake water, and fluxes of trace elements to sediment. Trace element concentrations in water are a function of mass loadings to the lake (i.e., inputs of trace elements), as modified by hydraulic flushing, and mass transfer to sediments.

Sources of arsenic loading to Kenogamisis Lake include:

- natural sources
- historical human-induced sources (e.g., tailings deposits)

- potential future Project activities (e.g., non-point source discharges associated with seepage from waste rock storage areas (WRSAs) and the tailings management facility (TMF), point source discharge of treated effluent during operation and pit lake discharge in closure, and dustfall)

As part of the Project, portions of the historical Hardrock and MacLeod tailings will be removed for containment in the new TMF, resulting in modification to existing loadings from historical activities. In addition, for some trace elements such as arsenic, there can be internal fluxes caused by release in response to changing loadings and/or redox (oxidation-reduction) conditions in sediment, leading to a diffusive flux from the sediment back to the water. The model does not explicitly simulate arsenic speciation; however, certain parameter values (e.g., the mass transfer rate to water, and the sediment-pore water partition coefficient) can be adjusted so that different or varying geochemical conditions, including diffusion of arsenic from sediment to water, are accounted for in the model.

The sediment sub-model, adapted from Kansanen and Seppala (1992), accepts inputs from the surface water sub-model and simulates the accumulation of sediment in the lake bed. The model allows for physical mixing of sediment layers near the surface (e.g., bioturbation), diminishing with depth below the surface. The intensity of mixing processes depends upon the characteristics of the lake. For example, some deep lake environments (especially meromictic lakes) lack benthic invertebrate communities, and exhibit "varved" or "laminated" sediments rather like tree rings that have not been subject to mixing after being deposited. However, most lake sediments exhibit some degree of mixing in the upper layer of sediments. Such mixing may be attributable to currents and wave action, but most commonly is attributed to the activity of burrowing aquatic invertebrates, and other sources of physical disturbance. Burrowing invertebrates such as chironomid (e.g., *Chironomus*) and mayfly (e.g., *Hexagenia*) larvae are reported to be abundant in the surface sediments of the lake (Stantec 2015).

In the sediment sub-model, fresh sediment is added to the top layer at each time step (i.e., 3 hours), and the existing layers are moved down in the sedimentary sequence by a corresponding amount. The model also allows specification of depth dependent mixing rates between adjacent sediment layers. The model was implemented to represent sediment layers of 0.2 centimetres (cm) thickness, to a depth of 20 cm, with mixing rates decreasing with depth in sediment, and ceasing at a depth of 10 cm below the sediment surface.

In addition to the processes described by Kansanen and Seppala (1992), the dissolved arsenic concentration in the near-surface sediment layers was estimated from the total arsenic concentration in sediment, using empirically-based partition coefficients reflecting an oxygen-depleted environment. Cornett et al. (1992) studied Moira Lake, near Madoc, Ontario. The lake, described as a widening of the Moira River, was contaminated with arsenic by historical mining activity in upstream areas. The lake is shallow (4.4 m) and similar in area (827 ha) to the sub-basins of Kenogamasis Lake. The lake has a relatively low hydraulic flushing rate (0.34 years). Arsenic concentrations in the sediments of the lake were described as being very high (>500 milligrams per kilogram (mg/kg), and often exceeding 1,000 mg/kg in sub-surface sediments). The average total arsenic concentration in lake water was 47 micrograms per litre (µg/L), of which most (96%) was in dissolved form. Historical arsenic loading to Moira Lake (i.e., during periods of active mining and milling of ores up to about 1961) appears to have been substantially higher than arsenic loading at the time of the study (the late 1980s). The Moira Lake sediments exhibited a surface mixed layer of 3 to 8 cm depth, before becoming undisturbed. As a result of higher historical arsenic loading to the lake, the lake sediments were not in equilibrium with arsenic inputs from the overlying water column, and acted as a source of arsenic to the lake due to diffusion of arsenic across the sediment-water interface, and resuspension (Cornett et al. 1992). Viewed in a historical perspective, the diffusive flux of arsenic represents a modest "echo" of previous high levels of arsenic deposition to sediment, which may become important as a persistent internal source of arsenic when the external loading to the lake is substantially reduced.

Based on the work by Cornett et al. (1992), a concentration gradient is defined in the sediment sub-model as the difference between the dissolved arsenic concentration in sediment and the arsenic concentration in the overlying water, with an effective transport distance of 5 cm (i.e., the mid-point of the mixed sediment layer as determined from the sediment core data presented by Parks Environmental Inc. (2012)). The diffusive flux of arsenic from sediment back to overlying water was estimated following Cornett et al. (1992), using the diffusion coefficient for arsenate, and the depth-concentration gradient. The diffusion coefficient for arsenate was seasonally adjusted to reflect warm summer water temperatures (i.e., 20°C) and cold winter water temperatures (i.e., 0°C). In addition, a feature was added to the STELLA™ model to allow the diffusive flux of arsenic from sediment to water to be seasonally-enhanced to reflect higher rates of bioturbation by aquatic organisms, and/or wind resuspension of sediment containing arsenic into the water column. However, comparisons of total and dissolved arsenic concentrations in Kenogamisis Lake (Parks Environmental Inc. 2011, Figure 7-2) showed little difference between the two, indicating that arsenic is predominantly in the dissolved form. At higher total arsenic concentrations (i.e., >50 µg/L) in BBW, BBE and CBW, a small divergence was apparent, suggesting that up to 10% of the total arsenic concentration may be present as particulate arsenic. The particulate arsenic would include arsenic freshly taken up from the dissolved phase by phytoplankton and zooplankton, in addition to particulate matter re-suspended from the sediment reservoir. Therefore, it is reasonable to conclude that re-suspended bed sediments typically represent less than 10% of the total arsenic present in the water column.

Although the STELLA™ model does not include a formal sediment transport model, and the individual sub-basins are treated as being sediment traps, the model implicitly allows for the resuspension of arsenic from bed sediment (either as dissolved or particulate material), which once in the water column, could be transported to downstream sub-basins of the lake. However, based on the observations that arsenic in the lake water is predominantly found in the dissolved phase, and that the total suspended solids concentration measured in the lake water is typically less than 2 mg/L (Table 1), physical resuspension and downstream transport of bed sediments does not appear to be a major process in Kenogamisis Lake.

A diagram showing the details of the STELLA™ model structure is provided in Figure 2.

Table 1 Suspended Sediment Concentrations (mg/L) in Kenogamisis Lake, 2013-2017

Statistic	SWA	BBW	BBE	CBW	CBE	OB
n	33	15	39	25	34	9
Minimum	0.15	0.59	0.15	0.30	0.15	0.74
Mean	1.15	1.2	2.6	1.1	0.8	1.0
Maximum	4.35	2.38	8.42	2.22	1.38	1.0
5'th Percentile	0.15	0.8	0.4	0.8	0.25	0.83
95'th Percentile	2.33	2.1	6	1.7	1.1	1.0

Note:
Values reported as "non-detectable" were processed using a value of one-half the detection limit.

2.2 SIMULATION OF KENOGAMISIS LAKE 1920 TO 2018

Simulation of water and sediment quality in Kenogamisis Lake starts with setting up the model and performing an initial calibration to approximate the measured arsenic concentrations in the water and sediment. Parameters represented in the model include:

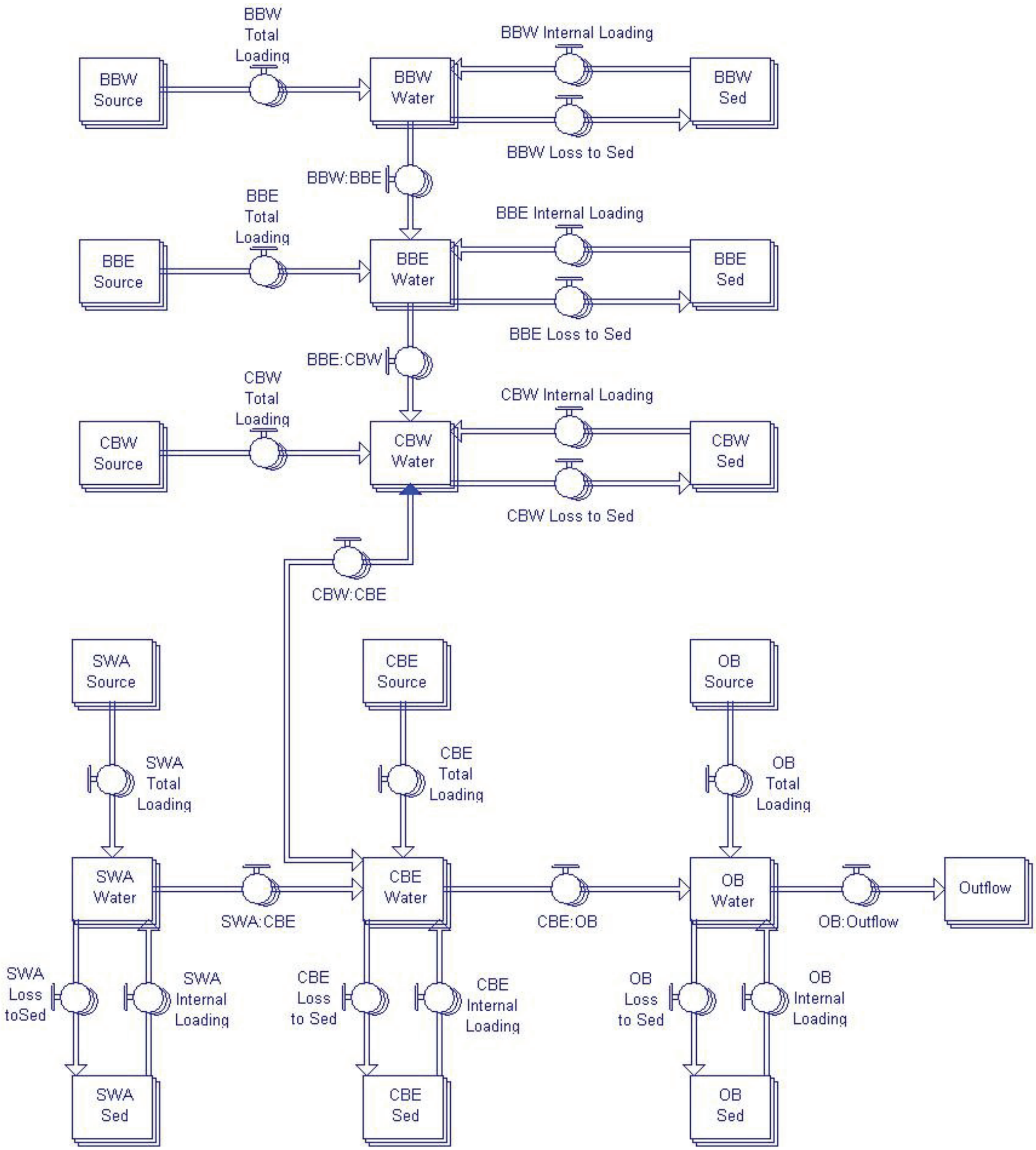
- physical characteristics of Kenogamisis Lake sub-basins
- flow conditions of Kenogamisis Lake sub-basins
- estimated direct arsenic loadings to Kenogamisis Lake sub-basins with surface water runoff, groundwater, and from atmospheric deposition.

The model can be used to provide estimates of the following quantities:

- seasonally-varying arsenic concentrations in lake water, in each sub-basin of the lake
- average sub-basin sediment arsenic concentrations, as a function of depth below the sediment-water interface
- arsenic fluxes between sub-basins, and as exchanges between water and sediment

Once the model is established and has been calibrated to reflect the historical conditions, a sensitivity analysis can be carried out to investigate how responsive the model may be too small or large changes in the values of key parameters. Following the sensitivity analysis, the model can be subjected to detailed calibration and validation steps, before the changes expected to occur as a result of the Project can be incorporated, to enable forecasting of potential future conditions. The key changes to the model inputs to reflect future conditions include:

- changes to the estimated arsenic loadings to Kenogamisis Lake
- changes to water flow characteristics to reflect potential changes in precipitation due to climate change between the present time, and 2100



Schematic of STELLA Model Structure	Scale:		Job No.:	Figure No.:
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Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS	

Stantec

2.3 MODEL INPUT PARAMETERS

Parameter values used to describe the physical dimensions of the six lake sub-basins are summarized in Table 2.

Table 2 Physical Characteristics of the Six Lake Sub-basins

Parameter	SWA	BBW	BBE	CBW	CBE	OB
Surface Area (m^2)	7,960,082	2,773,333	2,357,483	2,527,353	4,670,410	19,388,969
Mean Depth (m)	2.48	1.66	2.05	2.95	4.0	1.8
Volume (m^3)	19,690,796	4,626,977	4,833,121	7,418,604	18,619,758	33,644,028

Flushing rates for the sub-basins were simulated using 30-year mean monthly flows developed from regional flow equations as documented in the "Environmental Baseline Data Report (Combined 2014 and 2015) – Hardrock Project: Hydrology" (Baseline Report – Hydrology) (Stantec 2016a), updated in Chapter 10.0 of the Final Environmental Impact Statement / Environmental Assessment (Stantec 2017), and included in Table 3 below. Boundaries between sub-basins were established at natural and human-made constrictions, such as narrows, causeways and bridges. The Central Basin was divided into western (CBW) and eastern (CBE) portions due to the presence of a shoal extending across the lake. The primary water inflow to CBW was assumed to come from Barton Bay, whereas the primary water inflows to CBE are from the SWA, CBW, and the McKelvie Lake watershed. In addition to the net outflow of water from CBW, caused by surface water runoff, water exchange between CBW and CBE was simulated in the model as a function of the estimated cross-sectional area of the water body at the shoal, and a dispersive exchange of water across that boundary.

Table 3 Water Flow Characteristics for Sub-basins of Kenogamisis Lake

Location	Barton Bay West	Barton Bay (East and West)	Southwest Arm	Central Basin Outflow	Outflow Basin Outflow
Catchment Area (km^2)	154.8	181.1	839.7	1,145.2	1,291.2
Month	**30-year Mean Monthly Flow (m^3/second)**				
January	0.33	0.40	2.70	3.98	4.62
February	0.21	0.25	1.70	2.50	2.90
March	0.47	0.55	2.55	3.48	3.93
April	3.87	4.49	19.3	25.9	29.0
May	4.39	5.23	29.0	41.0	46.9
June	1.90	2.27	13.4	19.3	22.1
July	1.06	1.28	7.68	11.0	12.7
August	0.58	0.70	4.30	6.20	7.15
September	0.95	1.13	5.98	8.39	9.56
October	1.62	1.91	9.51	13.2	14.93
November	1.52	1.80	9.37	13.1	14.9
December	0.67	0.81	4.75	6.80	7.81

Table 4 provides a summary of the estimated arsenic loading rates to Kenogamisis Lake between 1920 and 2018. These loading rates are based on measured surface water and groundwater quality and estimated flow rates for the last 26 years (generally between 1990 and 2016) calculated from available field monitoring information. The arsenic loading rates summarize data on arsenic loadings from surface water, groundwater (including seepage through historical mine tailings), and atmospheric deposition, as presented Chapter 10.0 of the Final Environmental Impact Statement / Environmental Assessment (Stantec 2017).

For years prior to 1920, the arsenic mass loading rates were initially based on assumed background conditions (i.e., prior to the start of historical mining activities), and were adjusted as required through the period of historical mining activity, during the initial calibration phase of modelling, to account for the accumulation of arsenic observed in sediment cores (Parks Environmental Inc. 2012). These assumed historical arsenic loadings were assumed to result from direct discharge of water from mining operations, as well as groundwater seepage through historical mine tailings. The loadings were applied to BBW, BBE, CBW and SWA, and are substantial (Table 4). However, the purpose of these loadings was to account for the observed arsenic concentrations in lake sediment. During the period from 2000 to 2017, the arsenic loadings to Kenogamisis Lake were generally constrained to be those reported in Chapter 10.0 of the Final Environmental Impact Statement / Environmental Assessment (Stantec 2017), representing the mean estimated loadings from surface water runoff, groundwater sources, and atmospheric deposition. The sole exception to this was BBE, where a continued additional arsenic loading of 400 kg/y was found to be required to account for present-day arsenic concentrations in lake water. This additional arsenic loading was assumed to originate from an unrecognized source or sources outside of the Project area, but within the catchment of BBE.

Table 4 Estimated Historical Arsenic Loadings[1] (kg/year)

Period	SWA	BBW	BBE	CBW[2]	CBE	OB
1920 - 1929	349	230	19	0	249	330
1930 - 1939	349	1,051	1,699	0	249	330
1940 - 1949	1,459	2,074	3,689	256	249	330
1950 - 1959	2,624	2,470	4,077	513	249	330
1960 - 1969	4,898	1,413	4,764	769	249	330
1970 - 1979	4,898	1,413	2,764	769	249	330
1980 - 1989	4,898	1,413	2,764	769	249	330
1990 - 1999	4,898	1,413	2,764	769	249	330
2000 - 2017	544	1,413	2,764	769	249	330

Notes:

1 Loadings are estimates of the mass of arsenic directly entering each sub-basin. They do not include arsenic inputs with water flow from upstream sub-basins, or internal cycling of arsenic between sediment and water.

2 CBW has a very small direct drainage area, and as such, direct inputs of arsenic to this sub-basin may have been very small prior to the onset of historical mining activity.

The transfer of arsenic from water to sediment was modeled (as in Bird et al. 1993) using a mass transfer coefficient with units of 1/year (y^{-1}). As described by Bird et al. (1993), one way to parameterize this first-order kinetic process is from mass balance studies of trace element retention and export from lakes. Thus, at steady state:

$$a_i = \rho R_i/(1-R_i) \qquad \textbf{Equation 1}$$

where: a_i is the transfer rate for contaminant i from water to sediment (y^{-1})

ρ is the lake's hydrological flushing rate (y^{-1})

R_i is the retention coefficient for contaminant i in the lake sediments (unitless).

The primary process transporting parameters from water to sediment in lakes can be conceptualized as the sorption of the contaminant to suspended solids (including inorganic particles as well as living and non-living organic particles) in the water column, followed by the deposition of suspended solids (and associated contaminants) to bed sediment in the lake. The loss rate for suspended solids from water to sediment can be approximated using the following equation:

$a_{TSS} = S/(TSS \times z)$ **Equation 2**

where: a_{TSS} is the transfer rate for suspended solids from water to sediment (y^{-1})

S is the net sediment accumulation rate in the lake (kg dry sediment/m^2/y)

TSS is the total suspended solids concentration in the lake water (kg/m^3)

z is the mean depth of the lake (m).

Using representative values for S (0.16 kg dry sediment/m^2/y) and z (4.6 m) for Canadian Shield lakes as described by Bird et al. (1993), and assuming a typical value for TSS of 0.002 kg/m^3, a generic value of 17.4 y^{-1} is obtained for a_{TSS}. This is equivalent to a removal rate for TSS from the water column of about 4.7% per day. Values for S and TSS may be correlated (i.e., a high sedimentation rate implies a high total suspended sediment concentration). However, Equation 2 also implies that shallow lakes (z <4.6 m) would have higher relative transfer rates than deeper lakes (z >4.6 m). For a lake having a mean depth of 2 m, comparable to some of the sub-basins of Kenogamisis Lake, and assuming the same representative mean values for S and z, the a_{TSS} value could rise to approximately 40 y^{-1}.

If all of the trace element present in the water column was associated with particles, then the loss rate for that trace element would be similar to the loss rate for the suspended solids (a_{TSS}). Conversely, for a trace element that is not associated with particles, but exists solely in dissolved form in the water, the loss rate for the trace element to bed sediments would be close to zero. Thus, the loss rate for trace elements that are associated with particles can be conceptualized as being equal to the loss rate for suspended solids, multiplied by the fraction of the total concentration of the trace element in water that is associated with particles. The empirical evidence from analysis of total and dissolved arsenic concentrations in the water of Kenogamisis Lake indicates that arsenic is predominantly present in the dissolved form (i.e., not retained on filters).

The fraction of a trace element that is associated with suspended solids in the water column (P_{solids}) can be estimated using a partition coefficient (Kd, m^3/kg). Thus:

$P_{solids} = Kd \times TSS$ **Equation 3**

Combining Equations 2 and 3 and cancelling terms as appropriate gives the following equation:

$a_i = (Kd_i \times TSS \times S)/(TSS \times z)$ **Equation 4**

Equation 4 can be further simplified by cancelling terms that are represented in both the numerator and the denominator, thus:

$a_i = (Kd_i \times S)/z$ **Equation 5**

Since P_{solids} is by definition unitless and is constrained to a range of values bounded by 0 and 1, it follows that for this generic example, the a_i values for an individual trace element are constrained to be less than 17.4 y^{-1}. However, for site-specific conditions where the sedimentation rate, mean depth and sediment-water concentration ratios of a lake basin are known, it would also be possible to calculate site-specific values for a_i.

Sheppard et al. (2010) provide water to sediment Kd values for a suite of trace elements in 33 sediment samples collected at sites <5 m deep from lakes in northern Ontario. For arsenic, they provided a Kd value of 1.4 m^3/kg, which had a relatively large geometric standard deviation of 4.3. Allowing for two standard deviations about the mean value, this implies that the mean Kd value for arsenic likely lies within the range of 0.08 to 25.9 m^3/kg. Higher values likely apply to particles suspended in the water column at high redox potential, as opposed to bed sediments where the redox potential may be lower, and reduction of iron from insoluble ferrous to soluble ferric species may be occurring. Measured solid-water partition coefficients for arsenic in Moira Lake were about 20 m^3/kg for suspended sediments, and ranged from <1 to >5 m^3/kg for bed sediments, decreasing with increasing depth in the sediment profile (Cornett et al. 1992). Kuhn and Sigg (1993) studied arsenic cycling in eutrophic Lake Greifen, Switzerland. The lake is deep (>30 m), monomictic (mixing through the winter period) and undergoes seasonal anoxia at depths greater than 7 to 10 m from August to December. Partition coefficients for arsenic on suspended particles ranged from 2 m^3/kg to 19 m^3/kg, averaging 10 m^3/kg.

Using the Kd value of 25.9 m^3/kg, a sedimentation rate of 0.16 kg/m^2/y and a lake mean depth of 2 m, an a_i value of about 2.1 y^{-1} is derived for arsenic, although it is stressed that this is subject to variation based on site-specific considerations of lake morphometry, chemistry (particularly iron availability and chemistry) and biology (e.g., bioaccumulation of arsenic by phytoplankton) can be expected to modify this value. Therefore, this parameter was subject to adjustment as part of the model calibration process. The values of a_{As} after the initial calibration were 3.0 y^{-1} in sub-basin BBE; 2.5 y^{-1} in sub-basins BBW and CBW; and 1.0 y^{-1} in sub-basins SWA, CBE and OB. The variation in these transfer rates may reflect the availability and deposition of iron in the sediments of the individual sub-basins. Parks Environmental Inc. (2012) showed iron concentrations in sediments of Kenogamisis Lake ranging from high values of 28,600 to 62,400 mg/kg in BBE, to low values of 4,030 to 24,200 mg/kg in OB.

For the sediment model, a sedimentation rate of 0.16 kg dry sediment/m^2/y (*i.e.*, the geometric mean of sedimentation rate based on ^{210}Pb-dated cores as reported by Bird et al. 1993) was assumed across all sub-basins. Although dating of sediment cores was previously undertaken as part of the work by Parks Environmental Inc. (2012), the sedimentation rates estimated using the ^{210}Pb data did not take into consideration sediment mixing as a result of bioturbation, although this was strongly suggested by sediment core trace element (and ^{210}Pb) profiles. As a result, the reported sediment accumulation rates were not considered to be representative. A partition coefficient (Kd, m^3/kg) was also used to simulate arsenic binding to sediment solids. This partition coefficient was iteratively adjusted for each lake sub-basin as part of the initial model calibration and detailed calibration processes.

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3.0 INITIAL MODEL CALIBRATION AND SENSITIVITY ANALYSIS

Kenogamisis Lake is a dynamic ecosystem, comprising six individual sub-basins, each of which has different water flow rates, different arsenic loadings, and different geochemical conditions. Barton Bay (represented by BBW and BBE), and the western portion of the Central Basin (CBW), have substantially higher levels of arsenic and iron than the remaining sub-basins, due to effects from historical mining operations (i.e., deposition of tailings adjacent to or within the basins and the effects of seepage to surface water and groundwater). High levels of iron in BBW, BBE, and to a lesser extent CBW, are expected to result in more rapid transfer of arsenic from water to sediment, and greater retention of arsenic in sediment, than in the other sub-basins where iron levels are much lower.

The main source of water for Kenogamisis Lake is the Kenogamisis River, which enters the southwest end of SWA, passes through CBE, and exits via OB. As a result, these sub-basins have substantially higher flushing rates than BBW, BBE and CBW, which are supplied with water by much smaller tributaries entering from the northwest. Several of these tributaries are also important sources of arsenic loading to the lake due to historical mining activities in their upstream drainage areas. Rapid flushing rates result in less effective retention of arsenic by lake sediments than is the case for lake basins that have slower flushing rates.

The lake sub-basins are generally shallow, having mean depths ranging from 1.7 m (BBW) to 4.0 m (CBE). Along with the shallow water depths, which expose bottom sediments to shear stress from wind-driven currents, the sediments also support abundant burrowing invertebrates (e.g., chironomids, and the burrowing mayfly *Hexagenia*) which disturb and mix the sediments (accounting for sediment core profiles that indicate mixing as deep as 10 cm), and which may increase the exchange of pore water between lake sediment and the overlying lake water as a result of their respiration.

3.1 INITIAL MODEL CALIBRATION

An iterative process was used to achieve an initial calibration of the surface water and sediment sub-models. First, it was necessary to develop a set of arsenic loading values representing the period from 1920 to 2018 that could account for the observed concentrations and historical levels of arsenic in the lake sediments. It was also necessary to develop mass transfer coefficients that could achieve an appropriate balance between arsenic accumulation in sediment and concentrations in water. Lastly, it was also necessary to develop partition coefficients for arsenic in sediment that would allow for its retention in sediment, post-deposition, while also allowing for internal cycling of arsenic between water and sediment. These calibration activities occurred in the context of sub-basins that also have differing loadings of iron, and differing iron concentrations in sediment. Iron plays an important role in arsenic cycling, and hydrous oxides of iron are a key, but labile, binding phase for iron in sediments. The initial calibration process relied upon three key lines of evidence which impose constraints on the parameter values used in the model:

- the historical accumulation of arsenic throughout the sediment core profiles, and the present-day near-surface sediment arsenic concentrations from sediment grab samples, as documented by Parks Environmental Inc. (2012)
- the recent (2001-2011) record of arsenic concentrations in the water of the various lake sub-basins (Parks Environmental Inc. 2011)
- the requirement to approximate recent records of arsenic concentration in lake water, using the estimated present-day arsenic loadings to the various lake sub-basins (Stantec 2017)

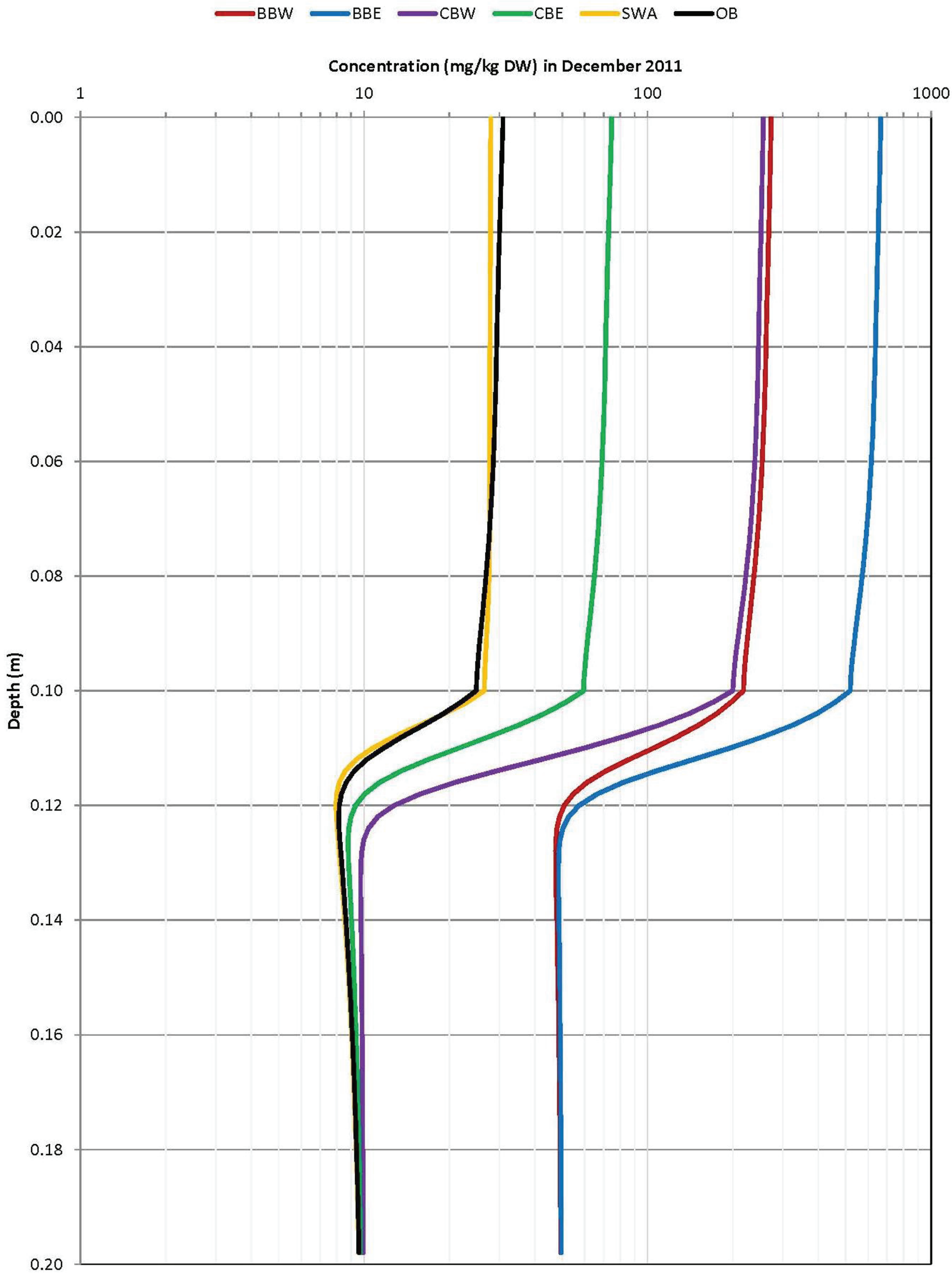
3.1.1 Model Hindcast Calibration to Sediment Arsenic Concentrations

The model was used to simulate the direct and indirect effects of historical mining activities (including but not limited to dustfall, treated effluent discharge, and tailings seepage) on lake water and sediment quality in the six main sub-basins of Kenogamisis Lake over the period 1920 to 2016. It was assumed that the lake was in a relatively undisturbed condition with respect to arsenic concentrations prior to 1920. As indicated previously, it was assumed (based on data from deep sections of sediment core samples) that existing arsenic concentrations in lake sediment were approximately 10 mg/kg dry weight in SWA, CBE, CBW and OB, and approximately 50 mg/kg in BBW and BBE. The higher existing levels of arsenic in BBW and BBE are consistent with these sub-basins being proximal to the areas of historical tailings deposition or predicted discharge of groundwater affected by the historical tailings.

Figure 3 shows the simulated sediment arsenic profiles at the end of year 2011. The mean surface sediment arsenic concentrations are predicted to range from about 26 mg/kg in SWA to about 670 mg/kg in BBE. These values, as well as the predicted values in the remaining sub-basins (OB, CBW, CBE and BBW) are in broad agreement with the results of core and surface sediment grab samples taken in 2012 (see Tables 3-1 to 3-6 and Figure 4-8 in Parks Environmental Inc. 2012).

3.1.2 Model Initial Calibration to Seasonal Arsenic Concentrations in Water

Figure 4 shows the simulated total arsenic concentrations in the water of the six lake sub-basins between 2001 and 2011. The highest arsenic concentrations occur in BBE and BBW, followed by CBW, CBE and OB. The lowest arsenic concentrations occur in SWA. Seasonal variability is marked in all sub-basins. In BBE, the range of predicted arsenic concentrations is from about 32 µg/L (late winter) to 115 µg/L (late summer). In SWA, the predicted annual range is from about 1.5 to 4.1 µg/L. These ranges, and the seasonal cycles of arsenic concentration, are consistent with ranges observed in the lake water through monitoring programs reported by Parks Environmental Inc. (2012) for the years 2001 to 2011. An earlier study by the Ontario Ministry of the Environment (1982) noted what appeared to be high, but declining arsenic concentrations in the lake water between 1979 and 1981. Although the two referenced studies both noted seasonal variation in arsenic concentrations, the full seasonal cycle was not captured (i.e., sampling typically occurred in spring and fall, and a “saw-toothed” seasonal pattern of low and high values was observed. More recent sampling by Stantec in the period 2013 to 2016 has included more frequent (monthly) sampling, and provides better resolution of the seasonal arsenic cycle in lake water. Representative data from Southwest Arm (Station 1) and Barton Bay West (Station 2) for the period 2013 to 2016 are presented in Figure 5.



Predicted Total Arsenic Concentrations in Sediment (mg/kg) by 2011	**Scale:** n/a	**Job No.:** 160961223		**Figure No.:** 3
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS	
Client: Greenstone Gold Mines GP Inc.				

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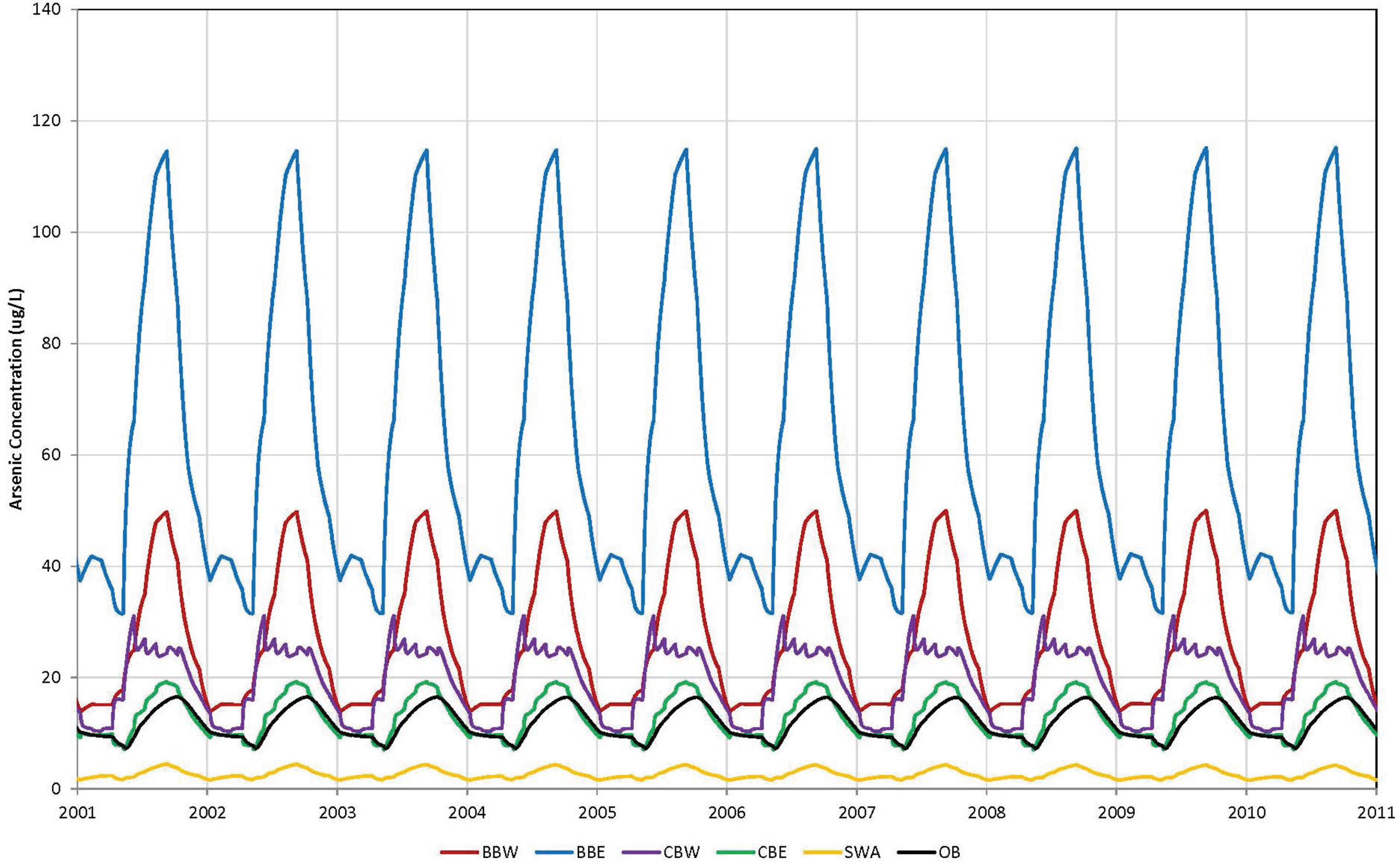
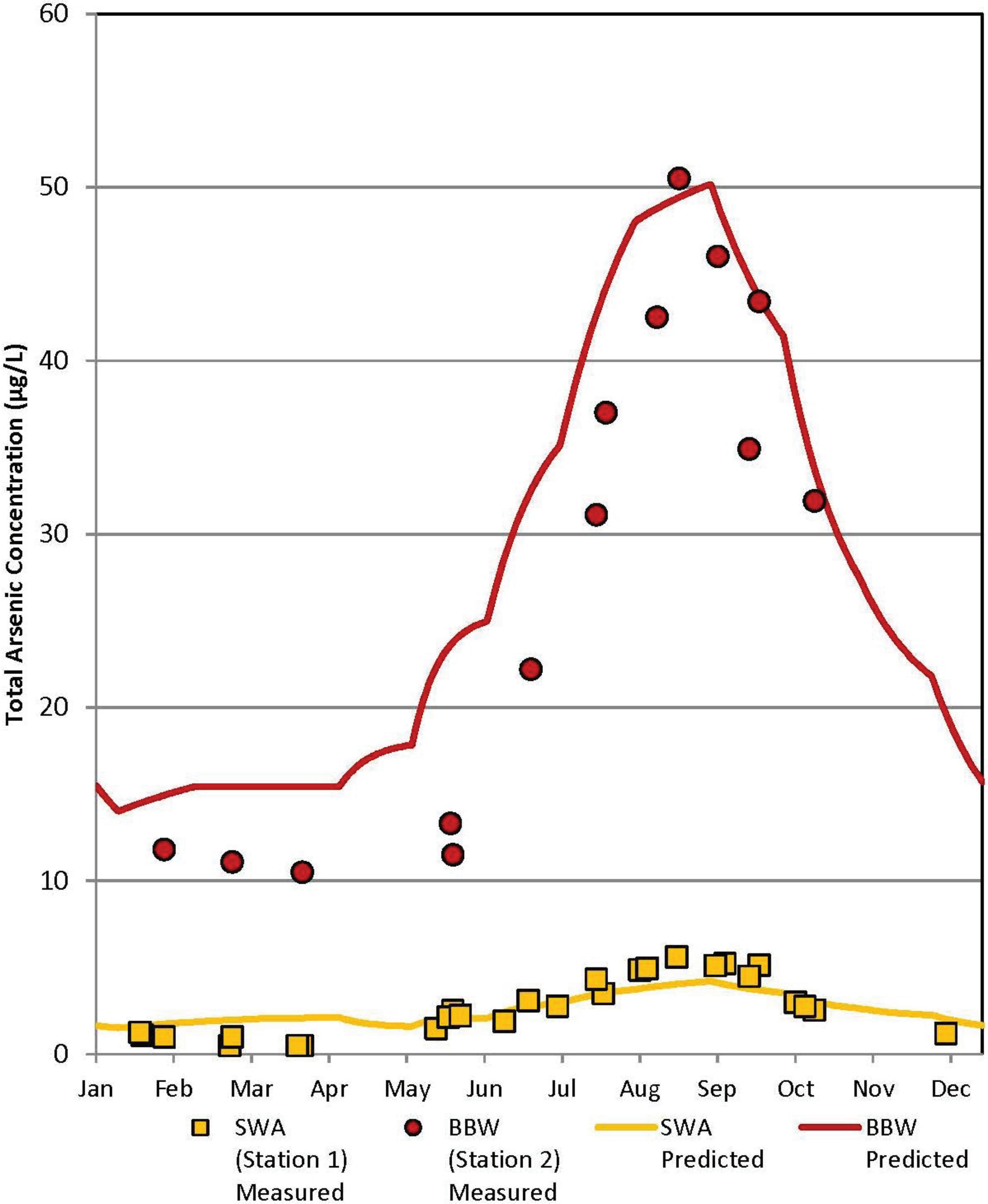


Predicted Total Arsenic Concentrations in Water (μg/L) 2001 to 2011	Scale: n/a		Job No.: 160961223		Figure No.: 4	Stantec
	Date: January 30, 2018	Dwn By: PM		Appd. By: MS		
Client: Greenstone Gold Mines GP Inc.						



Comparison of STELLA Model Predictions for Total Arsenic Concentrations in Water (µg/L) of SWA and BBW, to Seasonal Measurements of Water Quality, 2013 to 2016	Scale:	Job No.:	Figure No.:	Stantec
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	Date:	Dwn By: / Appd. By:		
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM / MS		

The initial calibration values for the STELLA™ model are presented in Table 5.

Table 5 Initial Calibration Values for the STELLA™ Model of Arsenic in Kenogamisis Lake

Parameter	BBW	BBE	CBW	CBE	SWA	OB
Sedimentation Rate (kg/m²/y)	0.16	0.16	0.16	0.16	0.16	0.16
Initial sediment As concentration (mg/kg)	50	50	10	10	10	10
Kd_{AS} (m^3/kg)	2.5	3.0	2.5	1.0	1.0	1.0
α_{AS} (y^{-1})	2.5	3.0	2.5	1.0	1.0	1.0
Diffusive flux multiplier	1x when lake is ice-covered; 1x during open water season					

3.2 MODEL SENSITIVITY ANALYSIS

The following section provides an analysis of the STELLA™ model sensitivity to variation in key parameter values. The water quality model relies upon a limited number of parameters, of which several are fixed or not variable when a particular lake is being simulated because they are known to be well-defined quantities. Thus, although the water quality model requires information on catchment area, lake area, and lake mean depth, these parameters are accurately determined and fixed for the six sub-basins of Kenogamisis Lake. As such, sensitivity analysis is not required for these parameters. In addition, the mixed sediment thickness (10 cm) was determined based on evaluation of core samples presented by Parks Environmental Inc. (2012). Therefore, only the following parameters, including runoff, total arsenic loading, water to sediment transfer rate, water to sediment partition coefficient, and sedimentation rate, are considered to be of primary relevance in the context of sensitivity analysis. The sensitivity analysis was undertaken with the STELLA™ model calibrated, as described above, prior to detailed calibration of the model.

Review of the data for the years 2013 to 2016 yielded 131 individual data points representing the total arsenic concentration (µg/L) in the lake water. These data points were paired with model predictions for the same day of each year. The paired values were then transformed (log10) to normalize the variance, and subjected to least squares linear regression analysis (all statistical analyses were performed using SYSTAT). The scatterplot and regression lines (including the upper and lower confidence intervals for the regression line, and the upper and lower prediction intervals for the regression) are shown in Figure 6. The regression analysis is summarized in Table 6. The adjusted r^2 value associated with the regression analysis is 0.844 (very good), indicating that the initial calibration of the model accounts for over 84% of the variation in measured total arsenic concentrations between 2013 and 2016. The Standard Error of the Estimate (Root Mean Square Error) is 0.203.

Table 6 Regression Statistics for Measured and Predicted Total Arsenic Concentrations in Kenogamisis Lake Water (n = 131 paired data points)

Effect	Coefficient	Standard Error	t	p-value
Constant	0.291	0.038	7.621	<0.001
Log Measured Arsenic	0.852	0.032	26.422	<0.001

Analysis of Variance

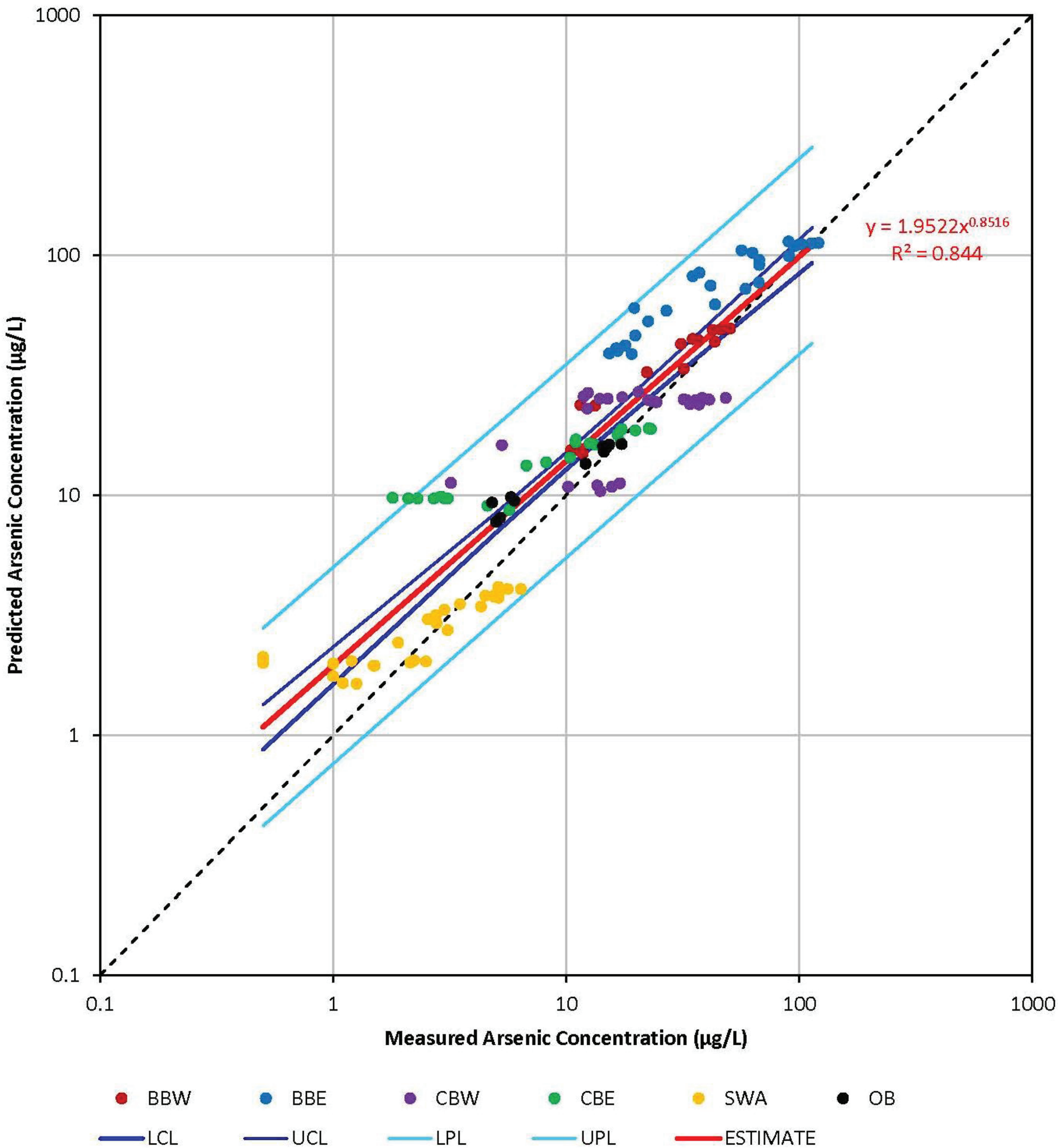
Source	Sum of Squares	Degrees of Freedom	Mean Square	F-ratio	p-value
Regression	28.720	1	28.720	698.14	<0.001
Residual	5.307	129	0.041		

As shown in Figure 6, the regression line for predicted vs. measured arsenic concentrations in water lies slightly above the 1:1 line, indicating that the model predictions tend to be slightly conservative (i.e., over-predicting) through most of the prediction range. This was a specific objective during the model calibration process (i.e., that to satisfy the requirements of the EIS/EA and Human Health and Ecological Risk Assessment processes, the model predictions should be reasonable, with a tendency to be conservative). The regression equation shown in Figure 6 serves as the basis for evaluating model sensitivity to variation in key parameter values, as described below.

3.2.1 Runoff

The hydrological processes represented in the STELLA™ model are based on a regional flow model representing Kenogamisis Lake. A standard hydrograph was developed, representing the 30-year mean monthly runoff values based on six long-term hydrological monitoring stations representing watersheds of similar dimensions to the sub-basins of Kenogamisis Lake. The regional flow assessment stations used to estimate flow through Kenogamisis Lake sub-basins were a sub-set of the regional flow assessment stations used in Chapter 10.0 of the Final EIS/EA. Bird et al. (1993) previously showed that the water quality model had low sensitivity to variations in runoff.

To evaluate model sensitivity to short-term variation in runoff, including years that were either wetter or drier than the long-term average condition, Stantec prepared a 10-year time series of variable monthly runoff values based on the actual monthly data from the hydrological monitoring stations supporting the regional flow model. The STELLA™ model was then re-run as before over the period between 1920 and 2006, using the long-term mean monthly runoff values. Starting in 2007 and continuing until the end of 2016, the hydrological function was replaced with the variable monthly mean values based on measured flows at the long-term hydrological monitoring stations. The resulting STELLA™ model output was then compared to the original model output to evaluate the effect of more realistic hydrological variability on short-term and longer-term model predictions of total arsenic concentrations in water. The time series incorporates periods when the runoff values were particularly high (e.g., the spring freshet values for 2013 and 2014), as well as periods of low runoff (e.g., the spring freshet in 2010, and the fall runoff periods of 2012 and 2013). This analysis helps to respond to several potential concerns, as follows:



Predicted vs. Measured Arsenic in Water	**Scale:**	**Job No.:**		**Figure No.:**	Stantec
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Client: **Greenstone Gold Mines GP Inc.**	January 30, 2018	PM	MS		

- The sensitivity of the water quality model to natural deviations from long-term mean flow.
- Scenarios looking at different flow rates ranging from dry periods to flood regimes.
- Climate change scenarios predicting an increase in precipitation in eastern Canada.

Figure 7 shows the variability in monthly mean runoff values during the 10-year period from 2007 to 2016 for Barton Bay East (BBE), when compared to the mean values based on long-term average monthly runoff values. Figure 8 (open symbols) shows the variability in predicted arsenic concentrations in water, as introduced by the variable runoff values during the period from 2007 to 2016. The solid lines show the standard estimates, based on the 30-year average runoff values. As shown in Figure 8, periods of lower than average runoff (e.g., the spring and early summer of 2010, and the late summer and fall of 2011 and 2012) result in higher than average total arsenic concentrations in the lake water. Periods of higher than average runoff (e.g., the fall of 2007, and the spring freshets of 2013 and 2014) result in lower than average total arsenic concentrations in the lake water. While this pattern is most easily resolved in BBE due to scale effects, it is repeated in the other lake sub-basins.

While the model is responsive to realistic short-term variations in runoff, the model predictions will revert to values consistent with those based on long-term mean runoff when viewed on an annual or multi-year basis. Further, although historical variations in runoff can be examined based on hydrological data, the best estimator of future conditions remains the long-term (30-year) average runoff record. Recognizing that climate change has the potential to change the historical climate normal, predictions of future conditions will consider both the long-term average runoff, as well as a climate change scenario representing generally warmer temperatures and higher levels of precipitation developing between the present time, and 2100.

3.2.2 Total Arsenic Loading

The total external arsenic loadings to Kenogamisis Lake were varied by ±25%, relative to the estimated values, over the simulation period between 2006 and 2017. As expected, higher total arsenic loadings resulted in higher arsenic concentrations in water, and lower loadings resulted in lower concentrations.

The effect of increasing or decreasing total arsenic loading is shown in Figure 9, together with the results of the model, when compared to the measured total arsenic concentrations in lake water between 2013 and 2017. Higher arsenic loadings result in higher predicted total arsenic concentrations in the lake water (i.e., a greater positive bias). Lower arsenic loadings resulted in lower predicted total arsenic concentrations in the lake water, becoming non-conservative at arsenic concentrations greater than about 20 µg/L. Overall, the model sensitivity to variation in arsenic loading was moderate, ranging from -19% to +21% in SWA, to -23% to +23% in BBW. The results of this analysis indicate that the estimated present-day loading values are realistic, and are preferred over higher or lower values.

3.2.3 Water to Sediment Transfer Rate

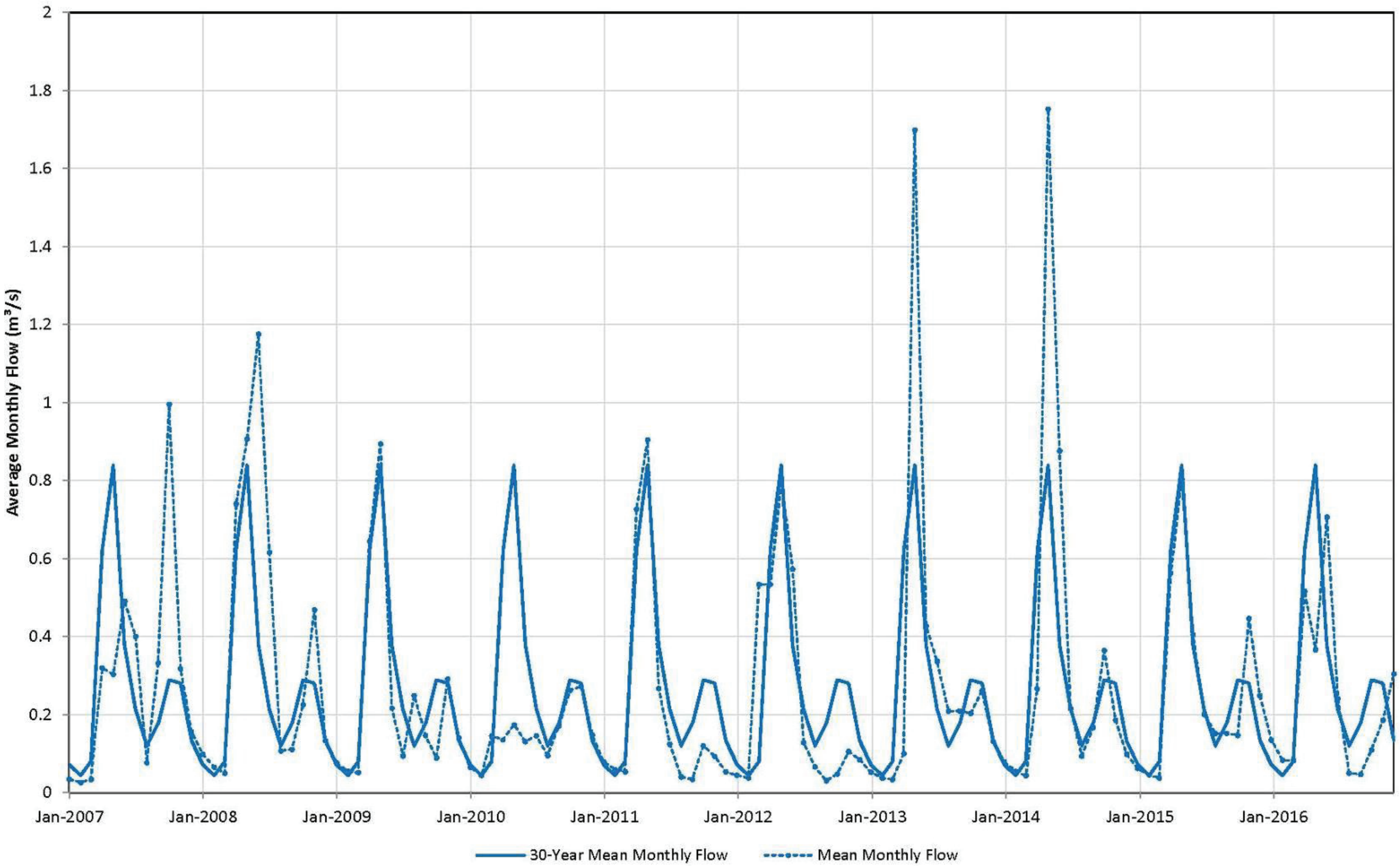
The water to sediment transfer rate (a_{As}, y^{-1}) represents the mass transfer rate of arsenic from the water compartment to the sediment compartment, and (along with the arsenic loading and runoff parameters) is an important determinant of the predicted total arsenic concentration in water, as well as sediment.

Bird et al. (1993) showed that when the surface water model is fully generic (i.e., nothing is known about the lake characteristics), values of a_i for various elements are typically subject to a high degree of uncertainty. However, for Kenogamisis Lake, the model validation and calibration processes outlined above provide additional constraint on values of a_{As}. Depending upon which sub-basin is being simulated (and reflecting the availability of iron in each sub-basin), the initial calibration values of a_{As} ranged from 1.0 y^{-1} (in SWA, CBE and OB) to 2.5 y^{-1} (in BBW and CBW) and 3.0 y^{-1} (in BBE). Bird et al. (1993) showed that this parameter typically can be expected to have a log-normal distribution. Therefore, the sensitivity analysis will consider the effects of halving, or doubling, the initial calibration values within each sub-basin.

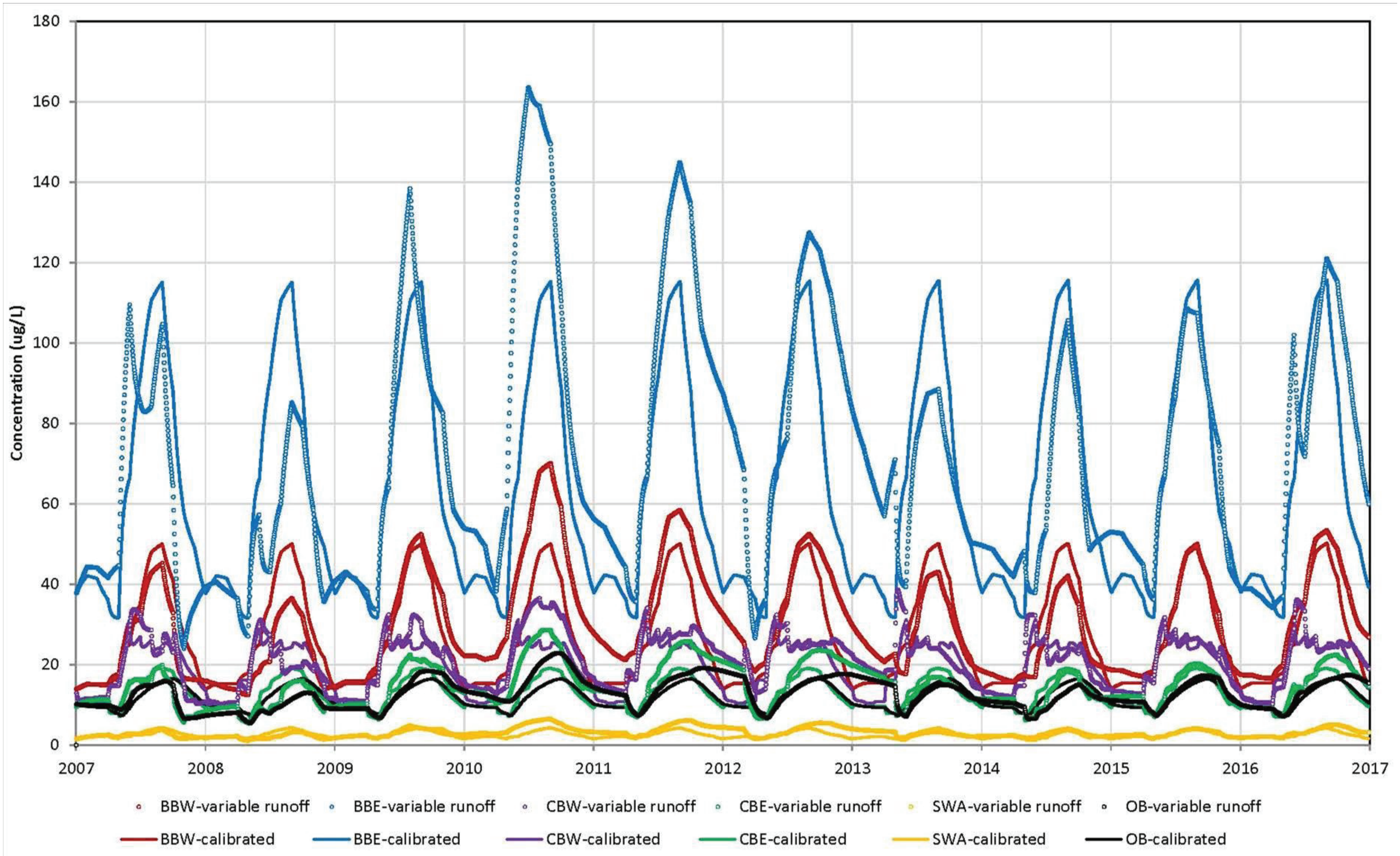
The effects of higher or lower values of a_{As} are shown in Figure 10, together with the results of the initially calibrated model, when compared to the measured total arsenic concentrations in lake water between 2013 and 2016. Lower values of a_{As} result in higher predicted total arsenic concentrations in the lake water (i.e., a greater positive bias), and a slight reduction in the r^2 value relative to the initial calibration model. Higher values of a_{As} resulted in lower predicted total arsenic concentrations in the lake water, with the predicted values becoming non-conservative at measured concentrations greater than about 20 µg/L. Overall, the model sensitivity to variation in values of a_{As} was moderate, ranging from -6% to +4% in SWA, to -22% to +16% in BBE. These results reflect variation in the calibrated values of a_{As} (ranging from 1 y^{-1} in SWA to 3.5 y^{-1} in BBE), as well as the relatively high hydraulic flushing rates of the various lake sub-basins. The results of this analysis indicate that in rapidly flushed sub-basins, the model is relatively insensitive to variations in a_{As}. However, in slowly flushed sub-basins, the model is more sensitive to a_{As}.

3.2.4 Water to Sediment Partition Coefficient

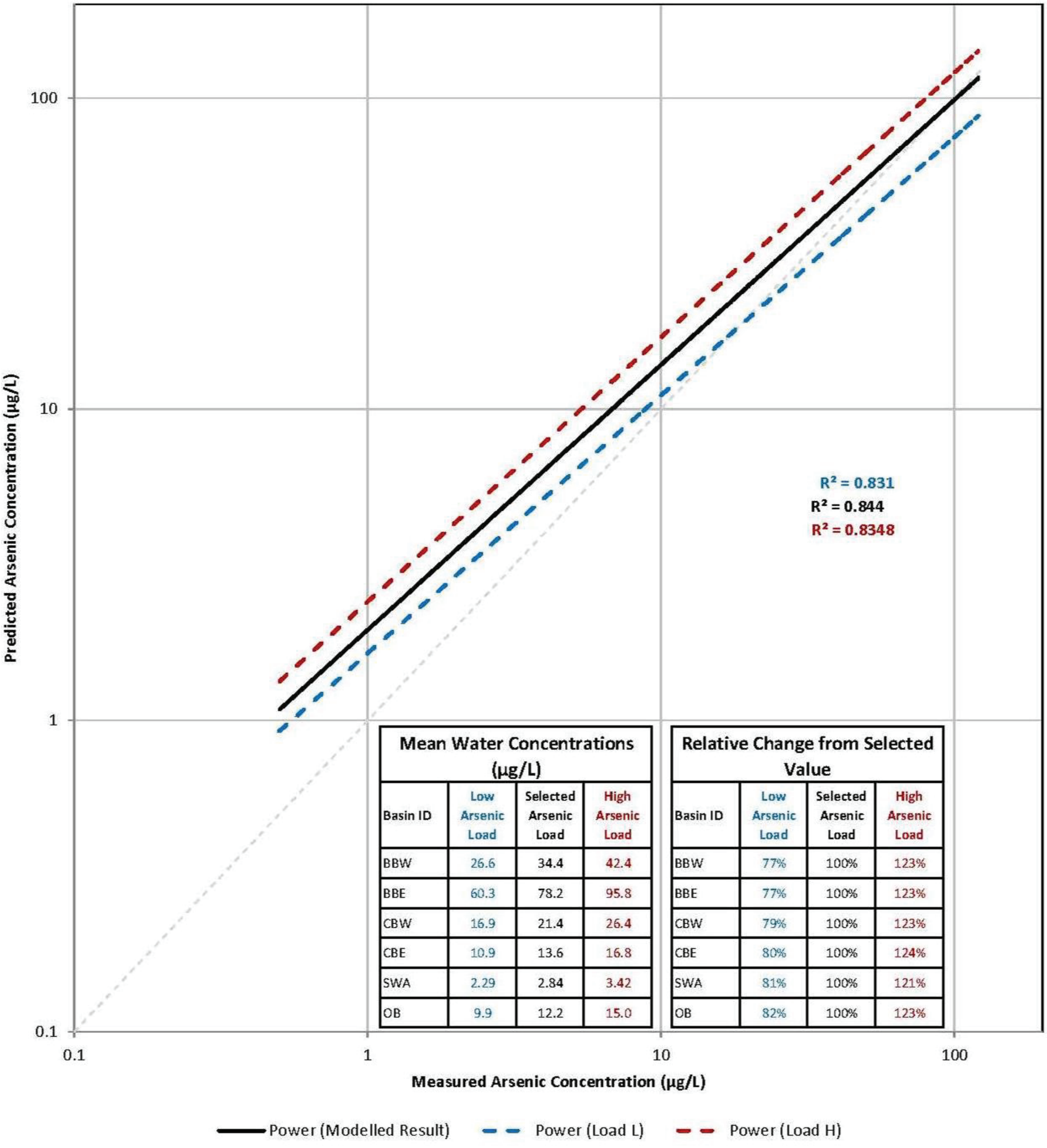
The water to sediment partition coefficient for arsenic (Kd_{As}, m^3/kg) represents the tendency for this element to bind to sediment solids, within the bed sediments. This parameter helps to determine the expected dissolved arsenic concentration in the sediment pore water, and consequently the diffusive flux of arsenic from the bed sediment back to the overlying water. Cornett et al. (1992) showed that partition coefficients for arsenic in the sediments of arsenic-contaminated Moira Lake, Ontario, were low, ranging from 4 to 6 m^3/kg in surface sediments, to values of 1 m^3/kg or less, deeper in the sediment profile. For Kenogamisis Lake, the model validation and calibration processes resulted in initial calibration values of Kd_{As} at an assumed depth range of 0 to 5 cm in the sediment profile ranging from 1.0 m^3/kg (in SWA, CBE and OB), to 2.5 m^3/kg (in BBW and CBW), and 3.0 m^3/kg (in BBE), reflecting the relative abundance of iron, which is known to help bind arsenic in lake sediments. This parameter is assumed to have a log-normal distribution. Therefore, the sensitivity analysis will consider the effects of halving, or doubling, the calibrated values within each sub-basin.



Expected Water Flows in the BBE Basin of Kenogamisis Lake	**Scale:** n/a	**Job No.:** 160961223		**Figure No.:** 7
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS	
Client: **Greenstone Gold Mines GP Inc.**				Stantec



Predicted Arsenic Concentrations in Water Based on 30-year Mean Monthly Runoff (solid line) or Variable Monthly Runoff (open circle)	**Scale:** n/a	**Job No.:** 160961223		**Figure No.:** 8	Stantec
	Date:	**Dwn By:**	**Appd. By:**		
Client: **Greenstone Gold Mines GP Inc.**	January 30, 2018	PM	MS		



Mean Water Concentrations (µg/L)			
Basin ID	Low Arsenic Load	Selected Arsenic Load	High Arsenic Load
BBW	26.6	34.4	42.4
BBE	60.3	78.2	95.8
CBW	16.9	21.4	26.4
CBE	10.9	13.6	16.8
SWA	2.29	2.84	3.42
OB	9.9	12.2	15.0

Relative Change from Selected Value			
Basin ID	Low Arsenic Load	Selected Arsenic Load	High Arsenic Load
BBW	77%	100%	123%
BBE	77%	100%	123%
CBW	79%	100%	123%
CBE	80%	100%	124%
SWA	81%	100%	121%
OB	82%	100%	123%

Predicted vs Measured Arsenic Concentrations in Water – Sensitivity to Arsenic Loading	Scale:		Job No.:	Figure No.:
	n/a		160961223	**9**
	Date:	Dwn By:	Appd. By:	
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS	

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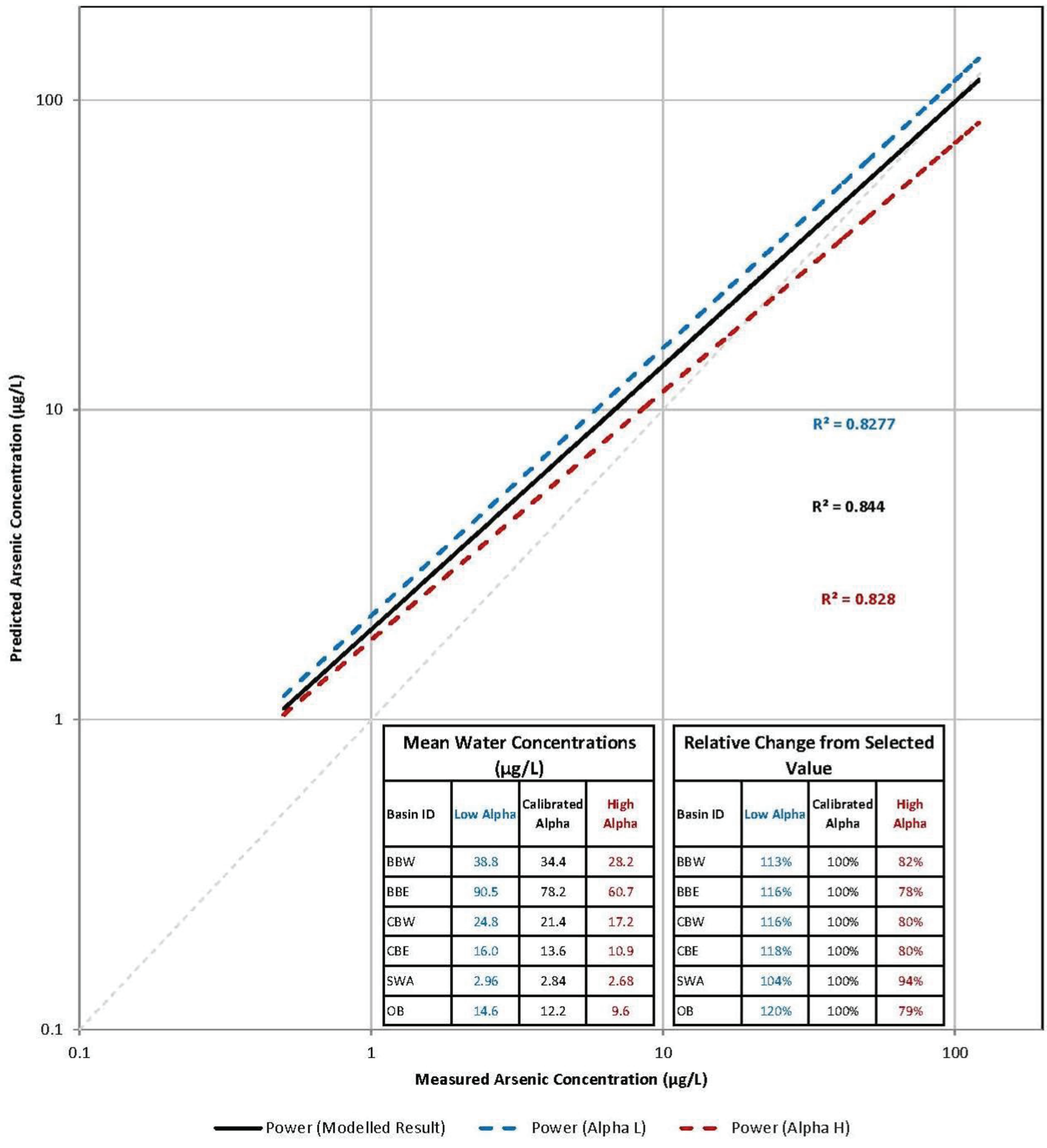
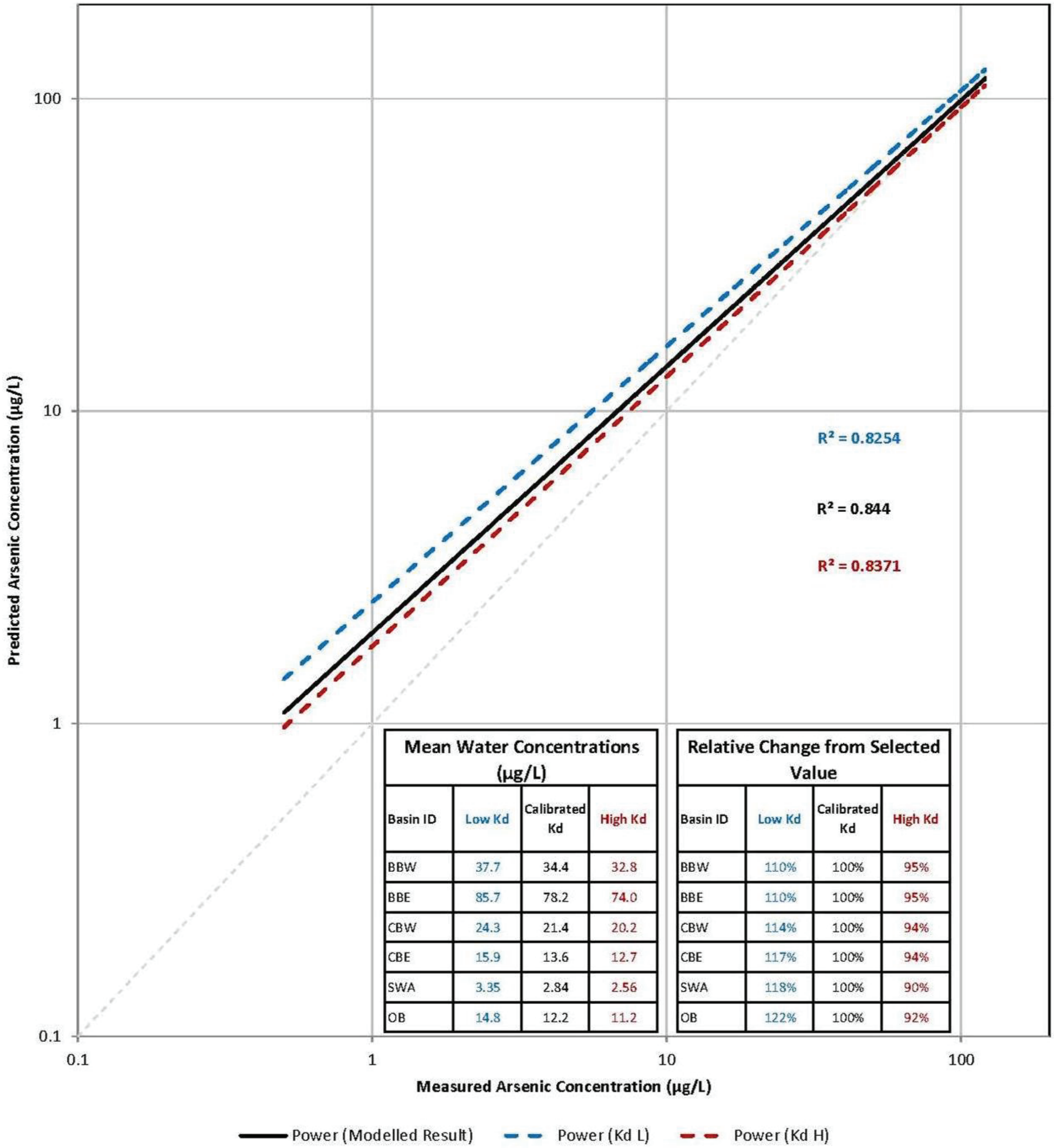


Mean Water Concentrations (µg/L)			
Basin ID	Low Alpha	Calibrated Alpha	High Alpha
BBW	38.8	34.4	28.2
BBE	90.5	78.2	60.7
CBW	24.8	21.4	17.2
CBE	16.0	13.6	10.9
SWA	2.96	2.84	2.68
OB	14.6	12.2	9.6

Relative Change from Selected Value			
Basin ID	Low Alpha	Calibrated Alpha	High Alpha
BBW	113%	100%	82%
BBE	116%	100%	78%
CBW	116%	100%	80%
CBE	118%	100%	80%
SWA	104%	100%	94%
OB	120%	100%	79%

Predicted vs Measured Arsenic Concentrations in Water – Sensitivity to Alpha Value	Scale:		Job No.:	Figure No.:	Stantec
	n/a		160961223	10	
	Date:	Dwn By:	Appd. By:		
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS		



Mean Water Concentrations (µg/L)			
Basin ID	Low Kd	Calibrated Kd	High Kd
BBW	37.7	34.4	32.8
BBE	85.7	78.2	74.0
CBW	24.3	21.4	20.2
CBE	15.9	13.6	12.7
SWA	3.35	2.84	2.56
OB	14.8	12.2	11.2

Relative Change from Selected Value			
Basin ID	Low Kd	Calibrated Kd	High Kd
BBW	110%	100%	95%
BBE	110%	100%	95%
CBW	114%	100%	94%
CBE	117%	100%	94%
SWA	118%	100%	90%
OB	122%	100%	92%

Predicted vs Measured Arsenic Concentrations in Water – Sensitivity to Kd Value	Scale:		Job No.:	Figure No.:
	n/a		160961223	11
	Date:	Dwn By:	Appd. By:	
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS	

Stantec

The effect of increasing or decreasing values of Kd_{As} are shown in Figure 11, together with the results of the calibrated model, when compared to the measured total arsenic concentrations in lake water between 2013 and 2016. Lower values of Kd_{As} result in slightly higher predicted total arsenic concentrations in the lake water (i.e., a positive bias). Higher values of Kd_{As} resulted in slightly lower predicted total arsenic concentrations in the lake water. Overall, the model sensitivity to variation in values of Kd_{As} was moderate, ranging from -5% to +10% in BBE, to -8% to +22% in OB. These results reflect both variation in the calibrated values of Kd_{As} (ranging from 1 m^3/kg in OB to 3.0 m^3/kg in BBE), and the high total arsenic concentrations in the sediments of BBE.

3.2.5 Sedimentation Rate

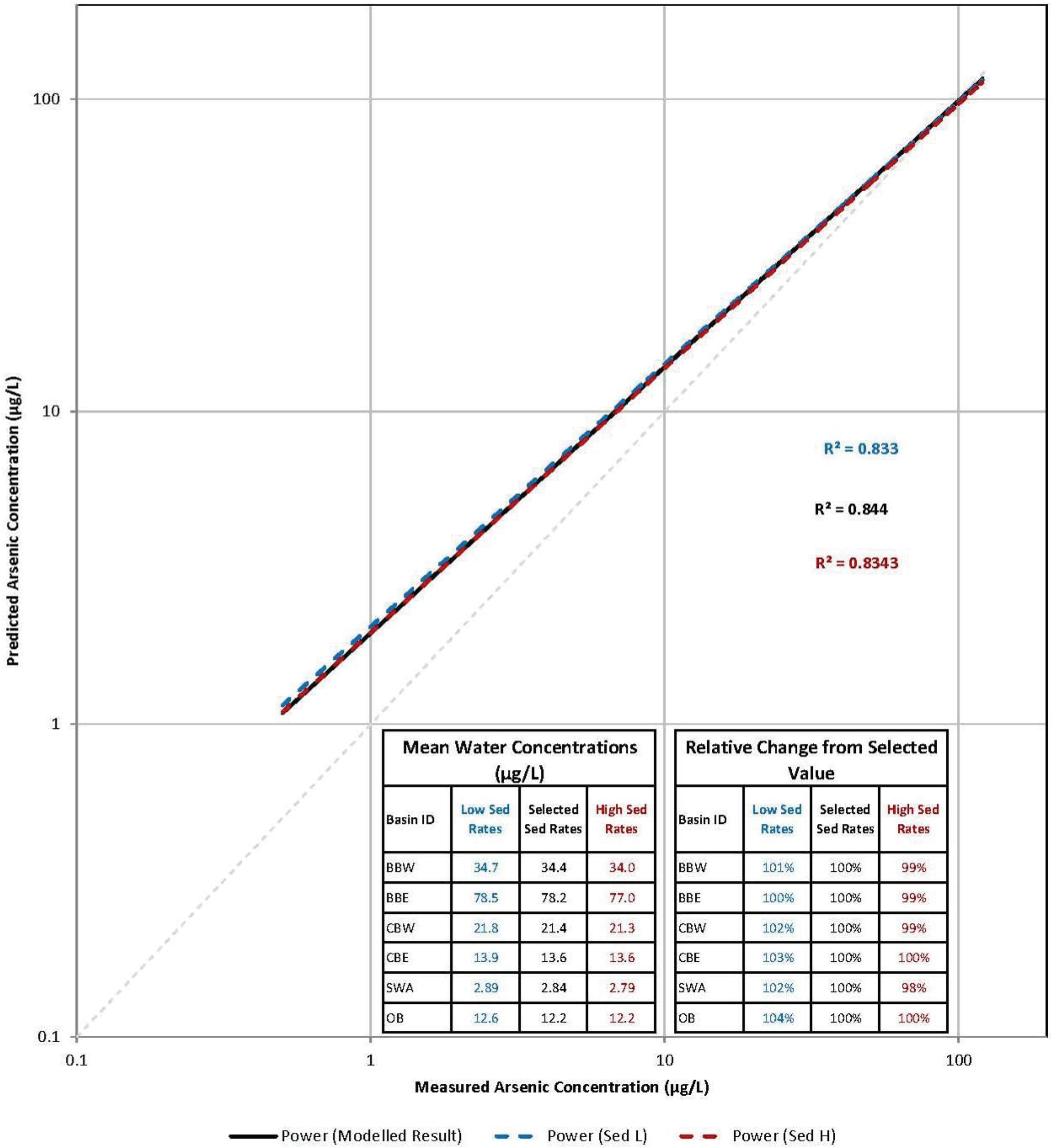
The sedimentation rate is the rate at which dry sediment accumulates on the lake bed (kg/m^2/y). This rate is not explicitly known for the sub-basins of Kenogamisis Lake. As a result, the geometric mean sedimentation rate for Canadian Shield lakes (i.e., 0.16 kg/m^2/y) was adopted from Bird et al. (1993). Bird et al. (1993) reported that this value has a geometric standard deviation (SD) of 2.48. Allowing the sedimentation rate to vary by ±1 SD resulted in adjusted sedimentation rates of 0.065 to 0.40 kg/m^2/y. To be meaningful, adjustments to the sedimentation rate were applied to the entire STELLA™ model simulation (i.e., from 1920 to the present day), and not just to the period between 2006 and 2017. However, the effects of adjusting the sedimentation rate were evaluated with reference to present-day conditions (as reported by Parks Environmental Inc. 2012).

The effects of increasing or decreasing sedimentation rate on water quality predictions are shown in Figure 12, together with the results of the calibrated model, when compared to the measured total arsenic concentrations in lake water between 2013 and 2017. The sedimentation rate is not directly involved in estimating the total arsenic concentration in lake water. However, it has a small indirect effect, as a higher sedimentation rate would lower the total arsenic concentration in sediment, and this in turn would reduce the expected arsenic concentration in the sediment pore water and the return flux of arsenic by diffusion from sediment to water. Thus, as expected, lower sedimentation rates result in slightly higher predicted total arsenic concentrations in the lake water. Higher sedimentation rate values resulted in slightly lower predicted total arsenic concentrations in the lake water. However, the sensitivity of the model water quality predictions to variation in sedimentation rate is almost negligible.

The effect of increasing or decreasing sedimentation rate on predicted sediment arsenic concentrations is shown in Figure 13. Higher sedimentation rates provide "dilution" to the mass of arsenic transferred from water to sediment, and more rapid movement of sediments down into the sediment profile. This results in slightly lower arsenic concentrations in the sediment profile, but deeper penetration of arsenic into the sediment. Lower sedimentation rates result in higher predicted sediment arsenic concentrations, and less penetration of arsenic into the sediment. As shown in Figure 13, the effect of varying the sedimentation rate on predicted surface sediment arsenic concentrations is modest, ranging from -10% to +4% in CBE, to -14% to +6% in BBW.

As was noted previously, the predicted sediment arsenic concentrations tend to be slightly under-predicted by the model, and this could result from one or more factors (i.e., imperfect calibration; under-estimated total arsenic loadings; under-estimated water to sediment transfer rates; over-estimated sedimentation rate; under-estimated water to sediment partition coefficient). However, the STELLA™ model predictions lie within the range of observed values within each sub-basin, and provide good prediction of the relative average arsenic concentration in each sub-basin.

At this point, the model was judged to be ready for detailed calibration against measured data obtained during the period 2001 to 2011, followed by validation against data collected during the period 2013 to 2016.



Mean Water Concentrations (µg/L)			
Basin ID	Low Sed Rates	Selected Sed Rates	High Sed Rates
BBW	34.7	34.4	34.0
BBE	78.5	78.2	77.0
CBW	21.8	21.4	21.3
CBE	13.9	13.6	13.6
SWA	2.89	2.84	2.79
OB	12.6	12.2	12.2

Relative Change from Selected Value			
Basin ID	Low Sed Rates	Selected Sed Rates	High Sed Rates
BBW	101%	100%	99%
BBE	100%	100%	99%
CBW	102%	100%	99%
CBE	103%	100%	100%
SWA	102%	100%	98%
OB	104%	100%	100%

Predicted vs Measured Arsenic Concentrations in Water – Sensitivity to Sedimentation Rate	**Scale:**		**Job No.:**	**Figure No.:**	Stantec
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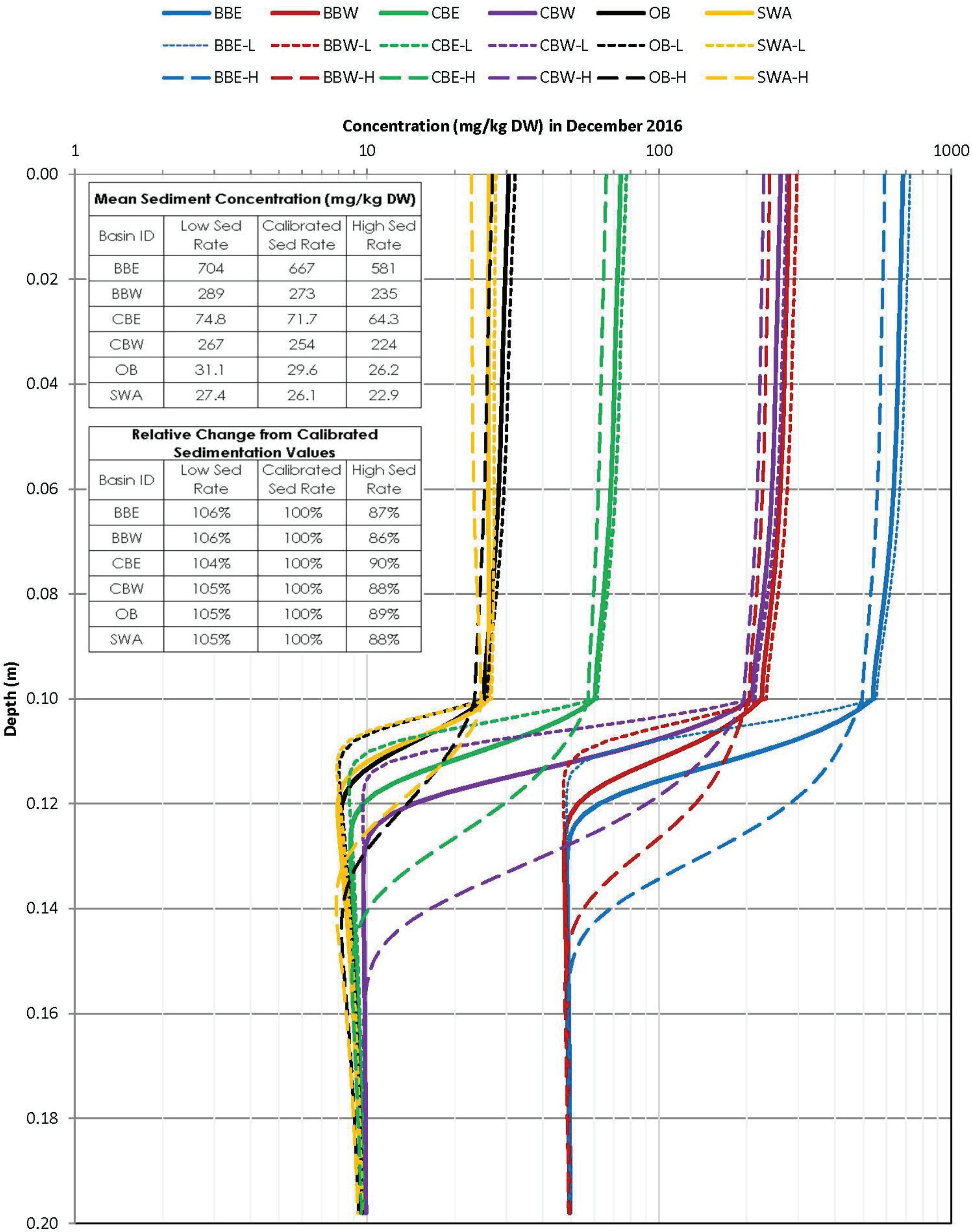
	Date:	**Dwn By:**	**Appd. By:**		
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS		



Mean Sediment Concentration (mg/kg DW)			
Basin ID	Low Sed Rate	Calibrated Sed Rate	High Sed Rate
BBE	704	667	581
BBW	289	273	235
CBE	74.8	71.7	64.3
CBW	267	254	224
OB	31.1	29.6	26.2
SWA	27.4	26.1	22.9

Relative Change from Calibrated Sedimentation Values			
Basin ID	Low Sed Rate	Calibrated Sed Rate	High Sed Rate
BBE	106%	100%	87%
BBW	106%	100%	86%
CBE	104%	100%	90%
CBW	105%	100%	88%
OB	105%	100%	89%
SWA	105%	100%	88%

Predicted Sediment Arsenic Concentrations – Sensitivity to Sedimentation Rate	Scale:		Job No.:	Figure No.:	Stantec
	n/a		160961223	13	
	Date:	Dwn By:	Appd. By:		
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS		

4.0 DETAILED MODEL CALIBRATION USING DATA FROM 2001 TO 2011

Reports by Parks Environmental Inc. (2011, 2012) provide historical data on arsenic concentrations in the water and sediments of the six sub-basins of Kenogamisis Lake, over the period from 1997 to 2011 (water quality), and in the fall of 2011 (sediment). Water quality data for the 10-year period between 2001 and 2011 were selected for the purpose of detailed calibration, due to concern about the quality of the earliest data, as well as the appropriateness of applying arsenic loading estimates for the period 2013 to 2016 retrospectively to the lake prior to the year 2000.

Starting with the initial model calibration, additional iterative rounds of manual model calibration were conducted to optimize the model fit to the measured water and sediment quality data. Parameter values subject to adjustment in the detailed calibration process included the water to sediment transfer rate for arsenic (a_{As}), the sediment partition coefficient for arsenic (Kd_{As}), the apparent rate of diffusion of arsenic from water to sediment (reflecting bioturbation and possible wind resuspension of sediment), and the rate of water exchange by dispersion across the boundary between sub-basins CBW and CBE. The results of the calibration were judged using regression analysis of the predicted and measured total arsenic concentrations in water (with predicted values being extracted from the STELLA™ model on the same model year and day as the actual water sample collection); and using regression analysis of the predicted arsenic concentration in the surface 5 cm of sediment against the average arsenic concentration measured in sediment grab and core samples by Parks Environmental Inc. (2012). Consideration was also given to the minimum, mean, and maximum predicted arsenic concentrations in lake water, when compared to the 5th percentile, mean, and 95th percentile of measured values from Parks Environmental Inc. (2011).

Concerning the measured water quality data over the period 2001 to 2011 (Parks Environmental Inc. 2011), three observations of very low arsenic concentrations were deleted from the data set as outliers. These three observations were collected in water samples collected in early spring, and were inferred to represent samples dominated by melting ice, rather than well mixed lake water.

Three calibration rounds were performed, after which it found that additional calibration efforts did not produce material improvement in model fit to the observed water and sediment quality data. The final calibration values for the STELLA™ model are presented in Table 7.

Table 7 Final Calibration Values for the STELLA™ Model of Arsenic in Kenogamisis Lake

Parameter	BBW	BBE	CBW	CBE	SWA	OB
Sedimentation Rate ($kg/m^2/y$)	0.16	0.16	0.16	0.16	0.16	0.16
Initial sediment As concentration (mg/kg)	50	50	10	10	10	10
Kd_{AS} (m^3/kg)	3	3.5	3	2	1.5	1.5
α_{AS} (y^{-1})	4	4	3	2.5	2	2
Diffusive flux multiplier	1x when lake is ice-covered; 3x during open water season					

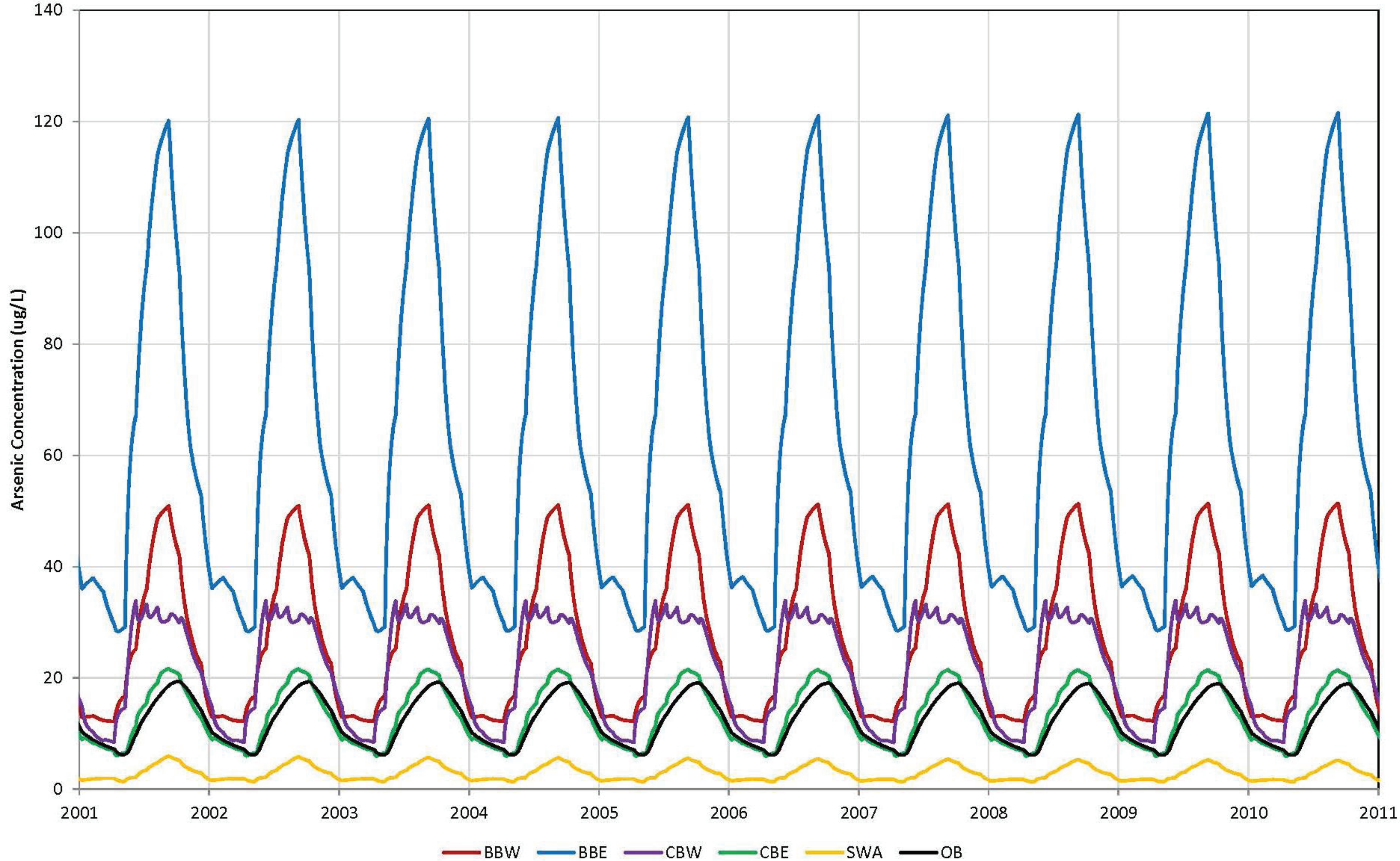
4.1 RESULTS OF DETAILED CALIBRATION

Table 8 shows the range (minimum, mean and maximum) of model predictions for arsenic concentrations in the water of Kenogamisis Lake during the period 2001 to 2011, alongside the range of observed values in each sub-basin (data from Parks Environmental Inc. 2011).

Table 8 Modelled and Measured Range of Arsenic Concentrations in Kenogamisis Lake, 2001 – 2011

Sub-Basin	Model Predicted Values (µg/L)			Measured Values (µg/L)		
	Minimum	Mean	Maximum	5^{th} Percentile	Mean	95^{th} Percentile
BBW	12.2	27.1	51.5	9.8	36.9	84.4
BBE	28.3	65.2	122	15.9	61.1	131
CBW	8.4	22.0	33.9	10.5	28.3	57.3
CBE	5.9	13.0	21.7	4.8	15.8	37.3
SWA	1.3	2.9	6.0	2.0	5.0	8.2
OB	6.1	12.3	19.4	3.7	12.4	26.1
Measured data from Parks Environmental Inc., (2011)						

Figure 14 shows the range and patterns of seasonal variation in modelled arsenic concentrations in water, over the period 2001 to 2011. These patterns, with annual minima in the spring, and annual maxima in the late summer, are consistent with patterns observed in the measured water quality data (see Figure 5).



Predicted Arsenic Concentrations in Water 2001-2011	**Scale:** n/a		**Job No.:** 160961223	**Figure No.:** 14	Stantec
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS		
Client: Greenstone Gold Mines GP Inc.					

Figure 15 shows the regression analysis of log-transformed modelled and measured arsenic concentrations in lake water, for the six sub-basins of Kenogamisis Lake, between 2001 and 2011. The slope of the regression line is 0.91, slightly less than 1. The regression line lies above the 1:1 line at measured arsenic concentrations less than about 40 µg/L, transitioning to lie slightly below the 1:1 line at higher concentrations. The adjusted r^2 value for the regression is 0.79 (good), indicating that the model accounts for 79% of the variation in measured total arsenic concentrations in water, across the six sub-basins, and over a period of 10 years. The Mean Square Error of the regression analysis is 0.049, and the Standard Error of the Estimate (Root Mean Square Error) is 0.220. Table 9 provides the details of the regression analysis for arsenic concentrations in water.

Figure 15 displays the empirically measured values for arsenic concentrations in water (the X-axis), as a function of the model predictions (the Y-axis). A dashed diagonal line shows the 1:1 relationship between predicted and measured values. The best-fit linear regression representing the predicted and measured arsenic values is shown as a straight red line (the Estimate line). Two dark blue lines show the lower confidence limit (LCL) and upper confidence limit (UCL), indicating the 95% confidence interval for the best-fit regression. The lower prediction limit (LPL) and upper prediction limit (UPL) represent the 95% prediction interval for the scatter of individual data points represented in the regression. Put simply, if there were 100 data points in the regression analysis, one would expect about 5 to fall outside these limits. Further information on this statistical terminology, as well as the underlying statistical methods, can be found in standard texts (e.g., Ostle and Mensing 1975).

Table 9 Regression Statistics for Measured (2001 through 2011 data) and Predicted Total Arsenic Concentrations in Kenogamisis Lake Water (n = 117 paired data points)

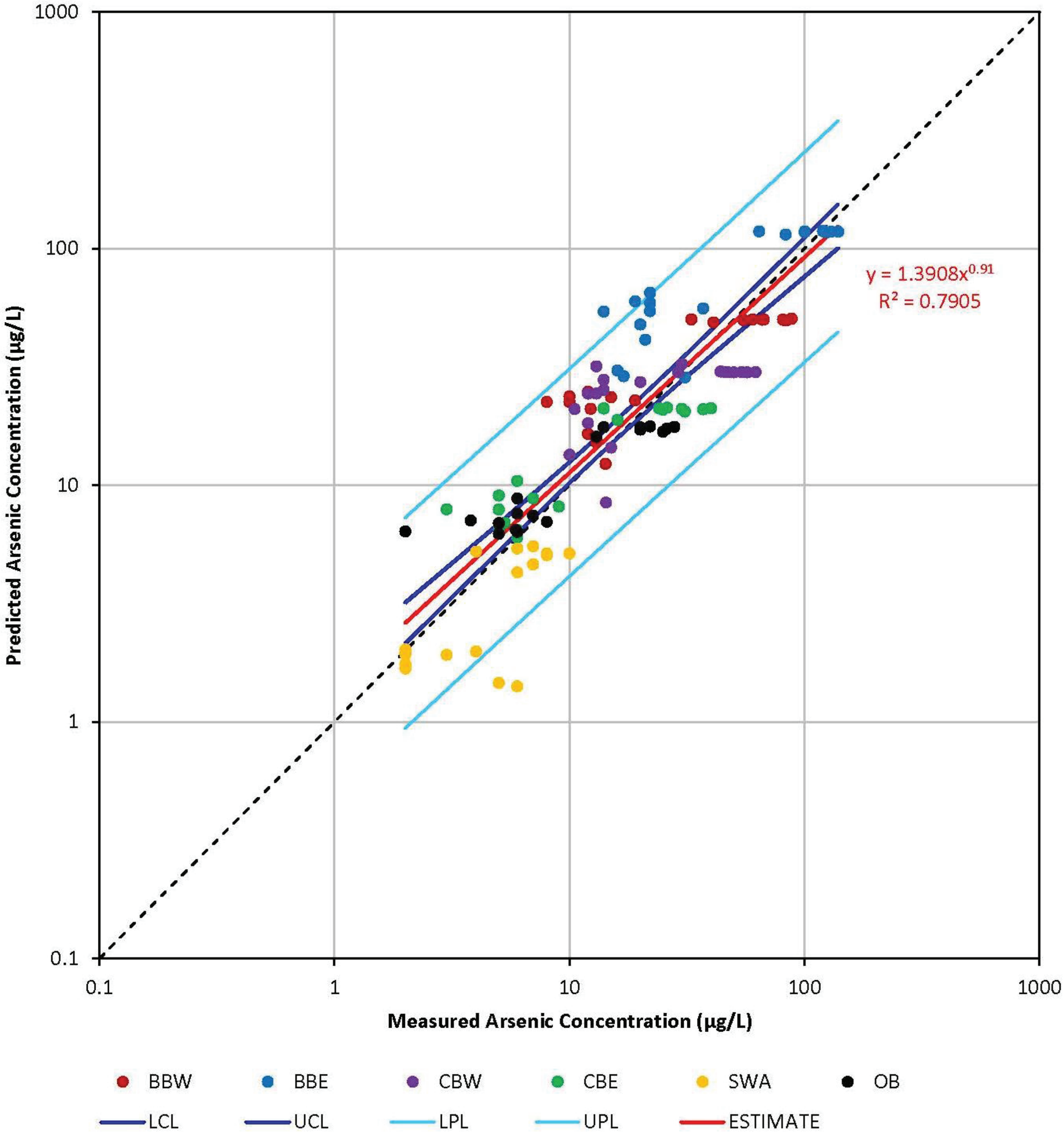
Effect	Coefficient	Standard Error	t	p-value	
Constant	0.143	0.056	2.576	0.011	
Log Measured Arsenic	0.910	0.044	20.829	<0.001	
Analysis of Variance					
Source	**Sum of Squares**	**Degrees of Freedom**	**Mean Square**	**F-ratio**	**p-value**
Regression	21.055	1	21.055	433.86	<0.001
Residual	5.581	115	0.049		

Figure 16 shows the simulated core profiles for the average arsenic concentration in lake sediments for the six sub-basins of Kenogamisis Lake. The results for the surface (0 to 5 cm) sediments are presented in context with the results for individual grab and core samples (data from Parks Environmental Inc. 2012) in Figure 17, along with the measured and predicted mean sediment arsenic concentrations (inset in Figure 17). Figure 18 shows the regression of the mean predicted and measured arsenic concentrations in sediment for the six sub-basins. The slope of this regression is not significantly different from 1, indicating very little bias in the model predictions. The adjusted r^2 value for the regression is 0.97 (excellent), indicating that the model accounts for 97% of the variation in mean total arsenic concentrations in sediment. The Mean Square Error of the regression is 0.008, and the Standard Error of the Estimate (Root

Mean Square Error) is 0.092. Table 10 provides the details of the regression analysis for arsenic concentrations in sediment.

Table 10 Regression Statistics for Measured (2011 data) and Predicted Mean Arsenic Concentrations in Kenogamisis Lake Sediment (n = 6 paired data points)

Effect	Coefficient	Standard Error	t	p-value	
Constant	0.295	0.162	1.823	0.142	
Log Measured Arsenic	0.887	0.074	12.023	<0.001	
Analysis of Variance					
Source	**Sum of Squares**	**Degrees of Freedom**	**Mean Square**	**F-ratio**	**p-value**
Regression	1.224	1	1.224	144.56	<0.001
Residual	0.034	4	0.008		



Regression of Predicted vs. Measured Values for As in Water 2001-2011	Scale:		Job No.:	Figure No.:
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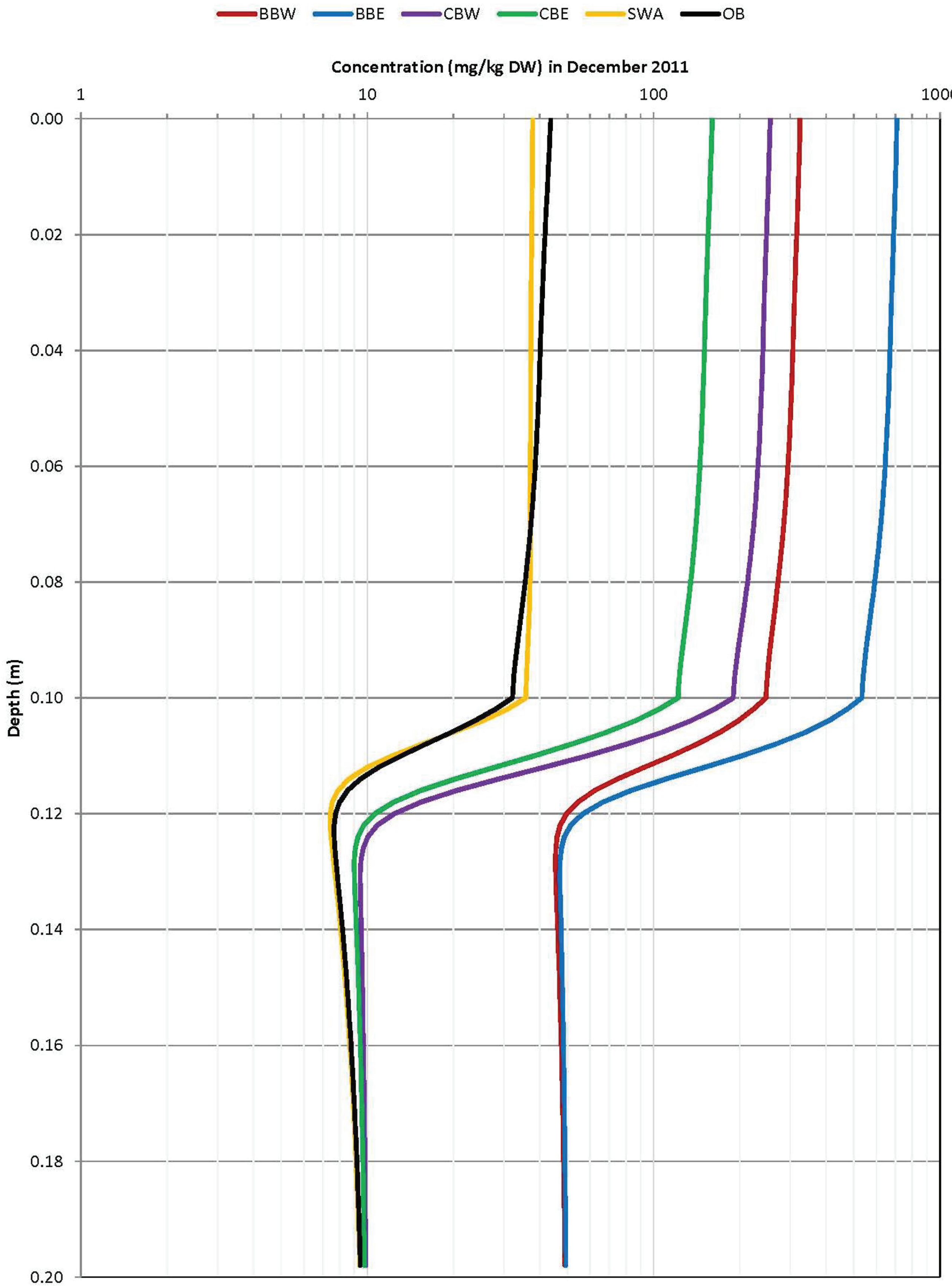
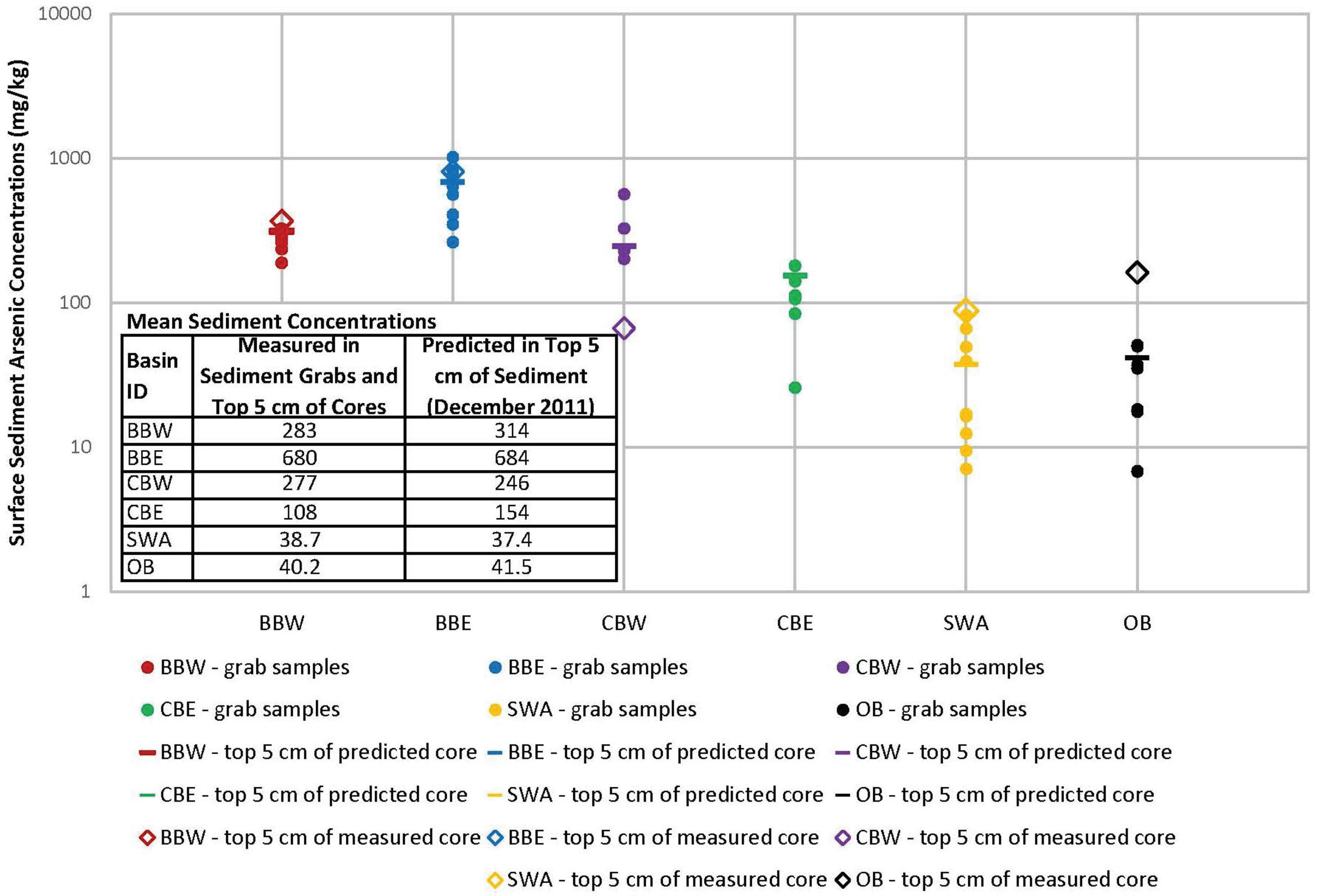
	Date:	Dwn By:	Appd. By:	
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS	



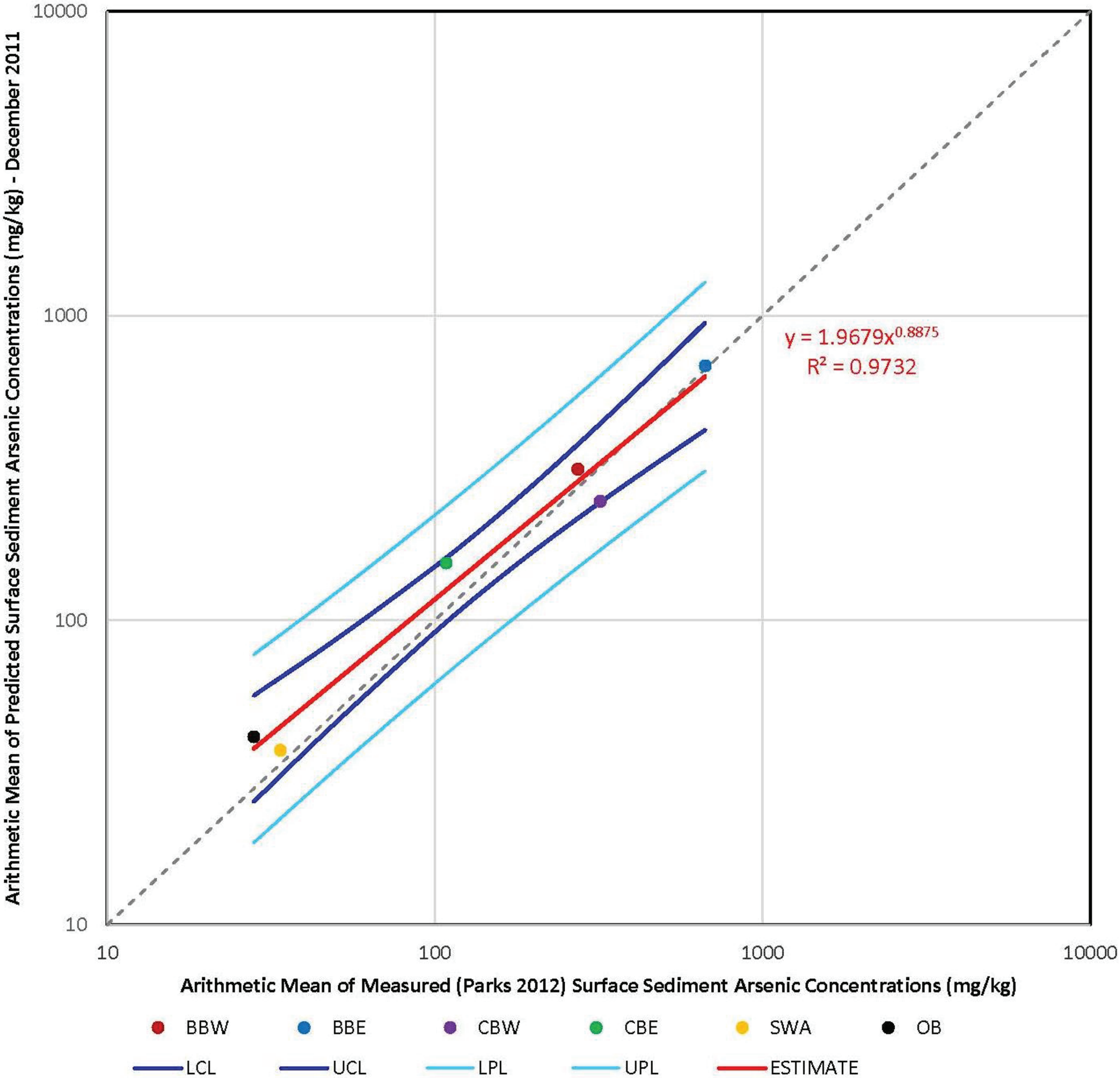
Predicted Total Arsenic Concentrations in Sediment (mg/kg) by 2011	Scale:	Job No.:	Figure No.:
	n/a	160961223	16
	Date: January 30, 2018	Dwn By: PM / Appd. By: MS	
Client: Greenstone Gold Mines GP Inc.			Stantec



Mean Sediment Concentrations

Basin ID	Measured in Sediment Grabs and Top 5 cm of Cores	Predicted in Top 5 cm of Sediment (December 2011)
BBW	283	314
BBE	680	684
CBW	277	246
CBE	108	154
SWA	38.7	37.4
OB	40.2	41.5

Mean Surface Sediment Arsenic Concentration Comparison, 2011	Scale: n/a	Job No.: 160961223	Figure No.: 17	Stantec
Client: Greenstone Gold Mines GP Inc.	Date: January 30, 2018	Dwn By: PM	Appd. By: MS	



Predicted vs. Measured Arsenic in Sediment, 2011	Scale:	Job No.:		Figure No.:	Stantec
	n/a	160961223		18	
	Date:	Dwn By:	Appd. By:		
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS		

5.0 MODEL VALIDATION USING DATA FROM 2013 TO 2016

Model validation was implemented by using the calibrated model to simulate a second set of water and sediment quality data, collected between 2013 and 2016 by Stantec (Stantec 2017). The water quality data were collected on a more frequent basis (i.e., generally monthly except in "shoulder seasons" when ice formation or melt made the lake inaccessible) between 2013 and 2016 than was the case for the earlier sampling program. However, the sediment sampling programs (2014 and 2016) were more targeted on characterizing "hotspots" in BBW and BBE, and "background" conditions in SWA, and as such, the data are less representative of "average" conditions within each sub-basin than was the case for the data reported by Parks Environmental Inc. (2012).

Table 11 shows the range (minimum, mean and maximum) of model predictions for arsenic concentrations in the water of Kenogamisis Lake during the period 2013 to 2016, alongside the range of observed values in each sub-basin (data from Stantec 2017).

Table 11 Modelled and Measured Range of Arsenic Concentrations in Kenogamisis Lake, 2013 – 2016

Sub-Basin	Model Predicted Values (µg/L)			Measured Values (µg/L)		
	Minimum	Mean	Maximum	5'th Percentile	Mean	95'th Percentile
BBW	12.3	27.3	51.8	10.0	28.2	83.0
BBE	28.6	65.8	123	16.9	41.0	125
CBW	8.4	22.0	34.0	11.9	20.8	54.3
CBE	5.9	12.9	21.4	5.0	10.4	31.9
SWA	1.3	2.7	5.1	2.0	3.5	8.0
OB	6.1	12.2	18.9	2.0	8.3	25.1

Note:
Measured data from Stantec (2017)

Figure 19 shows the regression analysis of log-transformed modelled and measured arsenic concentrations in lake water, for the six sub-basins of Kenogamisis Lake, between 2001 and 2011. The slope of the regression line is 0.90, slightly less than 1. However, the regression line lies above the 1:1 line on the graph throughout the relevant range of arsenic concentrations (<1 to >100 µg/L), indicating that the model predictions are on average slightly conservative relative to the measured data. The adjusted r^2 value for the regression is 0.88 (very good), indicating that the model accounts for 88% of the variation in measured total arsenic concentrations in water, across the six sub-basins, and over a period of 4 years. The Mean Square Error of the regression is 0.032, and the Standard Error of the Estimate (Root Mean Square Error) is 0.180. Table 12 provides the details of the regression analysis for arsenic concentrations in water.

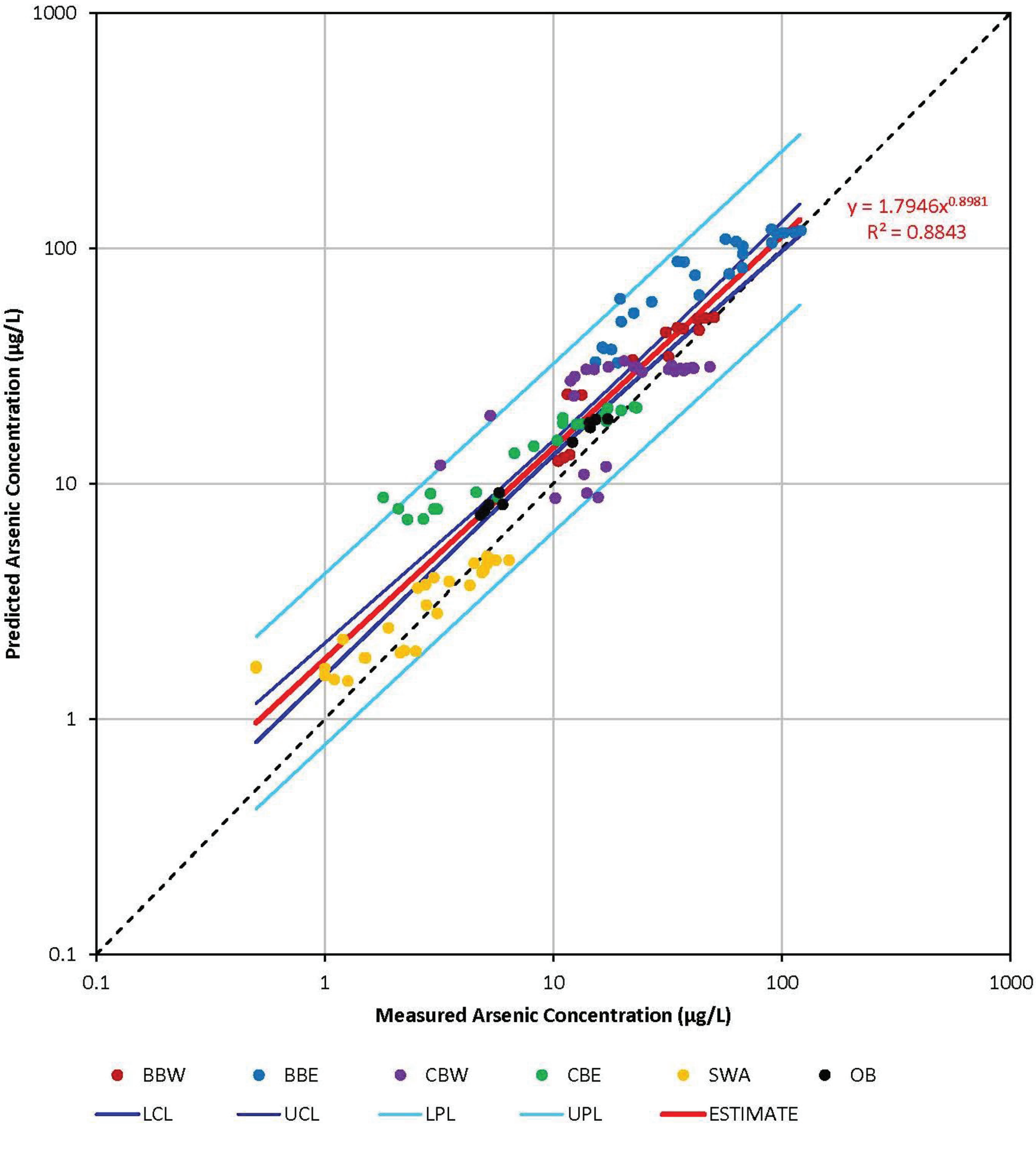
Table 12 Regression Statistics for Measured (2013 through 2016 data) and Predicted Total Arsenic Concentrations in Kenogamisis Lake Water (n = 131 paired data points)

Effect	**Coefficient**	**Standard Error**	**t**	**p-value**	
Constant	0.254	0.034	7.509	<0.001	
Log Measured Arsenic	0.898	0.029	31.402	<0.001	
Analysis of Variance					
Source	**Sum of Squares**	**Degrees of Freedom**	**Mean Square**	**F-ratio**	**p-value**
Regression	31.938	1	31.938	986.08	<0.001
Residual	4.178	129	0.032		

The model results for arsenic concentrations in the surface (0 to 5 cm) sediments are presented in context with the results for individual grab samples (data from Stantec 2017) in Figure 19, along with the measured and predicted mean sediment arsenic concentrations (inset in Figure 20). Figure 21 shows the regression of the mean predicted and measured arsenic concentrations in sediment for the six sub-basins. The slope of this regression is not significantly different from 1, indicating very little bias in the model predictions. The adjusted r^2 value for the regression is 0.86 (very good), indicating that the model accounts for 86% of the variation in mean total arsenic concentrations in sediment. The Mean Square Error of the regression is 0.047, and the Standard Error of the Estimate (Root Mean Square Error) is 0.218. Table 13 provides the details of the regression analysis for arsenic concentrations in sediment.

Table 13 Regression Statistics for Measured (2013 through 2016 data) and Predicted Mean Arsenic Concentrations in Kenogamisis Lake Sediment (n = 6 paired data points)

Effect	**Coefficient**	**Standard Error**	**t**	**p-value**	
Constant	0.162	0.419	0.388	0.718	
Log Measured Arsenic	0.975	0.198	4.927	0.008	
Analysis of Variance					
Source	**Sum of Squares**	**Degrees of Freedom**	**Mean Square**	**F-ratio**	**p-value**
Regression	1.151	1	1.151	24.28	0.008
Residual	0.19	4	0.147		



Predicted vs. Measured Arsenic in Water, 2011	Scale:		Job No.:	Figure No.:
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	Date:	Dwn By:	Appd. By:	
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS	

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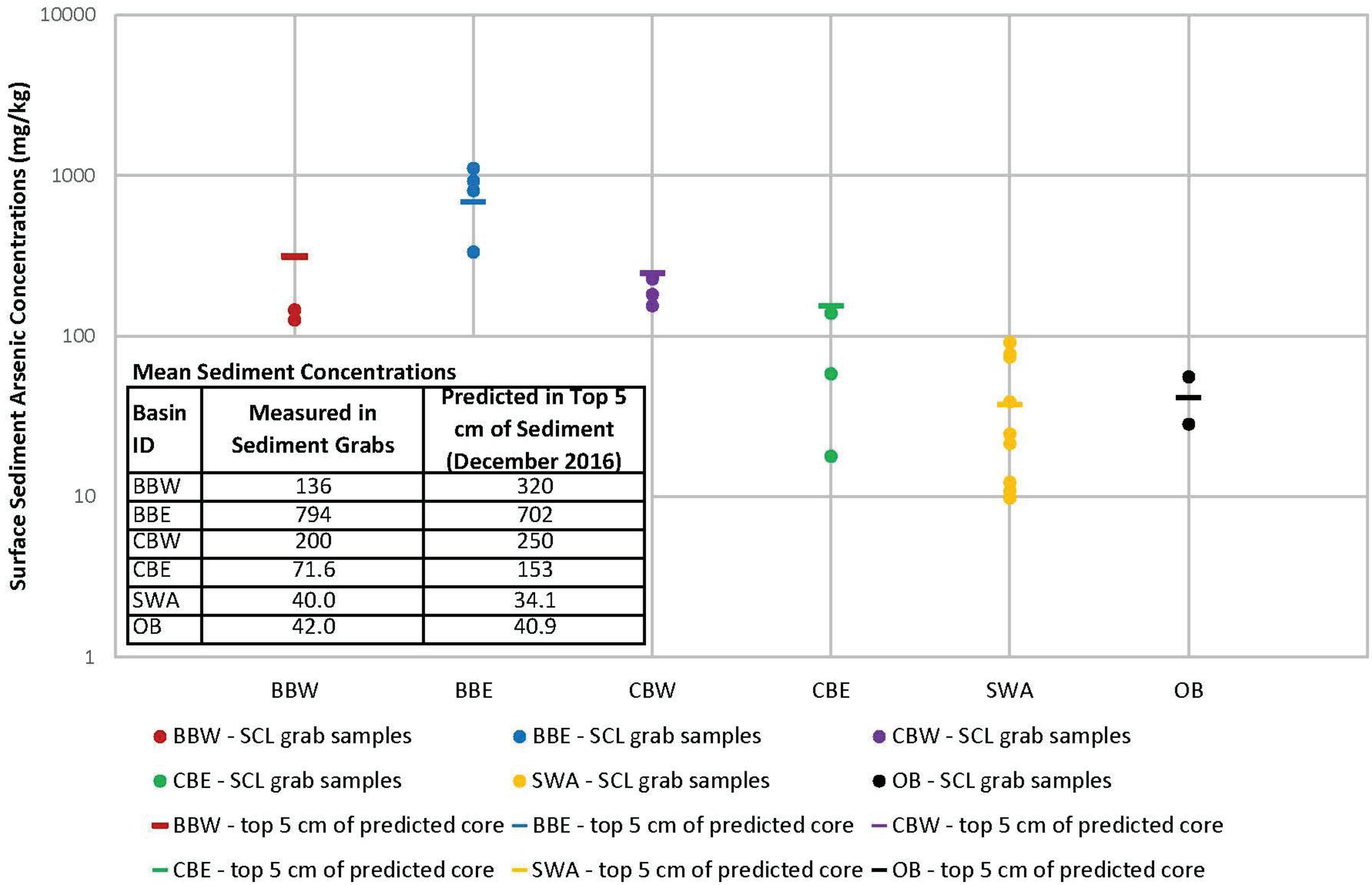
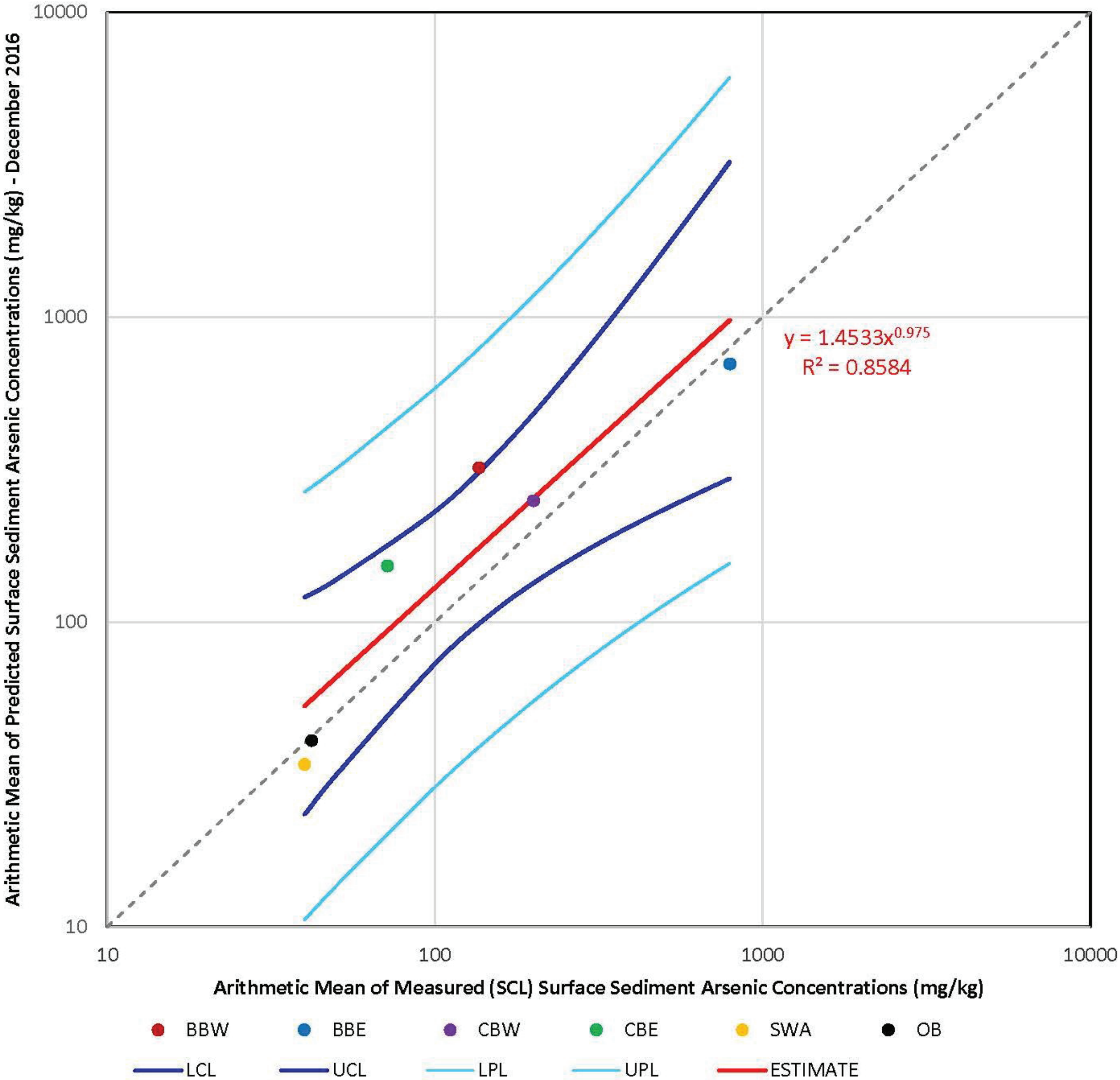


Mean Sediment Concentrations

Basin ID	Measured in Sediment Grabs	Predicted in Top 5 cm of Sediment (December 2016)
BBW	136	320
BBE	794	702
CBW	200	250
CBE	71.6	153
SWA	40.0	34.1
OB	42.0	40.9

Mean Surface Sediment Arsenic Concentration Comparison, 2013-2016	Scale: n/a	Job No.: 160961223	Figure No.: 20	Stantec
Client: Greenstone Gold Mines GP Inc.	Date: January 30, 2018	Dwn By: PM	Appd. By: MS	



Predicted vs. Measured Arsenic in Sediment, 2013-2016	Scale: n/a	Job No.: 160961223		Figure No.: 21	Stantec
	Date: January 30, 2018	Dwn By: PM	Appd. By: MS		
Client: Greenstone Gold Mines GP Inc.					

The prediction of arsenic concentrations in water is substantially improved in the validation data set, relative to the calibration data set. This improvement may be explained by one or more factors, including:

- The water quality measurements were more frequent (generally monthly except during shoulder seasons) during the period from 2013 to 2016, whereas sampling frequency between 2001 and 2011 was generally seasonal (spring and fall). This resulted in a more continuous distribution of points in the regression analysis between 2013 and 2016 than was the case for the period 2001 to 2011.
- Arsenic concentrations in the water of Kenogamisis Lake appear to have decreased slightly between 2001 and 2016. This may reflect a slight reduction in total arsenic loading to the lake over the same period of time.
- The arsenic loadings used in the STELLA™ model are based on measurements made between 2013 and 2016, which was the time period used as the validation data set.

Figure 22 presents the regression for all of the predicted and measured arsenic concentrations in water over the period from 2001 to 2016. The adjusted r^2 value for this regression is 0.84 (very good). The Mean Square Error of the regression is 0.042, and the Error of the Estimate (Root Mean Square Error) is 0.205. The slope of the regression line is 0.89, lying above the 1:1 line throughout the relevant data range (indicating that the model predictions are on average slightly conservative), becoming unbiased at predicted arsenic concentrations of about 100 µg/L. However, the degree of conservatism is generally minor. Table 14 provides the details of the combined regression analysis for arsenic concentrations in water.

Table 14 Regression Statistics for Measured (2001 through 2016 data combined) and Predicted Total Arsenic Concentrations in Kenogamisis Lake Water (n = 248 paired data points)

Effect	Coefficient	Standard Error	t	p-value
Constant	0.217	0.031	7.029	<0.001
Log Measured Arsenic	0.890	0.025	35.338	<0.001

Analysis of Variance

Source	Sum of Squares	Degrees of Freedom	Mean Square	F-ratio	p-value
Regression	52.462	1	52.462	1,248.75	<0.001
Residual	10.335	246	0.042		

The prediction of arsenic concentrations in sediment is somewhat degraded in the validation data set, relative to the calibration data set. This decline in precision is attributable to the targeted collection of sediment samples between 2013 and 2016 (i.e., sampling that focused on identifying "hotspots" in BBW, BBE and CBW, and the selection of sampling locations in the western end of SWA to serve as "background"). The earlier sediment samples (Parks Environmental Inc. 2012) incorporate less of this type of focus, and may provide a better basis for estimating the average arsenic concentration of sediments within each sub-basin.

Figure 23 presents the regression for the combined sediment quality data sets (2011 to 2016). The slope of this regression is not significantly different from 1, indicating low bias in the model predictions. The adjusted r^2 value for the regression is 0.97 (excellent), indicating that the model accounts for 97% of the variation in mean total arsenic concentrations in sediment. The Mean Square Error of the regression is 0.011, and the Standard Error of the Estimate (Root Mean Square Error) is 0.103. Table 15 provides the details of the regression analysis for arsenic concentrations in sediment.

Table 15 Regression Statistics for Measured (2011 through 2016 data combined) and Predicted Mean Arsenic Concentrations in Kenogamisis Lake Sediment (n = 6 paired data points)

Effect	Coefficient	Standard Error	t	p-value
Constant	0.161	0.187	0.862	0.437
Log Measured Arsenic	0.953	0.086	11.062	<0.001

Analysis of Variance

Source	Sum of Squares	Degrees of Freedom	Mean Square	F-ratio	p-value
Regression	1.298	1	1.298	122.37	<0.001
Residual	0.042	4	0.011		

The regression statistics for water and sediment can be used to derive statistical confidence intervals for prediction of future arsenic concentrations in the lake water. While the STELLA™ model can be used to simulate future conditions in the lake, based on expected changes in arsenic loadings and other conditions, the model predictions (which include seasonal variability) are predictions of the expected concentration at any given time. The uncertainty in future predictions can be expressed based on the empirically-observed uncertainty represented in the regression analyses.

Table 16 provides numeric estimates of the model predicted arsenic concentration at specific expected concentrations, with associated estimates of uncertainty based on the regression analysis. As indicated in Table 16, the predicted values tend to be conservative estimators of the expected values. For example, at an expected value of 25 µg/L, the predicted value from the STELLA™ model would be 28.9 µg/L, with a 95% confidence interval of 27.1 to 31.0 µg/L. Similarly, at an expected concentration of 50 µg/L, the predicted value would be 53.7 µg/L, with a 95% confidence interval of 49.1 to 58.7 µg/L.

Table 16 Predicted Values and 95% Confidence Intervals for Total Arsenic Concentrations (μg/L) in the Water of Kenogamisis Lake

Expected Concentration	Predicted Concentration	95% LCL	95% UCL
1	1.7	1.43	1.90
10	12.8	12.1	13.6
25	28.9	27.1	31.0
50	53.7	49.1	58.7
75	77.0	69.3	85.5
100	99.5	88.4	112
Notes: 95% LCL and 95% UCL represent the 95% confidence interval around the predicted concentrations.			

Table 17 provides numeric estimates of the predicted sediment arsenic concentration at specific expected concentrations, with associated estimates of uncertainty based on the regression analysis. As indicated in Table 17, at an expected value of 250 mg/kg, the predicted value from the model would be 278 mg/kg, with a 95% confidence interval of 207 to 374 mg/kg. Similarly, at an expected concentration of 500 mg/kg, the predicted value would be 532 mg/kg with a 95% confidence interval of 357 to 793 mg/kg.

Table 17 Predicted Values and 95% Confidence Intervals for Total Arsenic Concentrations (mg/kg) in the Sediment of Kenogamisis Lake

Expected Concentration	Predicted Concentration	95% LCL	95% UCL
50	61.7	44.1	86.5
100	118	90.7	154
250	278	207	374
500	532	357	793
1,000	1,020	599	1,730
Notes: 95% LCL and 95% UCL represent the 95% confidence interval around the predicted concentrations.			

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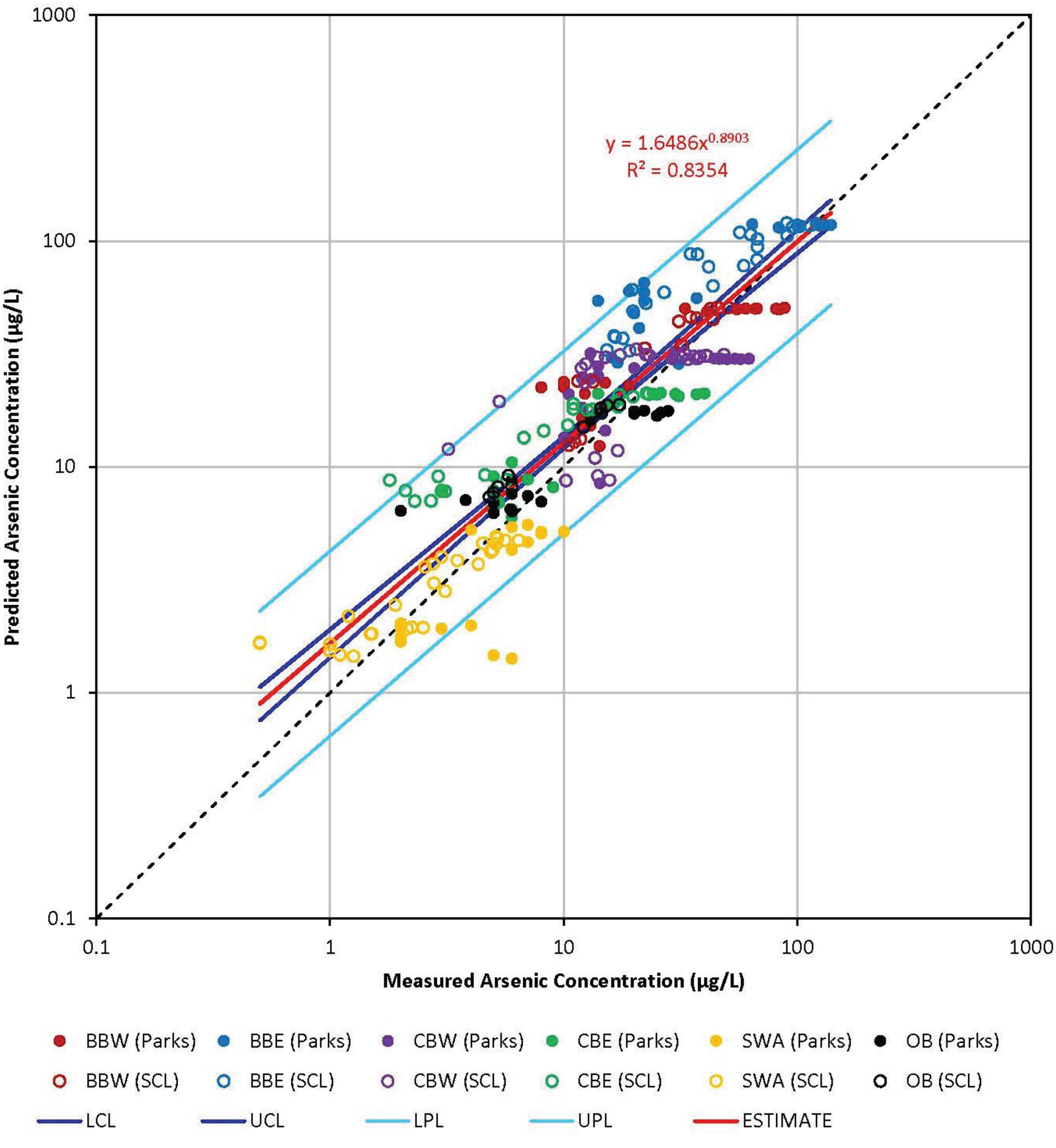
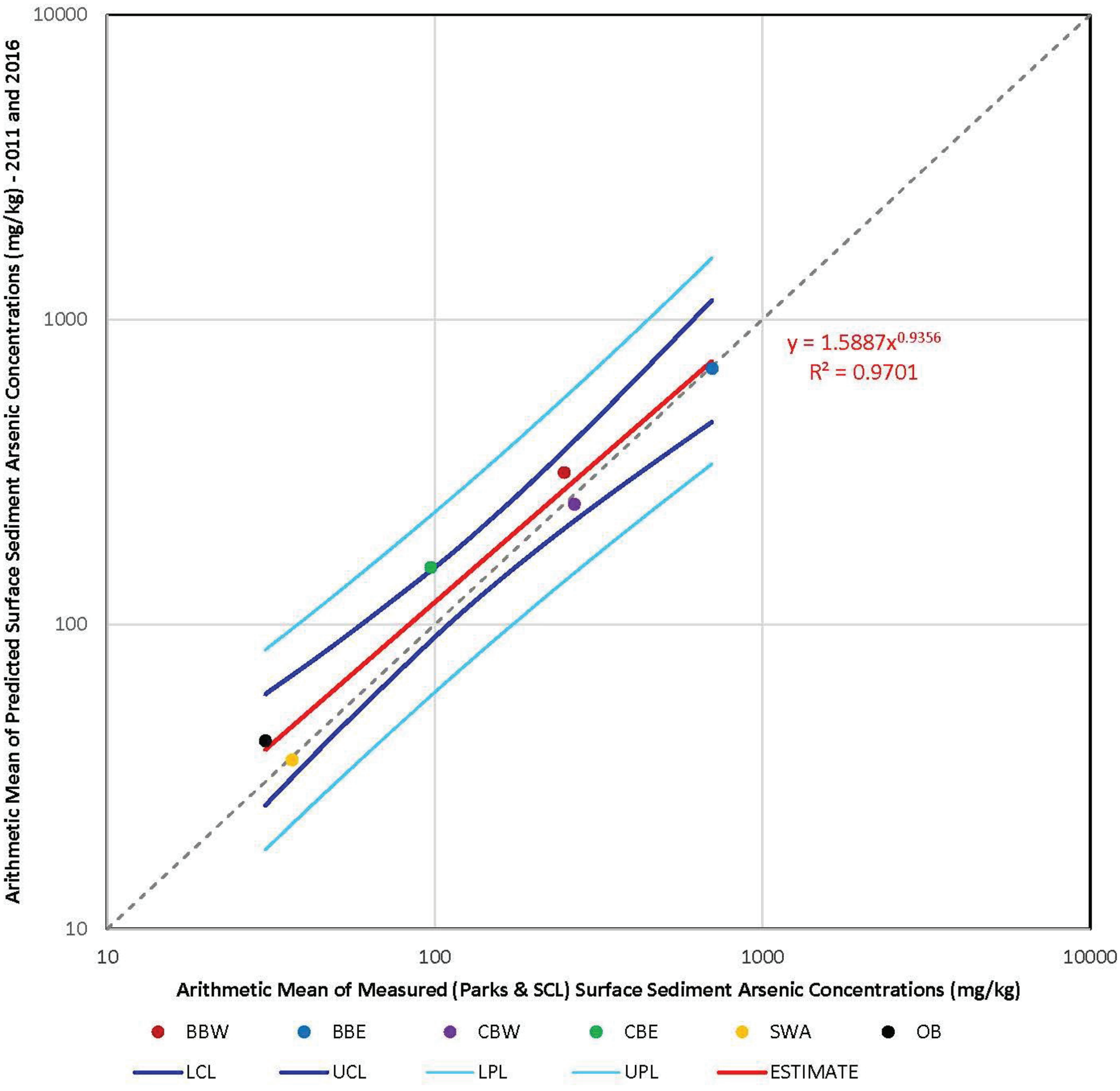


Predicted vs. Measured Arsenic in Water, 2001-2016	Scale: n/a	Job No.: 160961223		Figure No.: 22
	Date: January 30, 2018	Dwn By: PM	Appd. By: MS	
Client: Greenstone Gold Mines GP Inc.				

Stantec



Predicted vs. Measured Arsenic Concentrations in Lake Sediment 2011 – 2016	Scale:		Job No.:	Figure No.:	Stantec
	n/a		160961223	23	
	Date:	Dwn By:	Appd. By:		
Client: Greenstone Gold Mine	January 30, 2018	PM	MS		

6.0 MODEL PREDICTIONS (2018 TO 2100)

For the purposes of this modelling effort, it was assumed that Year 1 of operation corresponds to calendar year 2018, with operation extending to 2033; the active closure phase begins in 2034; and the open pit fills and begins to discharge to Kenogamisis Lake in the 2050s.

The following changes in loadings and flows were included in the model, in relation to the operation and closure phases (see Stantec 2017, Chapter 10.0, for more information):

- Groundwater loadings of arsenic originating from the WRSAs and TMF were incorporated into the model. No reduction in loading due to exhaustion of the tailings source, precipitation reactions, or processes are applied for the historical tailings, WRSAs and TMF. In reality, arsenic loadings would be expected to decline over time as the more readily leached inventories contained within the tailings and waste rock become exhausted. This results in a conservative approach to the long-term water quality predictions and loading to the environment by over-estimating long-term arsenic leaching rates.
- Removal of approximately 22% of the historical MacLeod tailings and 77% of the historical Hardrock tailings and their placement within the new TMF in designated locations.
- Installation of an enhanced cover over the remaining historical MacLeod high tailings to reduce infiltration and increase runoff, thereby further reducing loadings from the historical MacLeod tailings.
- The prediction of discharge from the WRSAs, ore stockpile, and historical tailings areas excludes the reduction due to collection of groundwater in the perimeter collection ditches.
- During operation, there is a reduction in the discharge from the historical tailings to Kenogamisis Lake due to the removal of the tailings and the changes in groundwater flow direction due to dewatering of the open pit.
- Treated effluent discharge from the effluent treatment plant (ETP) to the SWA represents a new loading during operation and was included at the maximum arsenic concentration of 100 µg/L and the mean annual discharge rate under climate normal conditions.
- During closure, to expedite the filling of the open pit, enhanced filling operations are planned and include pumping water from the TMF, the contact water collection ponds (via pond M1), and from the Southwest Arm of Kenogamisis Lake. The open pit will be filled to allow development of a density stratified meromictic lake. Once filled, and after water quality of the pit lake has been shown to meet discharge criteria, effluent will be discharged directly to the SWA. Arsenic loading associated with this discharge is included in the model.
- Once the pit lake fills, the effects of the open pit on groundwater flow are reduced and local groundwater flow towards Kenogamisis Lake resumes. The loading to Kenogamisis Lake due to groundwater discharge associated with the WRSAs, TMF, and historical tailings increase in comparison to operations, but remain well below existing conditions.

6.1 PREDICTED ARSENIC FLUXES THROUGH KENOGAMISIS LAKE

Table 18 provides a summary of expected future total arsenic loadings to Kenogamisis Lake. The effects of these changing arsenic loadings on expected water and sediment quality in Kenogamisis Lake, and arsenic fluxes within and between the sub-basins, were evaluated over the period of 2018 to 2100 using the calibrated and validated model.

Table 18 Estimated Future Arsenic Loadings[1] (kg/year)

Period	SWA	BBW	BBE	CBW[2]	CBE	OB
2018 - 2033	694	1,417	153	9	247	326
2034 - 2038	396	1,417	153	9	247	326
2039 - 2050s	383	1,413	149	0	244	324
2050s - 2100	695	1,413	1,055	135	244	323

Notes:

1 Loadings are estimates of the mass of arsenic directly entering each sub-basin. They do not include arsenic inputs with water flow from upstream sub-basins, or internal cycling of arsenic between sediment and water.

2 CBW has a very small direct drainage area, and as such, direct inputs of arsenic to this sub-basin may be very small when historical tailings have been removed, and when the open pit acts as a sump for groundwater seepage.

Figures 24 to 29 provide overall summaries of mean annual arsenic fluxes within and between the six lake sub-basins over the historical period (i.e., 1920 to 2017), and into the future (2018 to 2100). Numerical estimates of these mean annual arsenic fluxes are provided on a decadal basis in Table 19. Taking the year 2015 as a baseline, the model indicates little change in the total arsenic flux leaving BBW (where the anthropogenic sources of arsenic loading lie outside of the Project area). However, substantial short- and long-term decreases in total arsenic flux leaving BBE are indicated between 2015 and 2095, as is also the case for arsenic fluxes leaving CBW and CBE. The predicted arsenic flux leaving SWA increases slightly during Project operations (e.g., 2025), largely due to the mine effluent treatment plant discharge, but the predicted flux is lower for the remainder of the study period (i.e., 2035 through 2095). The total arsenic flux leaving OB is predicted to decrease substantially in all phases of the Project.

Figure 24 shows estimated total arsenic loadings to BBW increasing over the period from 1920 to 1959, as a result of historical mining activities. These loadings decline and are assumed to remain constant after 1960 as active mining within the upgradient catchment areas had ceased by the mid-1940s to early-1950s. Internal cycling of arsenic within BBW, leading to an internal flux of arsenic from sediment to water, is limited by high iron concentrations in the sediment, which increase the binding capacity for arsenic in the sediments. The arsenic flux from sediment to water remains smaller than the flux from water to sediment, hence the sediments of BBW remain a net sink for arsenic. The mean arsenic concentration in the sediments of BBW is therefore likely to continue to gradually increase over the foreseeable future, as a result of upstream sources of arsenic loading.

Figure 25 shows assumed total arsenic inputs to BBE increasing over the period from 1920 to 1969, then decreasing slightly to a plateau (due to arsenic loading from groundwater associated with historical mine tailings) between 1970 and 2017. After 2018, total arsenic loading to the lake would decrease substantially (due to remediation of some of the historical mine tailings, and development of the open pit mine which would limit groundwater flow into BBE). As a result, the arsenic loading to BBE becomes dominated by inputs from the upstream sub-basin (BBW). As a result, the arsenic flux from water to sediment is expected to decrease, and could be less than the diffusive flux from sediment back to water. Thus, during the period from 2018 to the 2050s, the sediments of BBE could represent a small net source of arsenic to this sub-basin. After the 2050s, as the open pit fills and normal groundwater flows resume, the total arsenic loading to the lake would increase again, concentrations in the water would increase slightly, and the sediments would again become a net sink for arsenic. However, even after the 2050s, the total arsenic loading to BBE would be lower than under present day conditions.

Table 19 Mass (kg/year) of Arsenic Lost by Outflow

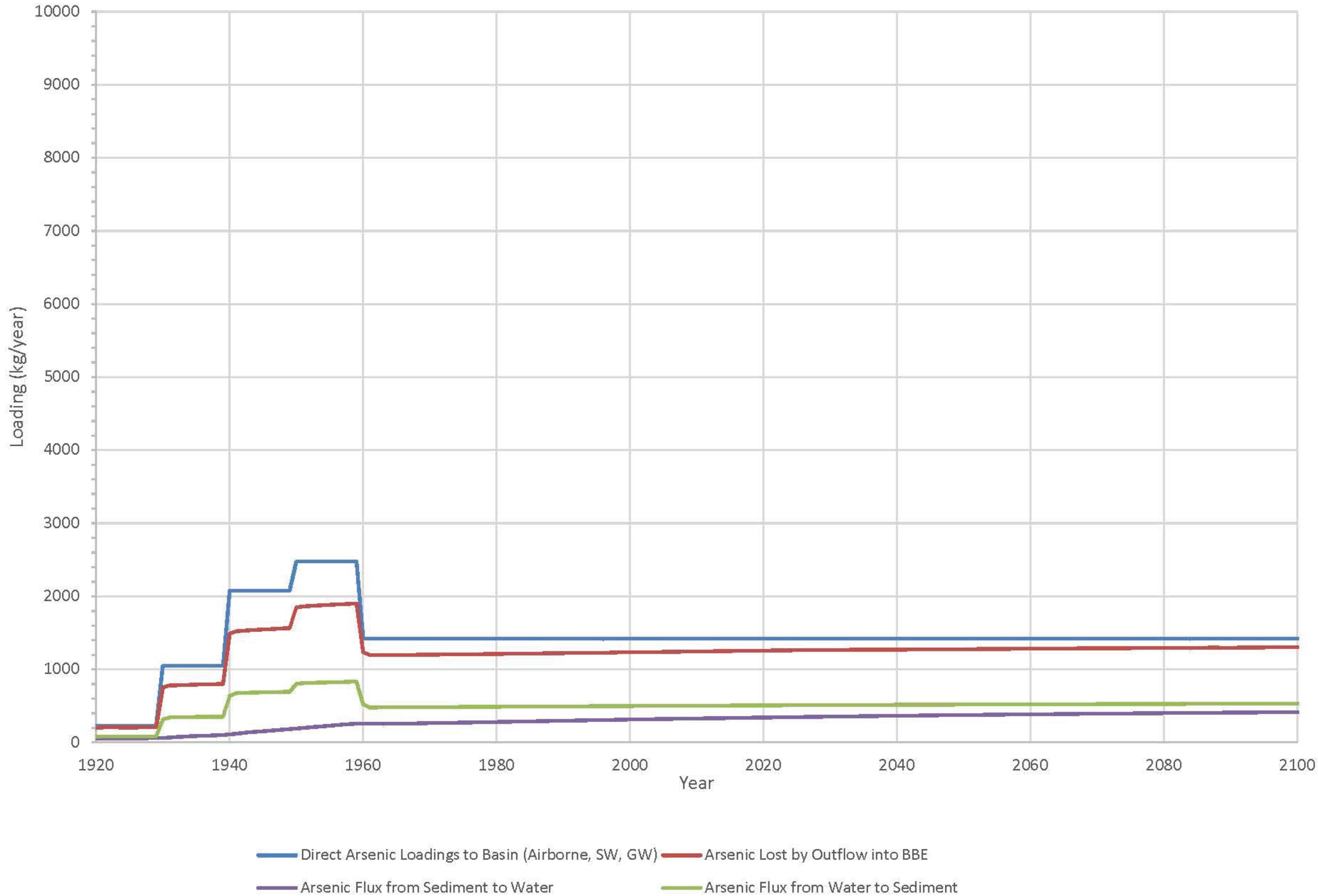
Year	From BBW into BBE	From BBE into CBW	From CBW into CBE	From CBE into OB	From SWA into CBE	From OB into Downstream System
1925	206	208	179	771	383	1,146
1935	791	1,891	1,727	2,186	378	2,413
1945	1,545	3,970	3,853	5,064	1,381	5,017
1955	1,883	4,625	4,688	6,869	2,455	6,704
1965	1,196	4,710	4,967	9,104	4,548	8,788
1975	1,205	3,354	3,768	8,165	4,617	8,055
1985	1,217	3,390	3,825	8,319	4,668	8,258
1995	1,228	3,426	3,882	8,454	4,705	8,435
2005	1,237	3,461	4,071	5,098	798	5,476
2015	1,250	3,506	4,120	5,078	737	5,430
2025	1,261	1,549	1,629	2,873	827	3,432
2035	1,269	1,530	1,609	2,567	545	3,108
2045	1,273	1,512	1,574	2,465	504	2,969
2055	1,279	2,185	2,298	3,336	765	3,710
2065	1,285	2,195	2,307	3,329	754	3,695
2075	1,290	2,201	2,313	3,319	745	3,676
2085	1,295	2,207	2,318	3,310	737	3,660
2095	1,301	2,216	2,324	3,308	731	3,653

Figure 26 shows total arsenic inputs to CBW. This sub-basin has very little direct arsenic loading, but receives substantial flux from the upstream sub-basin, BBE. The historical calibration to sediment core data suggests that loadings increased over the period from 1920 to 1969, then decreased and remained stable between 1970 and 2017. After 2018, there is expected to be a further decrease in total arsenic loadings to CBW (due largely to remediation of some of the historical mine tailings), and a resulting decrease in the total amount of arsenic exported from BBW. Due to lower total arsenic loadings between 2018 and the 2050s, arsenic deposition to the sediments of CBW decreases and the sediments of this sub-basin could become a small net source of arsenic to the overlying water. This situation is reversed (and the sediments of CBW become a small net sink for arsenic again) after the 2050s when the pit lake fills and normal groundwater flows resume.

Figure 27 shows total arsenic inputs to CBE (which include the flux from the BBW-BBE-CBW chain of sub-basins, as well as inputs from SWA). The total arsenic flux through CBE as estimated using the STELLA™ model is large, peaking at more than 9,000 kg/y in the 1960s, and over 5,000 kg/y at the present time. This flux decreases substantially between 2018 and the 2050s, after remediation of some of the historical MacLeod and Hardrock tailings deposits presently affecting water quality in BBE and CBW. A secondary decrease between about 2034 and the 2050s reflects the end of operation and treated effluent discharge to SWA. Arsenic inputs to CBE would increase again during the 2050s, when the open pit fills, and groundwater flows are no longer collected in the pit lake. Storage of arsenic in the sediments of CBE is low, due to the rapid flushing of this sub-basin. Presently, the sediments of CBE appear to be in equilibrium with respect to arsenic deposition and remobilization. With a reduction of arsenic inputs to this sub-basin beginning in 2018, the sediments would become a small net source of arsenic to the overlying water, but would return to an equilibrium condition during the 2050s.

Figure 28 shows total arsenic inputs to SWA. The sediments of this sub-basin appear to contain more arsenic than would be expected if SWA were in a pristine condition. This apparent excess of arsenic may reflect the surface water discharge originating from the historical Hardrock tailings to the SWA, a situation that underwent remediation in the 1990s. To address this, and given the rapid flushing rate of the SWA, a substantial historical source of arsenic was required to match the observed sediment arsenic concentrations. The total arsenic loading to SWA is presently dominated by natural sources (i.e., inflows from the Kenogamisis River), with a small additional contribution caused by a net flux from sediment to the overlying water. The model suggests that the sediments of SWA are presently a minor source of arsenic to the overlying water (i.e., the diffusive flux to water from sediment is slightly greater than depositional flux from water to sediment). Treated mine effluent release between 2018 and about 2033 would result in only a small increase in the total arsenic loading to SWA. Arsenic loading to SWA would decrease when operation ends in about 2033, and then increase again when the open pit fills and begins to discharge during the 2050s. The sediments of SWA are likely to remain a small but declining net source of arsenic for a longer period of time.

Figure 29 shows the total arsenic inputs to OB. Because this sub-basin is removed from the direct influence of historical or Project mining activities, arsenic inputs are dominated by the flux from CBE. The rapid flushing rate of this sub-basin, and lower availability of iron in the water and sediment, tend to limit the potential for arsenic storage in sediment. Between 2018 and the 2050s, with a decrease in arsenic inputs caused by removal of a portion of historical MacLeod and Hardrock tailings and development of the open pit, the sediments of the OB could become a small source of arsenic due to the net flux from sediment to water exceeding the depositional flux of arsenic from the water to sediment. After the 2050s, the sediments of the OB are predicted to be near an equilibrium condition with respect to deposition and internal cycling of arsenic.



Summary of Mean Arsenic Fluxes in BBW (kg/year) 1920-2100	**Scale:** n/a	**Job No.:** 160961223		**Figure No.:** 24
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS	
Client: Greenstone Gold Mines GP Inc.				

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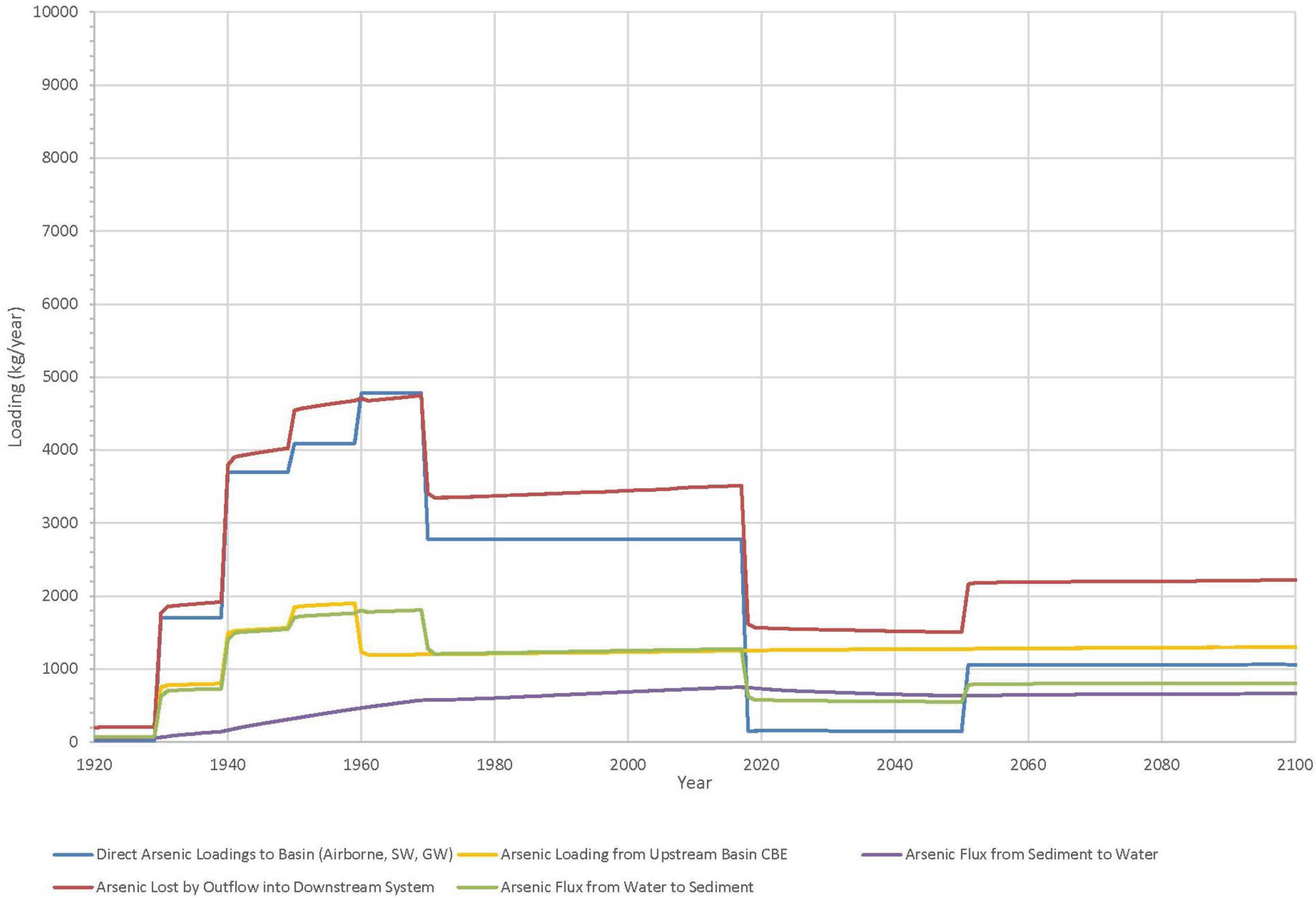
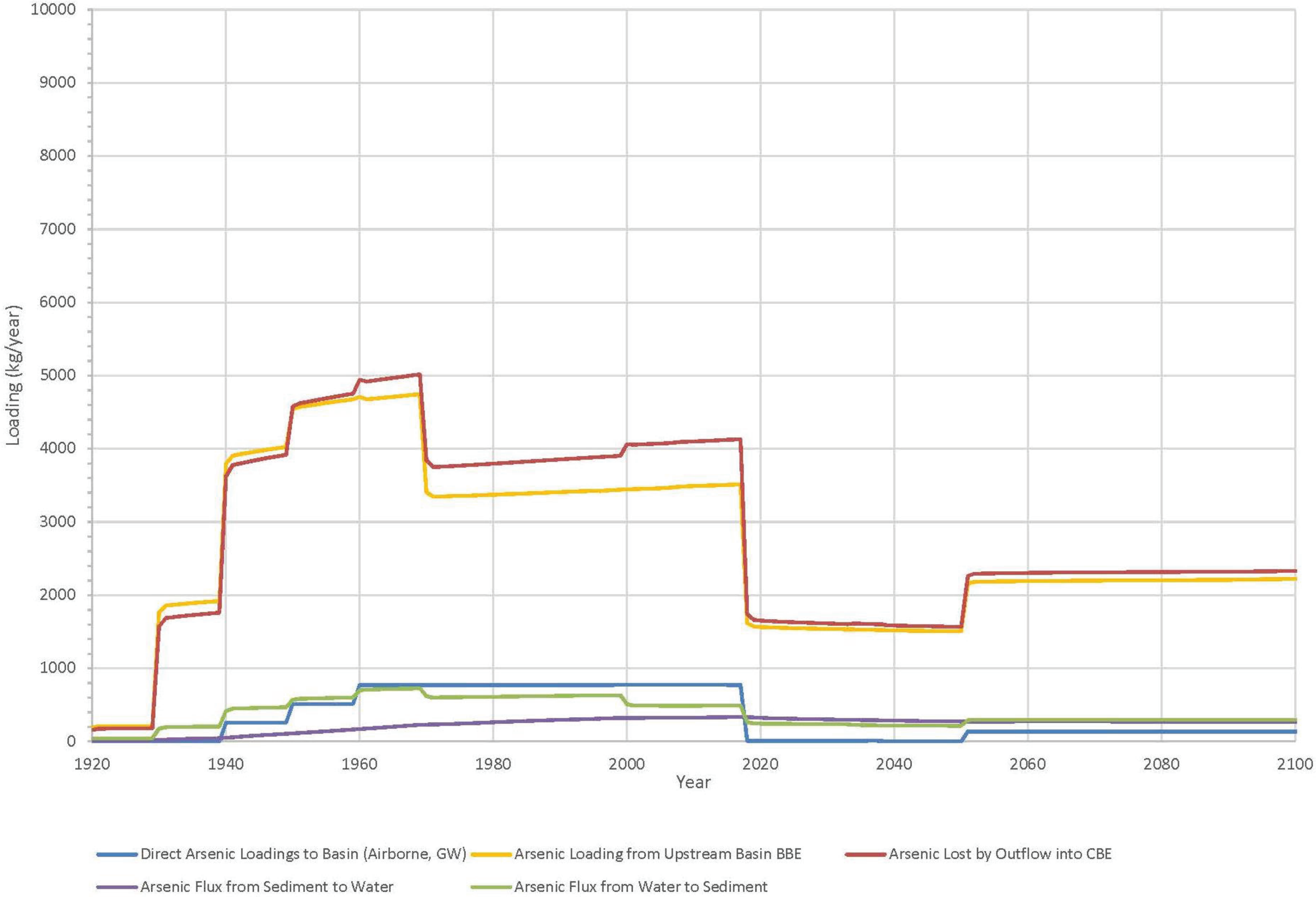
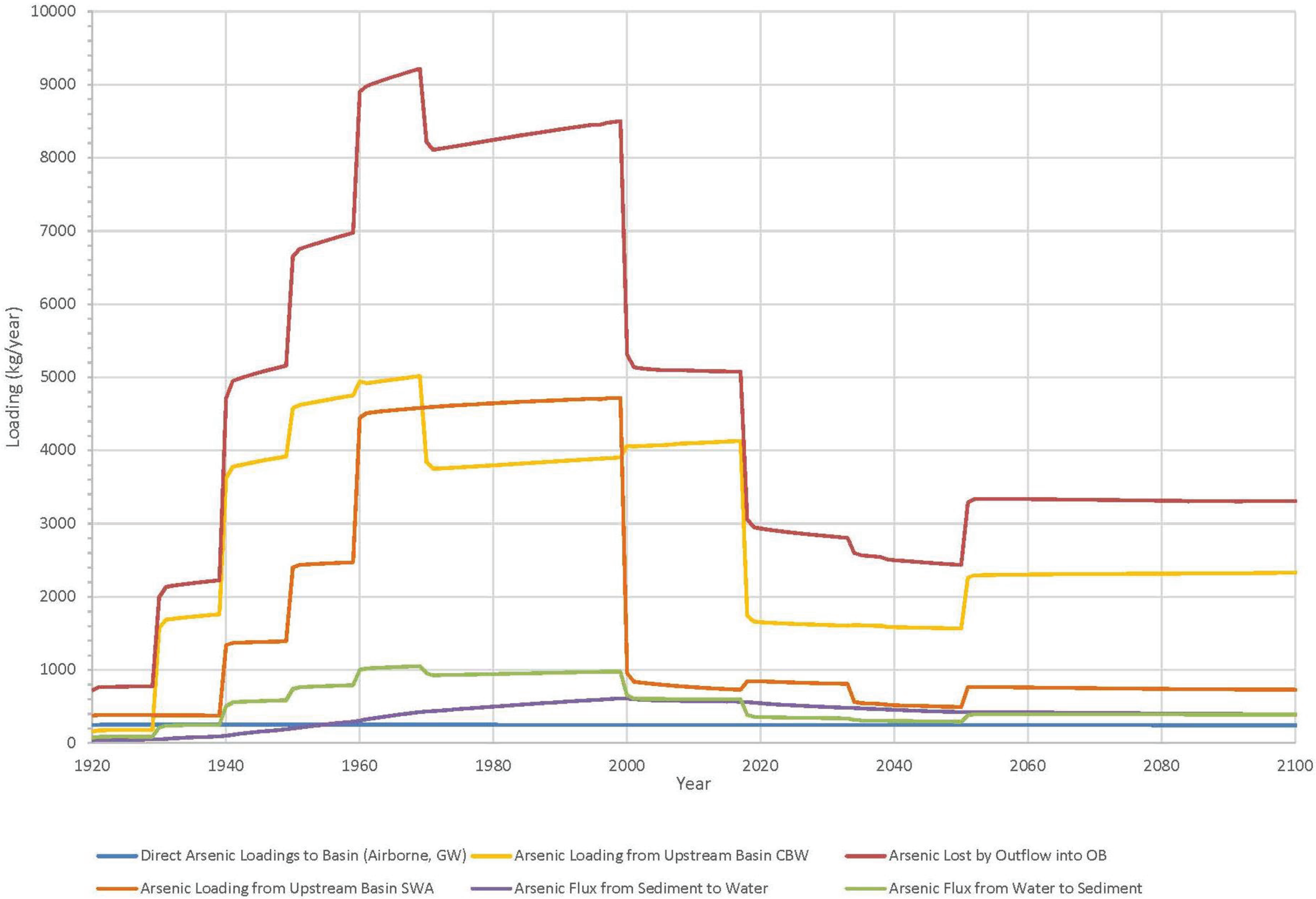


Summary of Mean Arsenic Fluxes in BBE (kg/year) 1920-2100	**Scale:** n/a		**Job No.:** 160961223	**Figure No.:** 25	Stantec
Client: Greenstone Gold Mines GP Inc.	**Date:** January 30, 2018	**Dwn By:** PM	**Appd. By:** MS		



Summary of Mean Arsenic Fluxes in CBW (kg/year) 1920-2100	Scale: n/a	Job No.: 160961223	Figure No.: 26	Stantec
Client: Greenstone Gold Mines GP Inc.	Date: January 30, 2018	Dwn By: PM	Appd. By: MS	



Summary of Mean Arsenic Fluxes in CBE (kg/year) 1920-2100	**Scale:** n/a		**Job No.:** 160961223	**Figure No.:** 27
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS	
Client: **Greenstone Gold Mines GP Inc.**				

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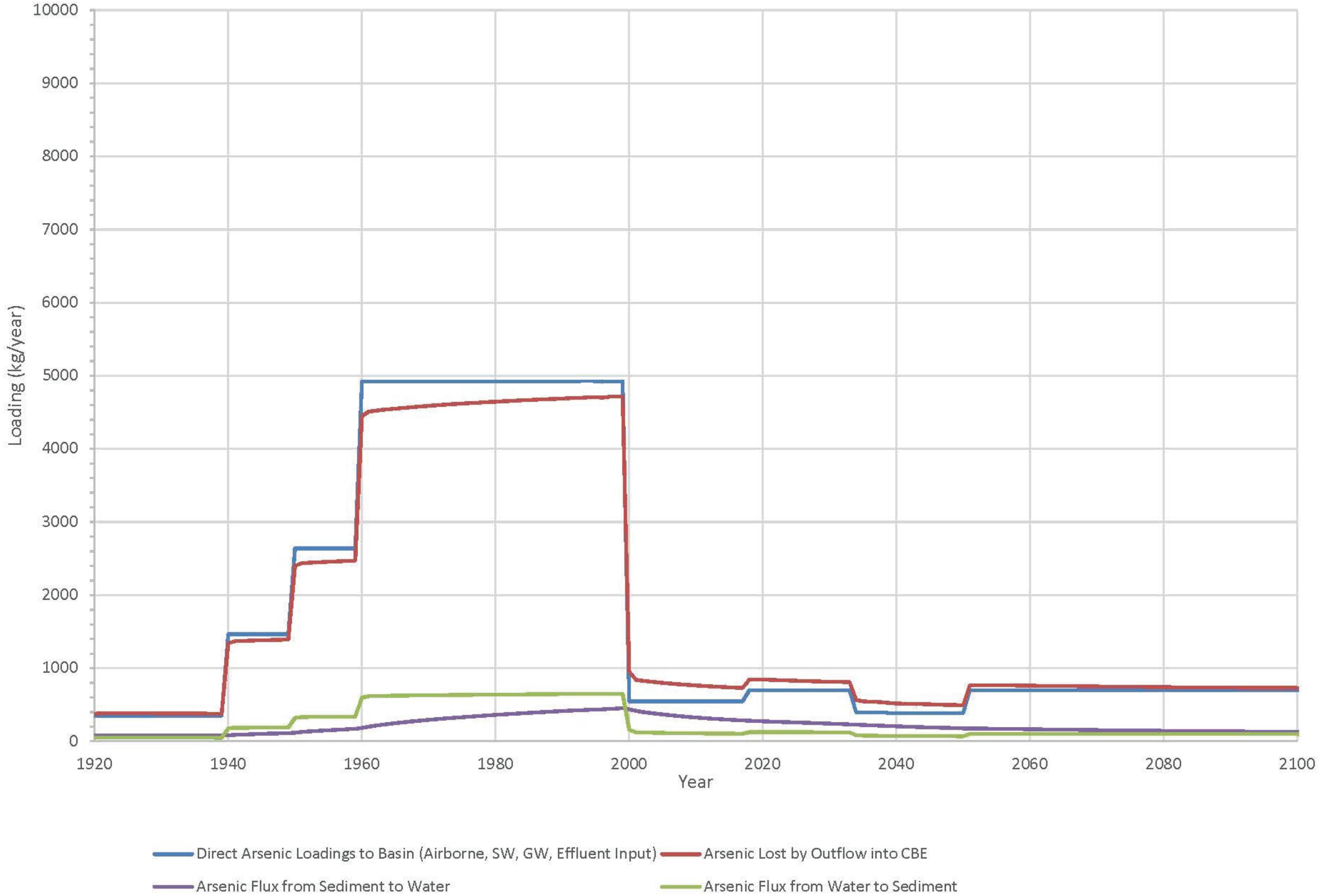
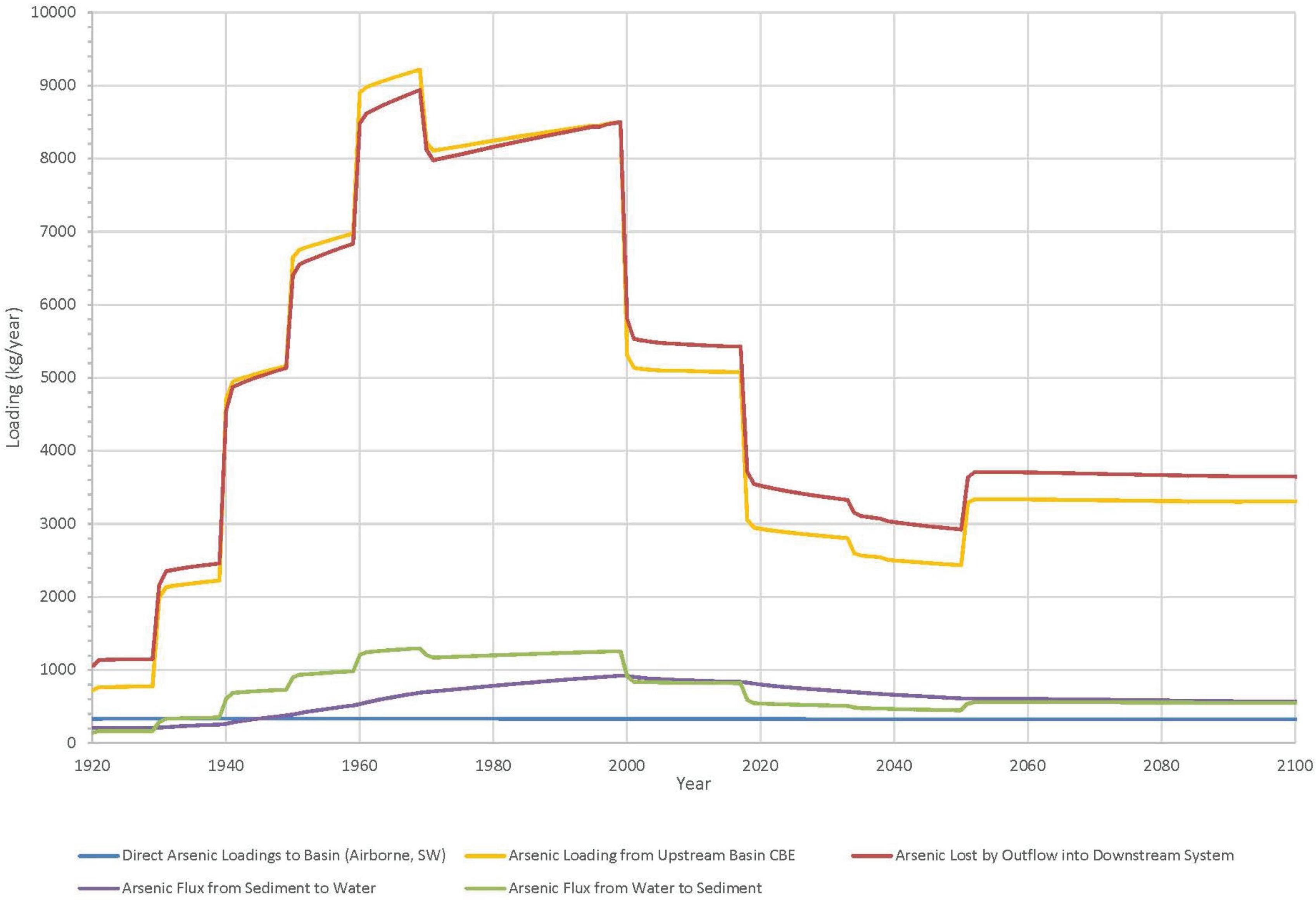


Summary of Mean Arsenic Fluxes in SWA (kg/year) 1920-2100	Scale: n/a		Job No.: 160961223	Figure No.: 28	Stantec
	Date: January 30, 2018	Dwn By: PM	Appd. By: MS		
Client: Greenstone Gold Mines GP Inc.					



Summary of Mean Arsenic Fluxes in OB (kg/year) 1920-2100	**Scale:** n/a		**Job No.:** 160961223	**Figure No.:** 29	Stantec
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS		
Client: Greenstone Gold Mines GP Inc.					

6.2 PREDICTED ARSENIC CONCENTRATIONS IN SEDIMENT

Figure 29 shows the simulated arsenic profiles in sediment for the six sub-basins of Kenogamisis Lake at the end of the year 2100. Surface sediment arsenic concentrations are predicted to range from about 15 mg/kg in SWA to about 620 mg/kg in BBE. Sediment arsenic concentrations are predicted to decline slightly from present-day levels in SWA, OB, CBE, CBW and BBE, and to increase slightly from present-day levels in BBW. Decreases in sediment arsenic concentrations are predicted to occur in most of the sub-basins because of reduced arsenic loadings, in combination with ongoing internal cycling of arsenic from sediment to the overlying water. Sediment arsenic inventories accumulated during historical periods of high arsenic loading will not be in equilibrium with expected lower arsenic loadings in future, and as a result, there may be a net diffusive flux of arsenic from sediment back to the overlying water. However, in sub-basin BBW, the arsenic loadings from historical mining operations upstream in the watershed (outside the Project area) are expected to remain, and the sediments are expected to remain a net sink for arsenic.

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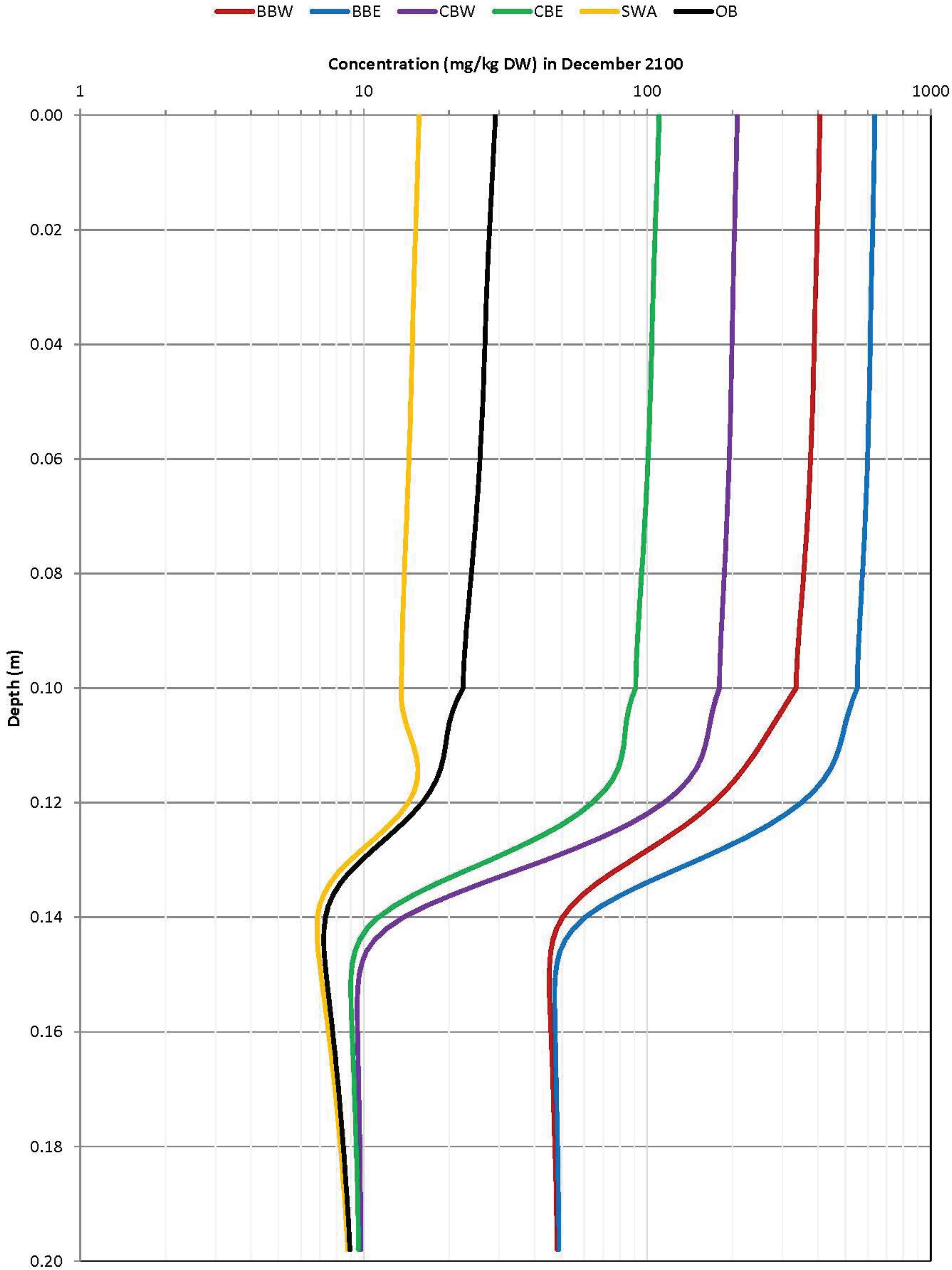

Predicted Total Arsenic Concentrations in Sediment (mg/kg) 2100	Scale:		Job No.:	Figure No.:	Stantec
	n/a		160961223	30	
	Date:	Dwn By:	Appd. By:		
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS		

6.3 PREDICTED ARSENIC CONCENTRATIONS IN WATER

Figures 31 to 36 show the simulated arsenic concentrations in water for the six lake sub-basins, over the period from 2010 to 2100. Table 20 provides a summary of the predicted annual minimum, maximum and mean total arsenic concentrations in the six sub-basins of Kenogamisis Lake.

While the model predictions and associated text in this section refer to the mean values predicted using the mass balance model, Tables 16 and 17 provide an indication of the model uncertainty (95% confidence intervals) for characteristic values of total arsenic concentrations in lake water and sediment, respectively.

Figure 31 shows predicted total arsenic concentrations in the water of BBW for the period 2010 to 2100. For the present day as defined in the model (i.e., 2015), the results (Table 20) suggest total arsenic concentrations in the water of BBW that exhibit a marked seasonal cycle, with concentrations ranging from about 12.4 µg/L (late winter) to 51.7 µg/L (late summer) with an annual average value of about 27.3 µg/L. This cycle is a result of interactions between hydrology (i.e., lake flushing) and geochemistry (i.e., seasonally variable arsenic concentrations in inflowing water and groundwater). The model predictions closely simulate the range of seasonal concentrations measured at water quality monitoring Station 2 (see Figure 1) between 2013 and 2016, which range from 10.5 µg/L (late winter) to 50.5 µg/L (late summer) with a mean value of 27.4 µg/L. Given the estimated future arsenic loadings to Kenogamisis Lake, future arsenic concentrations in BBW are predicted to remain relatively unchanged from present day conditions.

Figure 32 shows predicted total arsenic concentrations in the water of BBE for the period 2010 to 2100. For the present day, the model suggests total arsenic concentrations show a marked seasonal cycle, with concentrations (Table 20) ranging from about 29 µg/L (late winter) to 123 µg/L (late summer) with an annual mean value of about 66 µg/L. The model predictions closely simulate the range of seasonal concentrations measured at water quality monitoring Station 4 (see Figure 1) between 2013 and 2016, which range from 11.8 µg/L (late winter) to 130 µg/L (late summer) with mean of 52.9 µg/L. Given the assumed future arsenic loadings to Kenogamisis Lake, future arsenic concentrations in the water of BBE are predicted to decline substantially. During the period between 2020 and the 2050s, the annual mean concentration is predicted to be approximately 29 µg/L. Arsenic concentrations in the water of BBE would increase slightly after the 2050s, to an annual mean concentrations of about 41 µg/L.

Figure 33 shows predicted total arsenic concentrations in the water of CBW for the period 2010 to 2100. For the present day, the model suggests total arsenic concentrations in the water of this sub-basin that exhibit a moderate seasonal cycle, with concentrations (Table 20) ranging from about 8.4 µg/L (late winter) to 34 µg/L (late summer) with a mean value of about 22 µg/L. The model predictions are reasonably consistent with the range of seasonal concentrations measured at water quality monitoring Station 7 (see Figure 1) between 2013 and 2016, which range from 3.2 µg/L (late winter) to 48.4 µg/L (late summer) with a mean value of 23.5 µg/L. A higher level of variability in arsenic concentrations observed in CBW is consistent with the hydrology of this sub-basin, where flows from the historically affected BBW-BBE sub-basins mix with flows from the less affected SWA-CBE sub-basins. Given the estimated future arsenic loadings to Kenogamisis Lake, future arsenic concentrations in the water of CBW are predicted to decline substantially. During the period between 2020 and the 2050s, the annual mean concentration is predicted to be approximately 10 µg/L. Arsenic concentrations in the water of CBW would increase slightly after the 2050s, to annual average concentrations around 13.4 µg/L.

Table 20 Predicted Arsenic Concentrations in Water (µg/L), 2010-2100

Year	BBW Water Concentration (µg/L)			BBE Water Concentration (µg/L)			CBW Water Concentration (µg/L)			CBE Water Concentration (µg/L)			SWA Water Concentration (µg/L)			OB Water Concentration (µg/L)		
	Yearly Minimum	Yearly Average	Yearly Maximum	Yearly Minimum	Yearly Average	Yearly Maximum	Yearly Minimum	Yearly Average	Yearly Maximum	Yearly Minimum	Yearly Average	Yearly Maximum	Yearly Minimum	Yearly Average	Yearly Maximum	Yearly Minimum	Yearly Average	Yearly Maximum
2015	12.4	27.3	51.7	28.7	65.9	122.3	8.4	22.0	34.0	5.9	12.9	21.4	1.3	2.6	5.0	6.1	12.2	18.9
2025	12.5	27.6	52.2	13.1	29.4	51.6	5.1	10.8	17.4	3.8	7.5	12.1	1.6	3.2	5.2	4.2	7.8	12.0
2035	12.6	27.8	52.7	12.9	29.0	50.6	4.3	10.0	16.3	3.1	6.7	11.0	1.0	1.9	3.6	3.5	7.1	11.0
2045	12.7	27.9	53.0	12.8	28.6	49.8	4.1	9.7	15.7	3.0	6.4	10.4	1.0	1.8	3.3	3.4	6.8	10.4
2055	12.8	28.1	53.4	18.3	41.2	73.8	5.4	13.4	20.1	4.0	8.5	13.4	1.4	2.6	4.6	4.3	8.3	12.6
2065	12.9	28.2	53.7	18.4	41.4	74.2	5.4	13.4	20.1	4.0	8.4	13.4	1.4	2.6	4.5	4.3	8.3	12.5
2075	13.0	28.4	54.0	18.5	41.5	74.5	5.4	13.4	20.1	4.0	8.4	13.3	1.4	2.6	4.5	4.3	8.3	12.4
2085	13.1	28.5	54.4	18.5	41.7	74.8	5.3	13.4	20.1	4.0	8.4	13.2	1.4	2.5	4.4	4.3	8.2	12.4
2095	13.2	28.6	54.6	18.6	41.8	75.0	5.3	13.4	20.1	3.9	8.4	13.2	1.4	2.5	4.3	4.3	8.2	12.3

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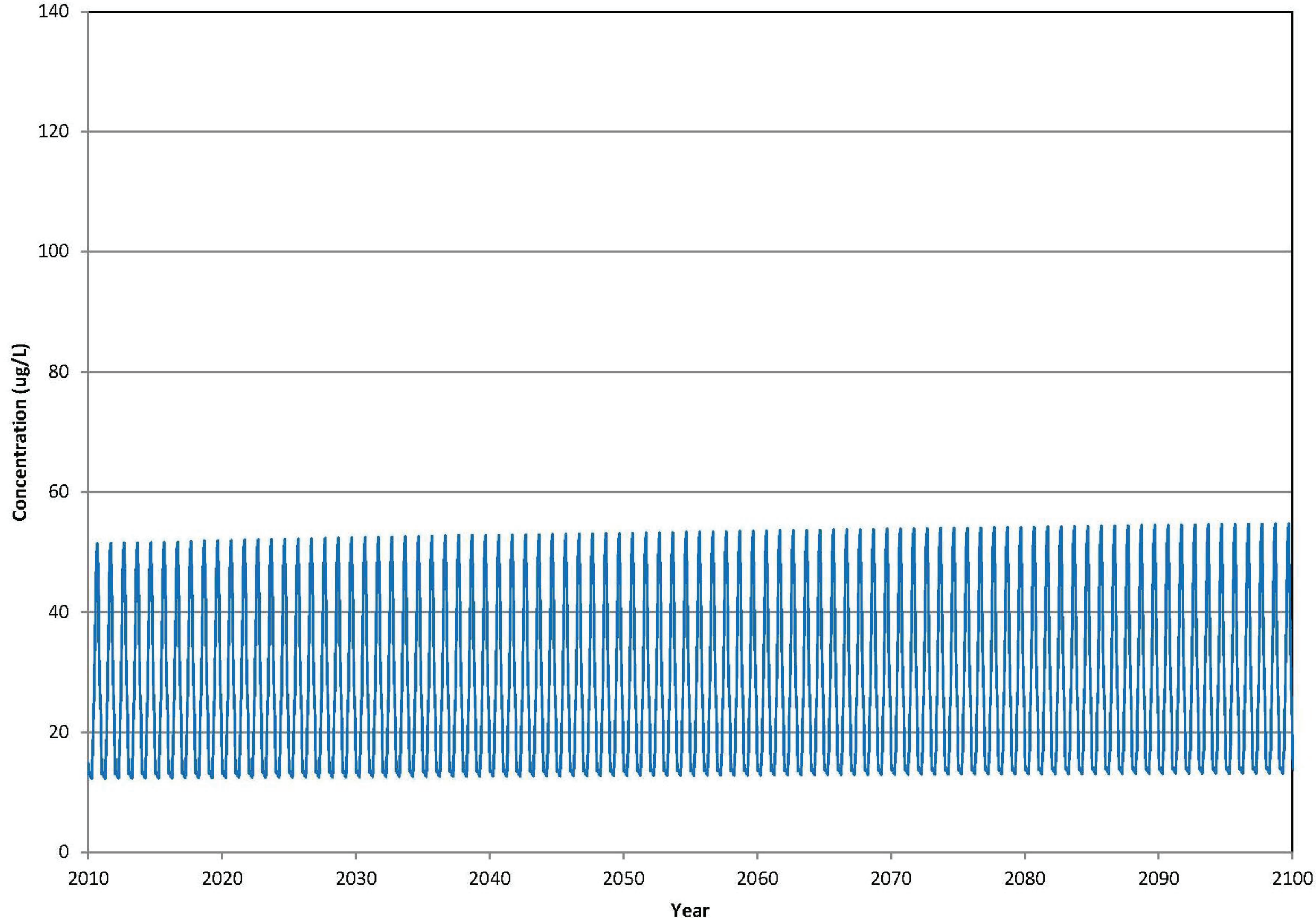
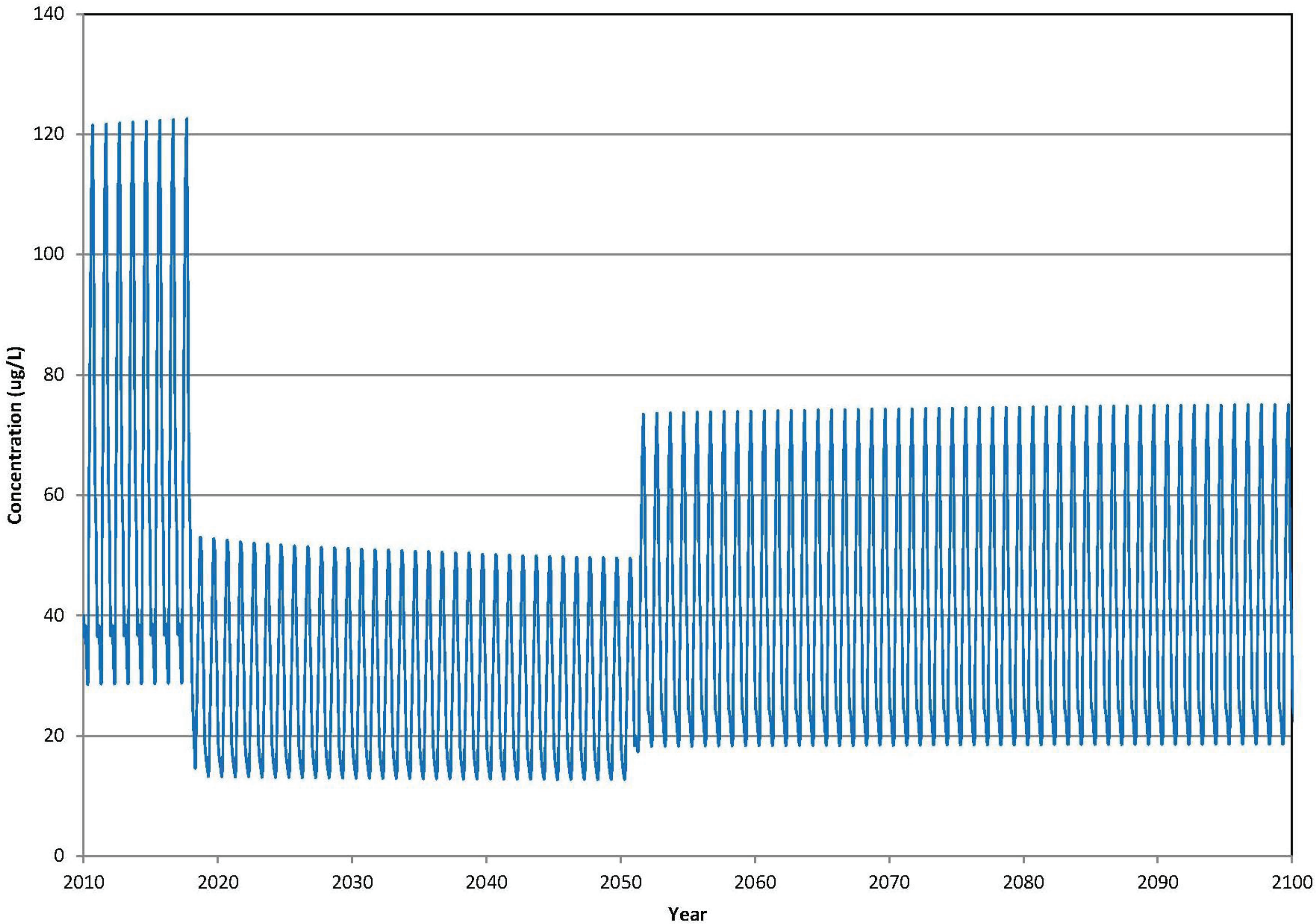


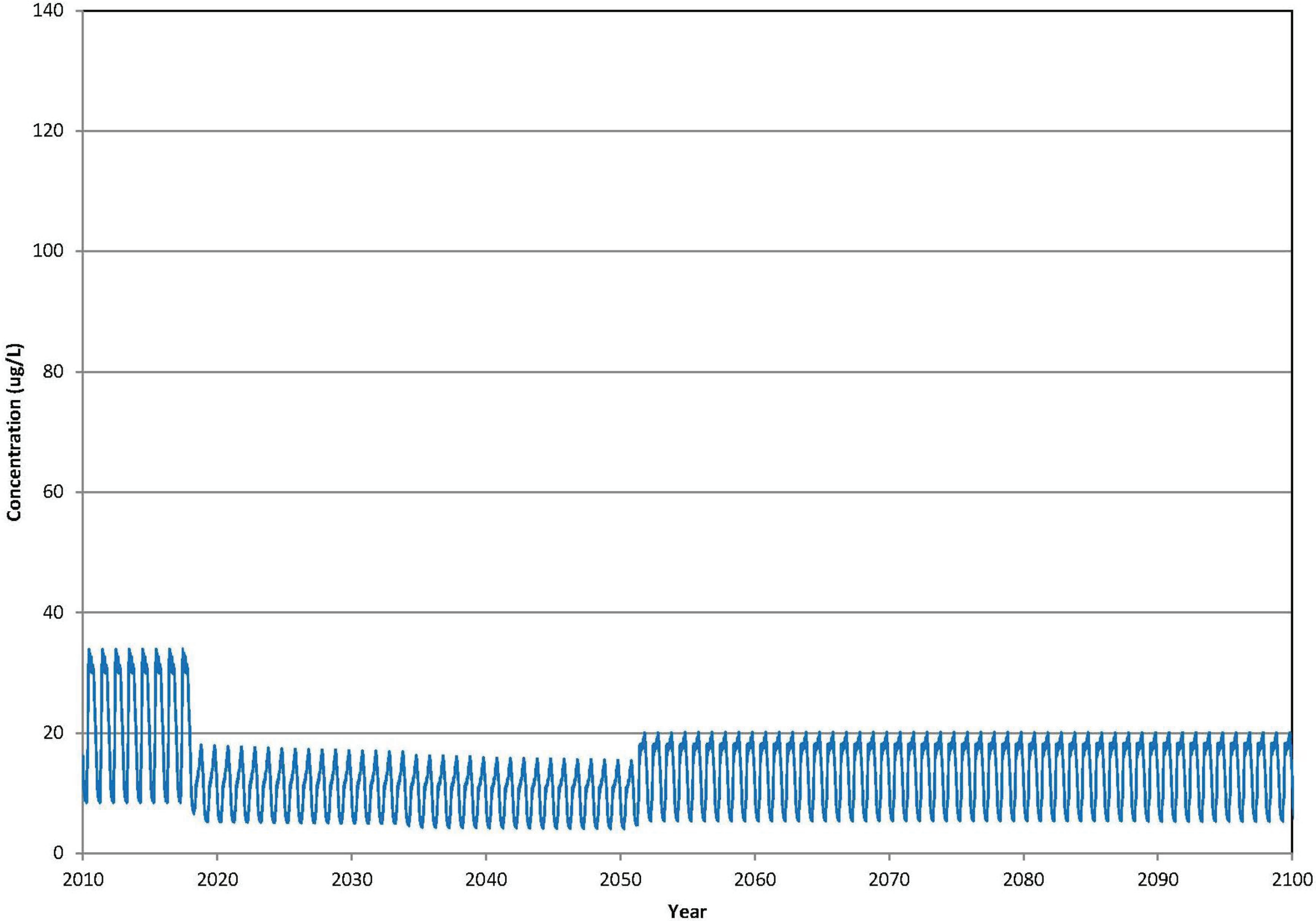
Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Predicted Total Arsenic Concentrations in Water (µg/L), BBW, 2010 to 2100	**Scale:** n/a		**Job No.:** 160961223	**Figure No.:** 31	Stantec
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS		
Client: Greenstone Gold Mines GP Inc.					



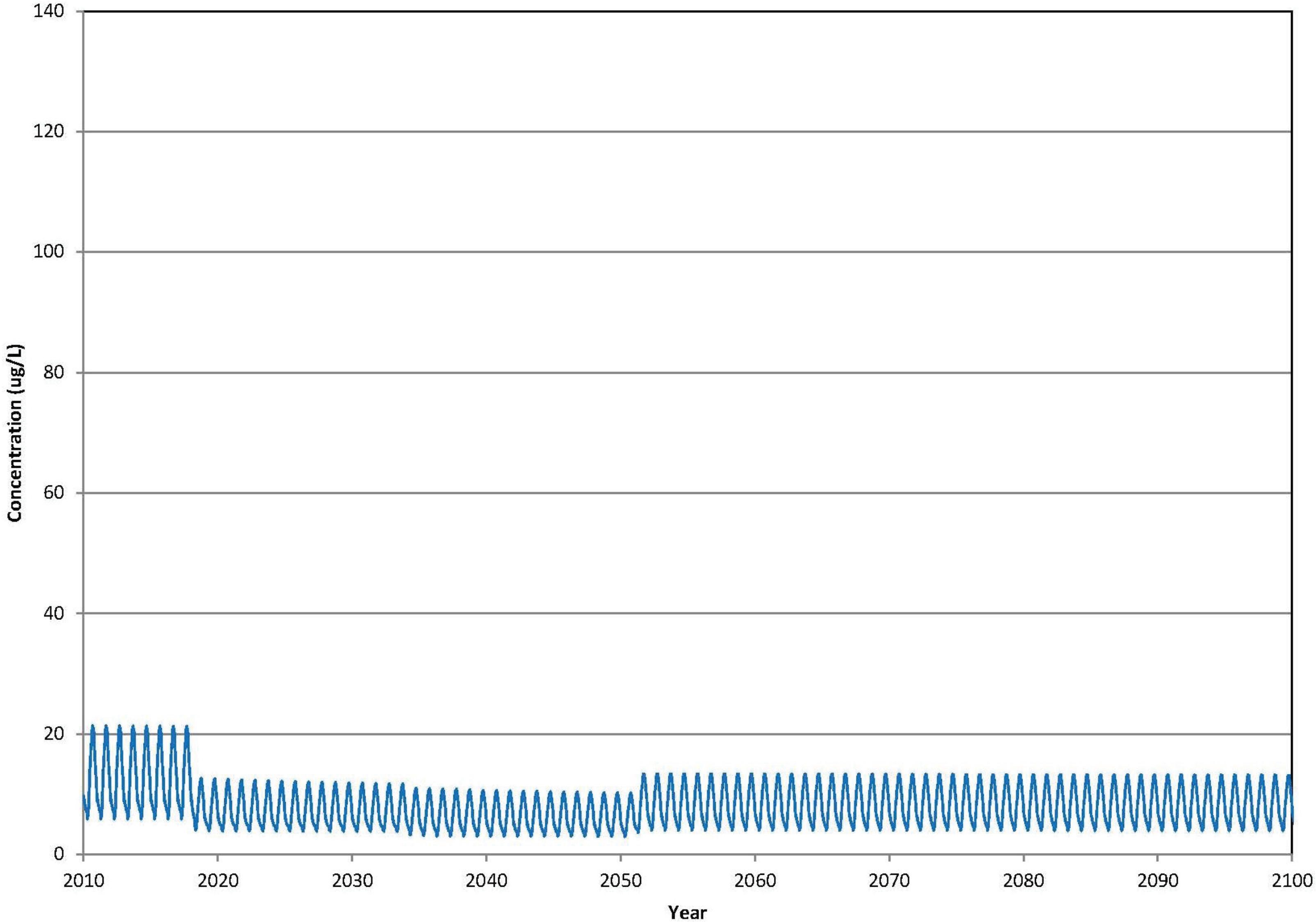
Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Predicted Total Arsenic Concentrations in Water (µg/L) BBE, 2010 to 2100	Scale: n/a	Job No.: 160961223	Figure No.: 32	Stantec
Client: Greenstone Gold Mines GP Inc.	Date: January 30, 2018	Dwn By: PM	Appd. By: MS	



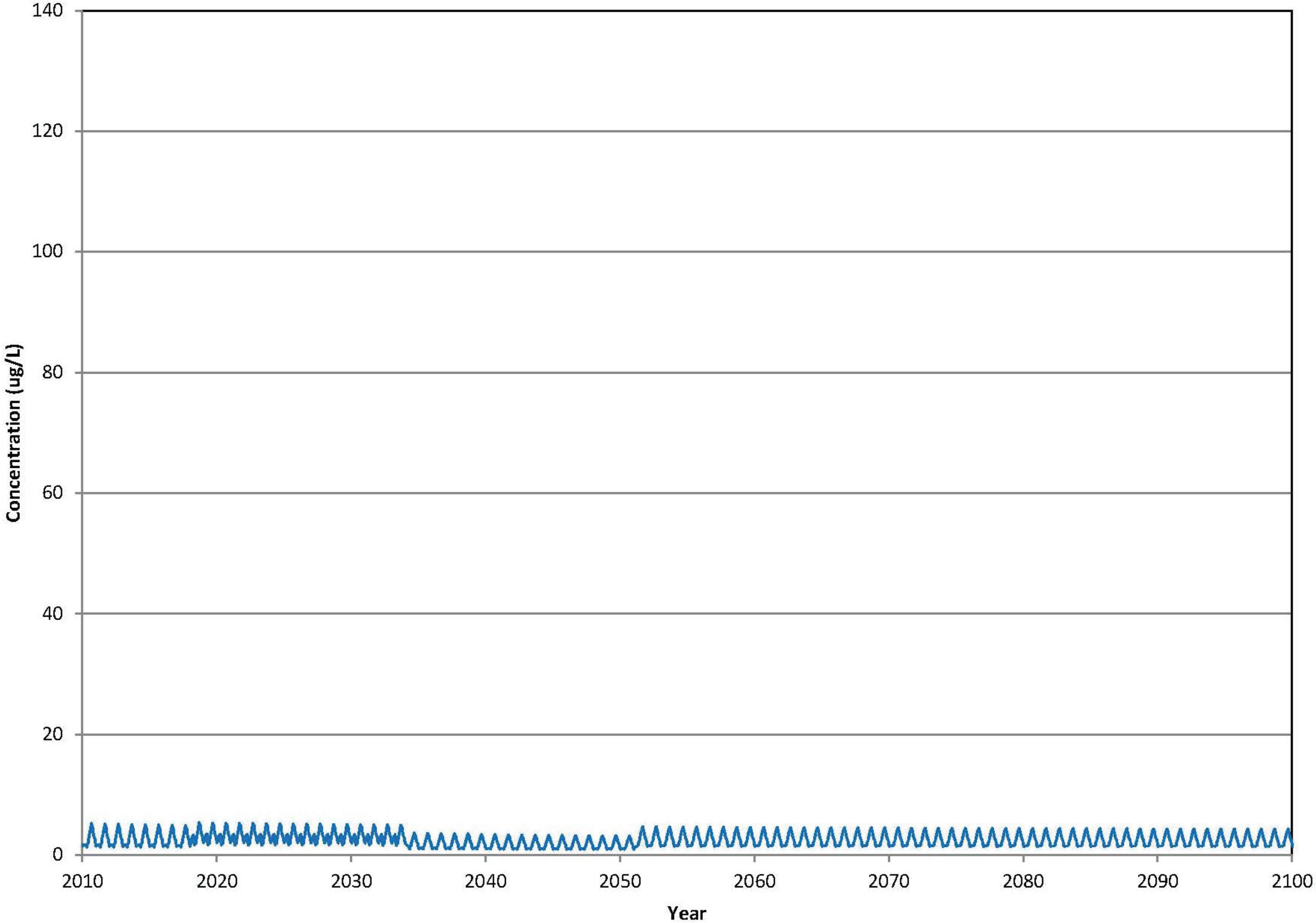
Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Predicted Total Arsenic Concentrations in Water (µg/L) CBW, 2010 to 2100	Scale: n/a	Job No.: 160961223	Figure No.: 33	Stantec
	Date: January 30, 2018	Dwn By: PM	Appd. By: MS	
Client: Greenstone Gold Mines GP Inc.				



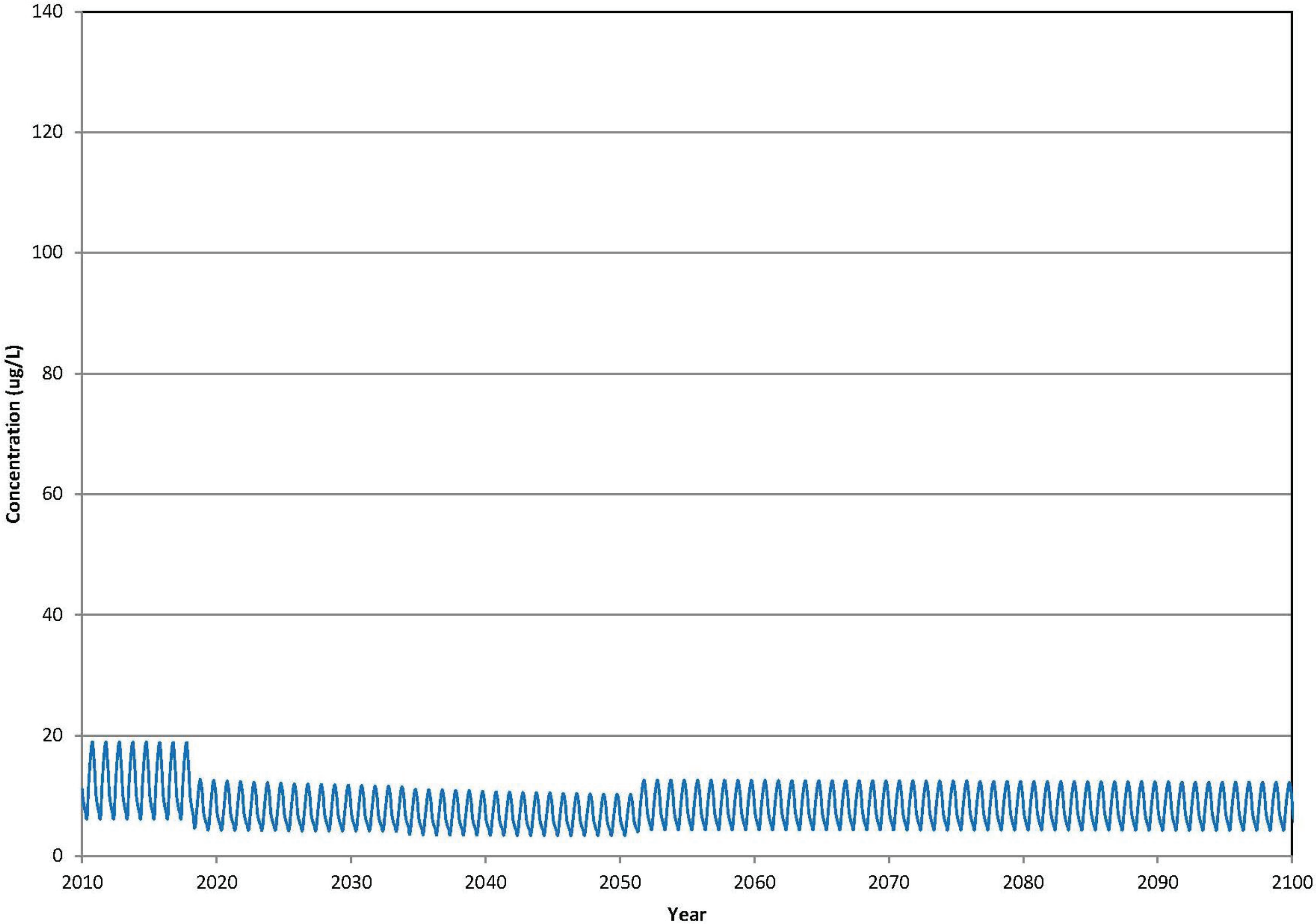
Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Predicted Total Arsenic Concentrations in Water (µg/L) CBE, 2010 to 2100	Scale: n/a		Job No.: 160961223	Figure No.: 34	Stantec
	Date:	Dwn By:	Appd. By:		
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS		



Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Predicted Total Arsenic Concentrations in Water (µg/L) SWA, 2010 to 2100	Scale: n/a		Job No.: 160961223	Figure No.: 35	Stantec
	Date:	Dwn By:	Appd. By:		
Client: Greenstone Gold Mines GP Inc.	January 30, 2018	PM	MS		



Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Predicted Total Arsenic Concentrations in Water (µg/L) OB, 2010 to 2100	**Scale:** n/a		**Job No.:** 160961223	**Figure No.:** 36	Stantec
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS		
Client: **Greenstone Gold Mines GP Inc.**					

Figure 34 shows predicted total arsenic concentrations in the water of CBE for the period 2010 to 2100. For the present day, the model suggests total arsenic concentrations in the water of this sub-basin that exhibit a modest seasonal cycle, with concentrations (Table 20) ranging from about 5.9 µg/L (late winter) to 21.4 µg/L (late summer) with a mean value of about 12.9 µg/L. The model predictions are reasonably consistent with the range of seasonal concentrations measured at water quality monitoring Station 8 (see Figure 1) between 2013 and 2016, which range from 1.8 µg/L (late winter) to 23.1 µg/L (late summer) with a mean value of 9.9 µg/L. Given the estimated future arsenic loadings to Kenogamisis Lake, future arsenic concentrations in the water of CBE are predicted to decline substantially. During the period between 2020 and the 2050s, the annual mean concentration is predicted to be approximately 7 µg/L. Arsenic concentrations in the water of CBE would increase slightly after the 2050s, to annual mean concentrations around 8 µg/L.

Figure 35 shows predicted total arsenic concentrations in the water of SWA for the period 2010 to 2100. For the present day, the model suggests total arsenic concentrations in the water of this sub-basin that exhibit a modest seasonal cycle, with concentrations (Table 20) ranging from about 1.3 µg/L (late winter) to 5 µg/L (late summer) with a mean value of about 2.6 µg/L. The model predictions closely simulate the range of seasonal concentrations measured at water quality monitoring Station 1 (see Figure 1) between 2013 and 2016, which range from 0.5 µg/L (late winter) to 6.4 µg/L (late summer) with a mean 2.9 µg/L. Given the estimated future arsenic loadings to Kenogamisis Lake, future arsenic concentrations in the water of SWA are predicted to increase slightly. During the period between 2020 and 2033, the annual average concentration is predicted to be approximately 3.1 µg/L. Arsenic concentrations in the water of SWA would decrease slightly after 2033 (when treated effluent discharge ends), to annual average concentrations around 1.8 µg/L. After the 2050s, when the pit lake has filled and begins to discharge to SWA, the total arsenic concentration in water is predicted to increase slightly to an annual average value of around 2.6 µg/L.

Figure 36 shows predicted total arsenic concentrations in the water of the OB for the period 2010 to 2100. For the present day, the model suggests total arsenic concentrations in the water of this sub-basin that exhibit a modest seasonal cycle, with concentrations (Table 20) ranging from about 6.1 µg/L (late winter) to 18.9 µg/L (late summer) with an annual mean value of about 12.2 µg/L. The model predictions closely simulate the range of seasonal concentrations measured at water quality monitoring Station 11 (see Figure 1) between 2013 and 2016, which range from 4.8 µg/L (late winter) to 17.3 µg/L (late summer) with a mean value of 10.0 µg/L. Given the estimated future arsenic loadings to Kenogamisis Lake, future arsenic concentrations in the water of OB are predicted to decrease. During the period between 2020 and the 2050s, the mean concentration is predicted to be approximately 7 µg/L. The annual average arsenic concentration in the water of OB would increase slightly after the 2050s, to around 8.3 µg/L.

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7.0 CLIMATE CHANGE SCENARIO (2018 TO 2100)

Stantec conducted a review of climate change predictions for northwestern Ontario covering the period from 2020 to 2100 to assess potential changes in precipitation patterns (see Appendix 1). Sources evaluated included the Intergovernmental Panel on Climate Change (IPCC 2014) assessment, a report by the Ontario Ministry of Natural Resources (McDermid et al. 2015), and extraction of specific projection data from the Climate Change Hazards Information Portal (CCHIP) database, via the Risk Sciences International (RSI) data portal.

Four different representative concentration pathways (RCPs) were considered, as indicative of potential future atmospheric greenhouse gas concentrations. These included RCP2.6, RCP4.5, RCP6.0 and RCP8.5. Of these, the RCP8.5 scenario was selected as the most conservative, and as the scenario most closely aligned with the current trajectory of global greenhouse gas emissions. Future climate projections for the Geraldton area for the 2020s, 2050s and 2080s were accessed from the CCHIP database via the RSI data portal. Based on this analysis, it was concluded that future annual average conditions at Geraldton are likely to become warmer, and wetter, with greater warming and precipitation in the winter months, and little change, to slightly drier conditions, during the summer months. These changes become more pronounced over time (Table 21).

Table 21 Monthly Average and Projected Ensemble Average Climate Change Projections for Precipitation at Geraldton, Ontario.

Month	1981-2010 Average	Climate Change Projection for 2020s		Climate Change Projection for 2050s		Climate Change Projection for 2080s	
	Total (mm)	Total (mm)	% change from current	Total (mm)	% change from current	Total (mm)	% change from current
January	33.5	39.1	16.7%	51.1	52.5%	63.2	88.7%
February	23.6	30.0	27.1%	37.4	58.5%	48.8	106.8%
March	31.9	35.6	11.6%	48.2	51.1%	54.0	69.3%
April	46.1	54.3	17.8%	66.9	45.1%	81.2	76.1%
May	71.7	76.8	7.1%	82.7	15.3%	89.3	24.5%
June	84.5	84.8	0.4%	87.7	3.8%	86.4	2.2%
July	108.6	106.9	-1.6%	105.4	-2.9%	103.6	-4.6%
August	83.6	85.3	2.0%	82.4	-1.4%	78.7	-5.9%
September	101.6	105.9	4.2%	106.2	4.5%	106.9	5.2%
October	83.1	86.7	4.3%	92.8	11.7%	99.0	19.1%
November	58.7	61.7	5.1%	69.0	17.5%	78.4	33.6%
December	38.0	46.3	21.8%	57.0	50.0%	67.6	77.9%

To accommodate the projected changes in precipitation, monthly runoff values for each of the sub-basins of Kenogamisis Lake were adjusted in proportion to the projected changes in precipitation. Linear interpolation was used to scale these adjustments between present day conditions based on the 30-year mean regional hydrological model, and the projected changes to 2025, between 2025 and 2055, and between 2055 and 2085. In addition, the potential for ongoing change beyond 2085 was addressed by extrapolating the predicted change between 2055 and 2085 through the period from 2085 to 2100. Thus, the climate change scenario implemented here is considered to be conservative, and likely to overstate the actual degree of change in precipitation for northwestern Ontario and Geraldton.

The STELLA™ model was then re-run using the same total annual arsenic loadings as previously, re-distributed to reflect changes in predicted mean monthly runoff patterns to evaluate the effect of increased runoff as a result of climate change on predicted total arsenic concentrations in water and sediment.

7.1 PREDICTED ARSENIC CONCENTRATIONS IN SEDIMENT

Figure 37 shows the simulated arsenic profiles in sediment for the six sub-basins of Kenogamisis Lake at the end of the year 2100. The predicted arsenic concentrations in surface sediments, and arsenic profiles in the simulated sediment cores are virtually unchanged from the previous simulation (e.g., Figure 30).

7.2 PREDICTED ARSENIC CONCENTRATIONS IN WATER

Figures 38 to 43 show the simulated arsenic concentrations in water for the six lake sub-basins, over the period from 2010 to 2100. These Figures are very similar to the corresponding model predictions made using runoff values based on the existing regional flow model (see Figures 31 to 36), the main difference being slightly lower minimum values occurring during the winter months.

The similarity in model predictions, in spite of substantial forecast changes in precipitation and runoff patterns, is due to the fact that precipitation levels in summer are not expected to change substantially from present-day conditions. During the summer, total arsenic concentrations in the lake water peak. However, the predicted precipitation patterns during the summer months (June, July and August) change very little between the present day and 2085. As a result, there is very little expected change in peak annual arsenic concentrations.

In winter and spring, the total arsenic concentrations in lake water are expected to be at a low level. Higher rainfall during the autumn, winter and spring would provide additional dilution, resulting in a slight reduction of arsenic concentrations in water during the autumn, winter and spring. Given warmer overall winter conditions, more of the winter runoff would be spread across the winter months (December to April), rather than being stored in snowpack and released as a strong pulse in April. As a result, a period of lower arsenic concentrations in the lake water would be spread across the winter months, rather than occurring so strongly during the spring freshet.

These conclusions are consistent with the findings from the sensitivity analysis, where wet years were shown to lead to predictions of lower arsenic concentrations in water, and dry years to predictions of higher arsenic concentrations in water, as a result in variations in the amount of flushing or dilution, relative to arsenic loadings. The effects of climate change would be observed in conjunction with ongoing variability in weather patterns (i.e., seasons and years that tend to be more or less wet than the long-term average condition, as in Figure 7). As was shown in Figure 8, the model predictions are responsive to monthly and seasonal variations in weather, even though the present analysis indicates little sensitivity to climate change.

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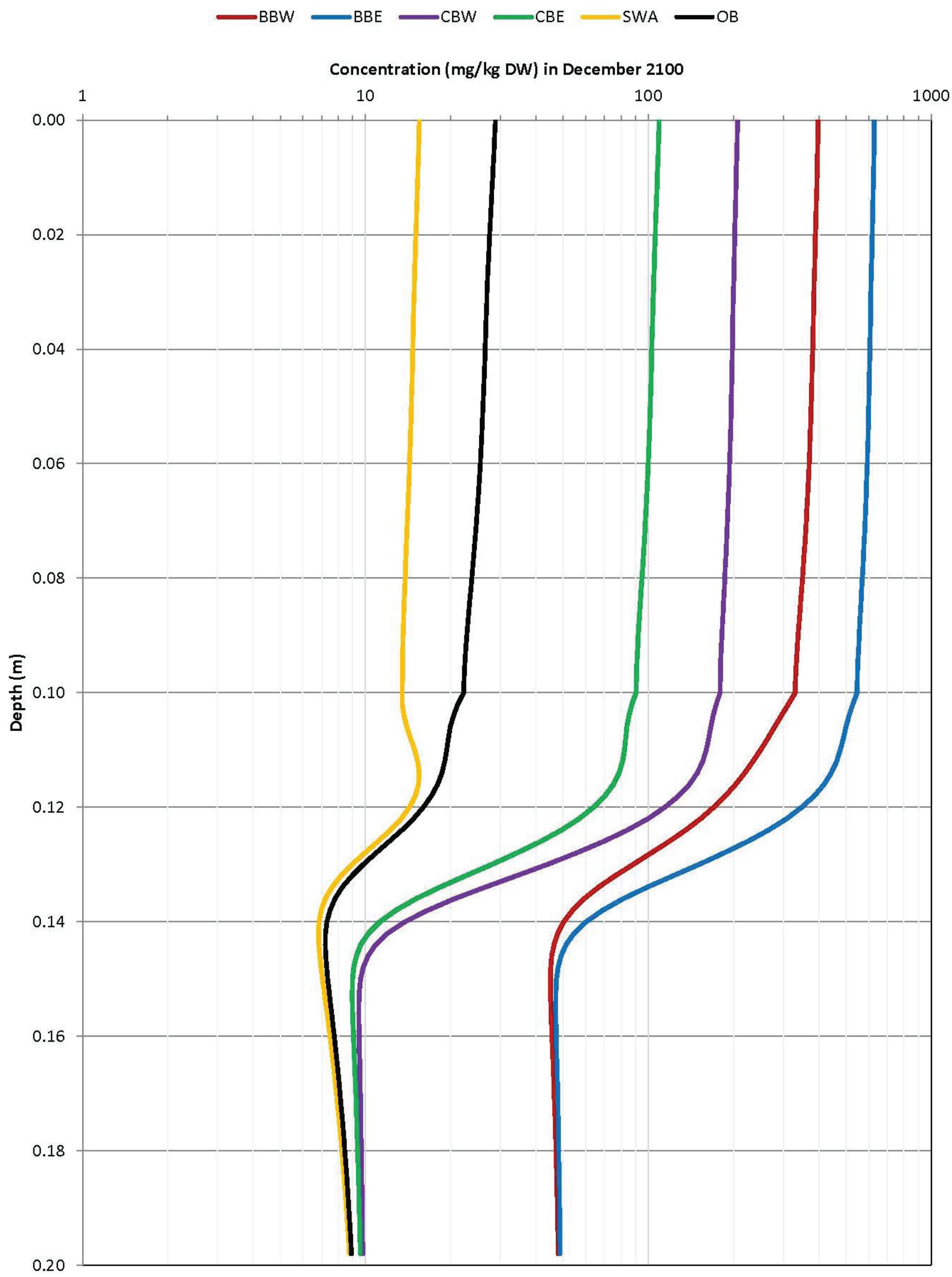
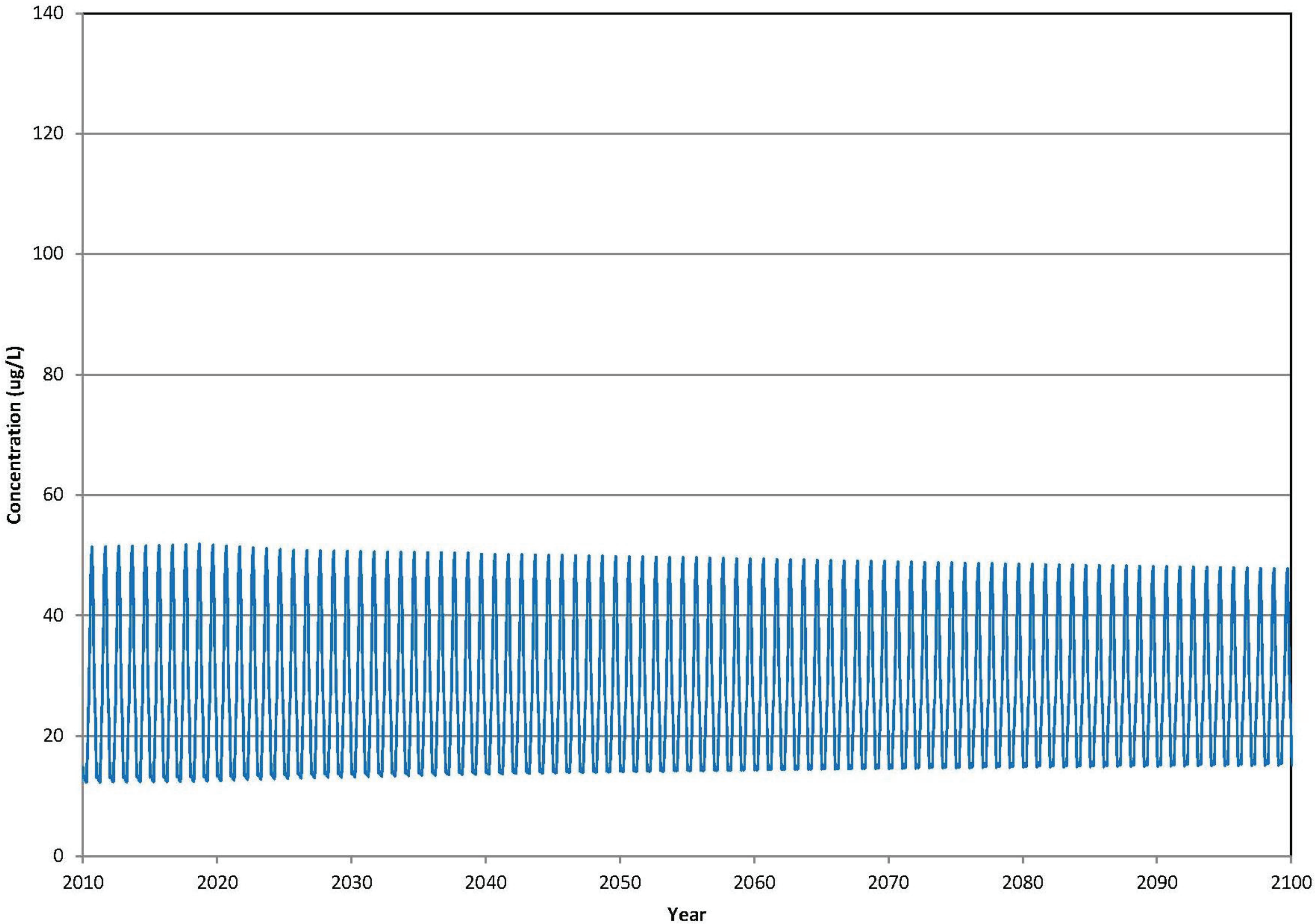


Total Arsenic Concentrations in Sediment under Climate Change Scenario (mg/kg) 2100	**Scale:** n/a		**Job No.:** 160961223	**Figure No.:** 37	Stantec
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS		
Client: Greenstone Gold Mines GP Inc.					



Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Total Arsenic Concentrations in Water (µg/L) BBW under Climate Change Scenario, 2018 to 2100	**Scale:** n/a	**Job No.:** 160961223		**Figure No.:** 38
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS	
Client: Greenstone Gold Mines GP Inc.				

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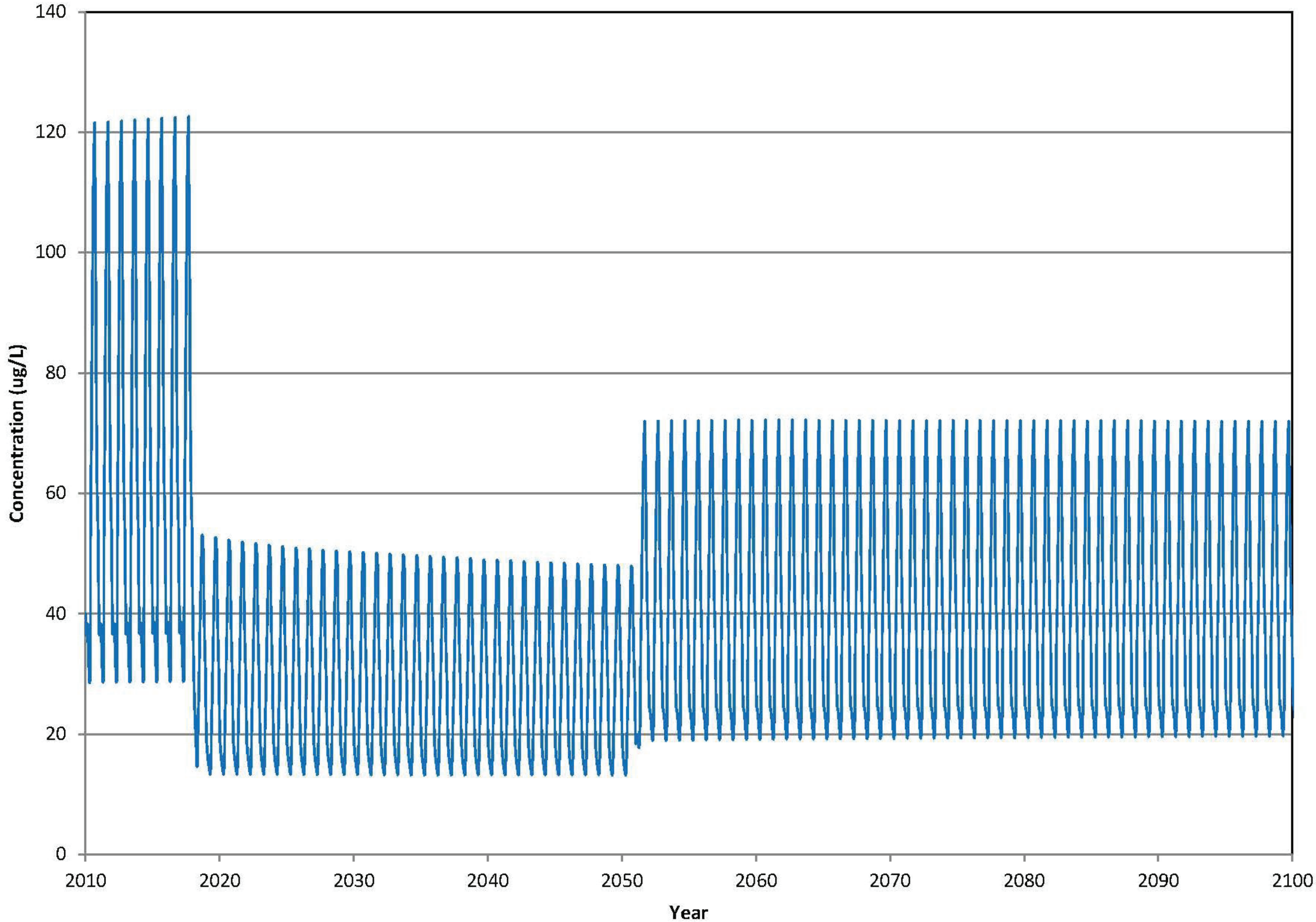

Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Total Arsenic Concentrations in Water (µg/L) BBE under Climate Change Scenario, 2018 to 2100	Scale: n/a		Job No.: 160961223	Figure No.: 39
Client: Greenstone Gold Mines GP Inc.	Date: January 30, 2018	Dwn By: PM	Appd. By: MS	

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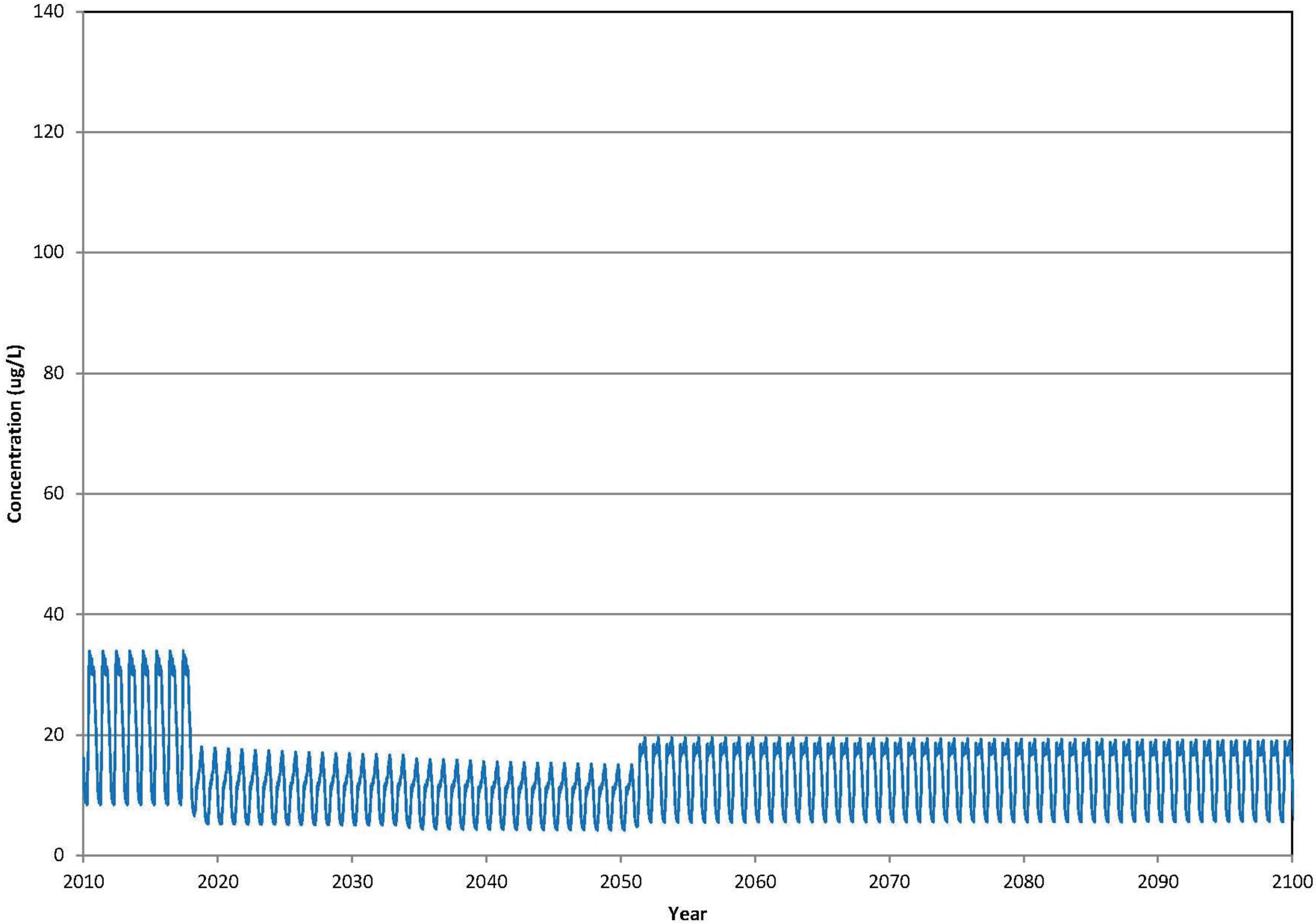
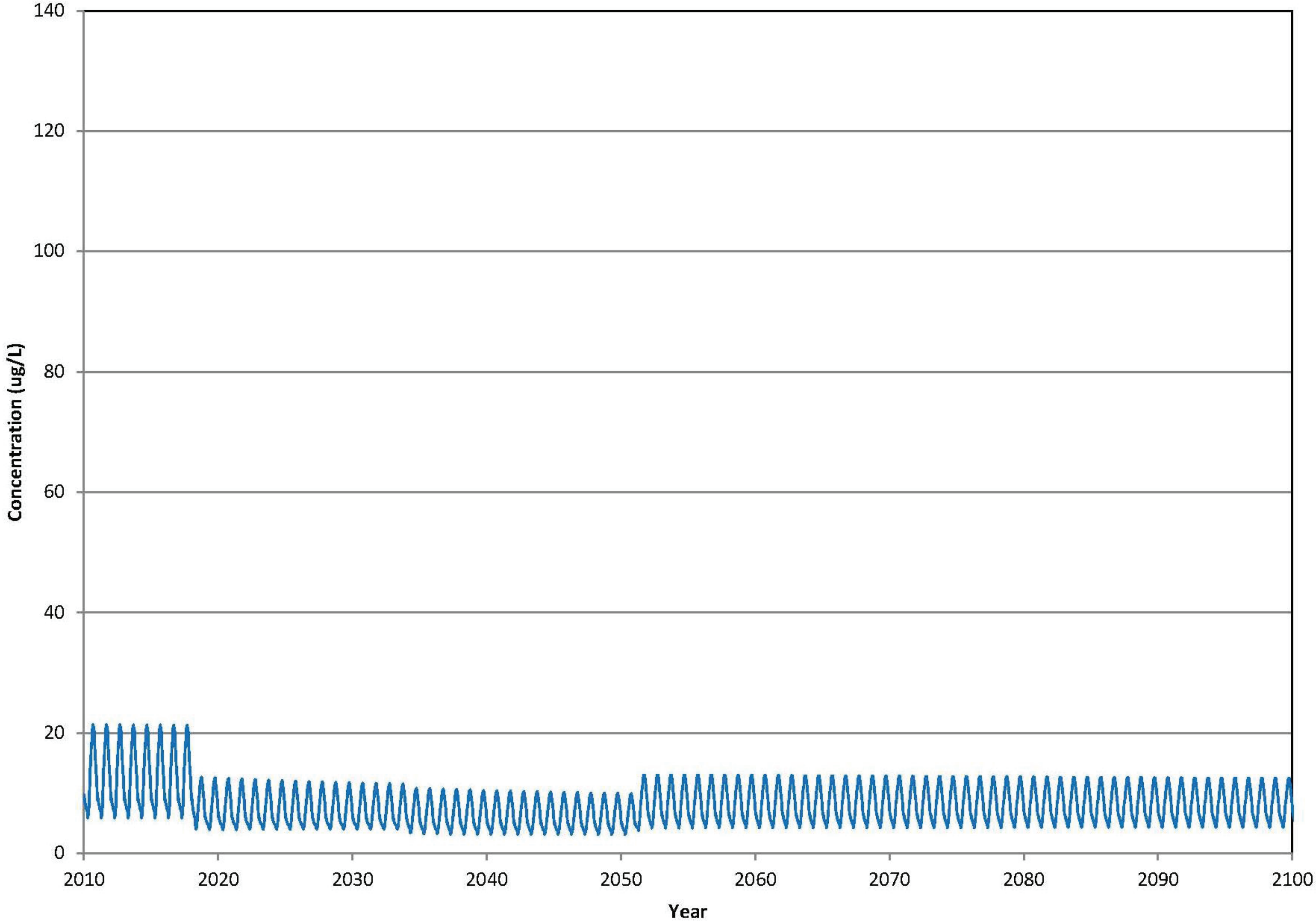


Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Total Arsenic Concentrations in Water (µg/L) **CBW under Climate Change Scenario, 2018 to 2100**	**Scale:** n/a	**Job No.:** 160961223		**Figure No.:** **40**
	Date: January 30, 2018	**Dwn By:** PM	**Appd. By:** MS	
Client: **Greenstone Gold Mines GP Inc.**				Stantec



Note: The line shows the predicted annual range of arsenic concentrations in water. Table 16 provides 95% confidence intervals for characteristic values of total arsenic in water.

Total Arsenic Concentrations in Water (µg/L) CBE under Climate Change Scenario, 2018 to 2100	**Scale:** n/a		**Job No.:** 160961223	**Figure No.:** 41	Stantec
Client: **Greenstone Gold Mines GP Inc.**	**Date:** January 30, 2018	**Dwn By:** PM	**Appd. By:** MS		

“GGM HARDROCK PROJECT - MERCURY IN SURFACE WATER, FISH TISSUE AND ASSOCIATED HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT” MEMO

To:	Steve Lines, Environmental Assessment and Permitting Manager Greenstone Gold Mines GP Inc.	From:	Sheldon Smith, MES, P.Geo Tony McKnight-Whitford, Ph.D. Stantec Consulting Ltd.
File:	160961144	Date:	January 12, 2018

Reference: GGM Hardrock Project - Mercury in Surface Water, Fish Tissue and associated Human Health and Ecological Risk Assessment

INTRODUCTION

Since the submission of the Final Environmental Impact Statement/Environmental Assessment (Final EIS/EA), several comments were submitted regarding the evaluation of potential ecological and human health effects related to the potential effect that the Project could have on mercury levels in surface water and fish tissue in Kenogamisis Lake. This memo provides additional information to clarify the baseline surface water sampling data for mercury in Kenogamisis Lake used in the assessment. It also identifies how non-detect samples were treated in the assessment and explains how the selected approach provides conservative over-estimates of future case mercury and methylmercury concentrations in surface water and fish tissue. This memo also clarifies how the approach used to estimate mercury levels in surface water and fish tissue results in over-estimations of potential exposures to mercury and methylmercury and the associated human health risks.

The surface water modelling results presented in the Hardrock Project Final EIS/EA incorporated 924 surface water samples and followed well established peer-reviewed methods to provide a conservative evaluation of the potential increase in mercury concentrations in Kenogamisis Lake. Based on this assessment, there is a high degree of confidence that the Project will make a negligible contribution to mercury and methylmercury concentrations in surface water in Kenogamisis Lake. Monitoring has been proposed to confirm these predictions. Based on the conservatism used in predicting mercury and methylmercury concentrations in surface water and fish tissue, there is also a high degree of confidence that the Project will make a negligible contribution to ecological and human health risks.

MERCURY IN SURFACE WATER

Mercury concentrations in surface water, under Baseline Case and Future Case conditions, are discussed in detail in Sections 10.2 through 10.4 of the Final EIS/EA. The following discussion provides an overview of the process used to determine baseline mercury concentrations in surface water bodies monitored by the Project and how these data were used to predict future mercury concentrations in surface water.

A total of 924 baseline surface water samples collected in support of the Project between 2013 and 2016 were submitted for metals analysis, including mercury. Mercury concentrations were below the original detection limit of 0.10 µg/L in the initial 45 water samples collected in late 2013. The detection limit of 0.10 µg/L is ½ the Provincial Water Quality Objective (PWQO) for mercury of 0.20 µg/L and is consistent with the MISA Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater (MOECC 2016), which indicates that the analytical method detection limits and limits of characterization for mercury should be 0.10 µg/L.

To obtain measured mercury concentrations in surface water, an additional 297 samples were collected and submitted for analysis using a mercury detection limit of 0.01 µg/L. Mercury concentrations in all 297 samples were below the 0.01 µg/L detection limit. In the remaining 582 samples collected as part of the baseline surface water sampling program, the mercury detection limit was lowered to 0.005 µg/L. Mercury concentrations were below the 0.005 µg/L detection limit in 569 of these 582 samples. Detectable concentrations of mercury were found in only 13 of the 582 samples.

Although the data strongly indicate that mercury concentrations in surface water are typically below 0.005 µg/L, the water quality assessment adopted a conservative approach in predicting both Baseline Case and Future Case mercury concentrations in surface water in Kenogamisis Lake. In samples where mercury concentrations were below the detection limit, consistent with ECCC 2012, mercury was assumed to be present at ½ the detection limit as follows:

i. For the 45 samples below detection at 0.10 µg/L, a concentration of 0.05 µg/L was used.

ii. For the 297 samples below detection at 0.01 µg/L, a concentration of 0.005 µg/L was used.

iii. For the 569 samples below detection at 0.005 µg/L, a concentration of 0.0025 µg/L was used.

When this conservative approach is used, the mercury mean aggregate concentration is calculated as 0.006 µg/L

Most of the baseline surface water samples were collected monthly from up to 35 sample locations. Some locations were sampled quarterly rather than monthly. Thus, the 924 surface water samples reflect seasonal and annual mercury concentrations from fixed locations in the study area over a three-year period. The 13 samples where mercury was detected at concentrations greater than 0.005 µg/L represent 1.4% of the samples. These data show that mercury concentrations at most sampling locations are below detection limits over the 3-year period even though the detection limits were lowered over the course of the sampling program. The minor increase in detections identified in sample sets with lower detection limits suggests that if the lowest detection limit of 0.005 µg/L were applied over the entire surface water monitoring program since 2013, it is expected that only 2 – 3% of samples would have been above the detection limit. This suggests that mercury concentrations in surface water are typically below 0.005 µg/L in surface water in Kenogamisis Lake. Based on these results it is reasonable to assume that mercury concentrations are below 0.005 µg/L. Thus, it would be reasonable to apply a ½ detection limit of 0.0025 µg/L to the 911 of 924 samples where mercury concentrations were below the detection limits. Such an approach would result in an estimated mercury concentration of 0.0025 µg/L Although, there is sound rationale for using 0.0025 µg/L as the estimated Baseline Case mercury concentration in surface water, the assessment used 0.006 µg/l as the estimated mercury concentration to provide conservative estimates of both Baseline and Future Case mercury concentrations in surface water.

The conservative data handling of non-detects samples (i.e., assumed mercury was present at ½ the detection limit) has resulted in an over-estimation of baseline mercury concentrations in surface water in Kenogamisis Lake. The over-prediction of baseline conditions results in a corresponding over-prediction of future conditions. This over-prediction of Future Case conditions is discussed further in the following sections.

MASS BALANCE WATER QUALITY ASSESSMENT

Building on the mass balance assessment completed for baseline conditions, a mass balance assessment for operation and closure was completed to predict water quality changes in watercourses/waterbodies including Barton Bay, Southwest Arm, Central Basin and the Outlet Basin of Kenogamisis Lake. Mercury was among the parameters selected for further assessment due to regulatory agency and Aboriginal community comments. The predicted changes in mercury in water during operation and closure for Kenogamisis Lake are discussed below.

Table 1 provides a mercury-focused overview of baseline conditions and predicted concentrations during operation, active closure and post-closure for the basins of Kenogamisis Lake. The increases predicted in Central Basin East reflect the over-prediction of baseline mercury concentrations at a station in the Central Basin. Other predicted increases are an artifact of baseline overprediction described above by use of ½ of the detection limit.

Table 1: Mercury Surface Water Quality - Baseline, Operation, Active Closure and Post-Closure

Site	Table Referenced in Final EIS/EA	Unit	PWQO	CWQG -FAL	Baseline	Predicted Operation	Predicted Active Closure	Predicted Post-Closure
Barton Bay West	Table 10-39	µg/L	0.2	0.026	0.0105	0.0105	0.0105	0.0105
Barton Bay East	Table 10-41	µg/L	0.2	0.026	0.0089	0.0091	0.0091	0.0091
Southwest Arm of Kenogamisis Lake	Table 10-43	µg/L	0.2	0.026	0.006	0.0069	0.0068	0.0068
Central Basin East	Table 10-45	µg/L	0.2	0.026	0.025	**0.029**	**0.0293**	**0.0279**
Outlet Basin	Table 10-47	µg/L	0.2	0.026	0.0068	0.0077	0.0073	0.0074

Note:
Bold numbers are identified as exceedances of PWQO/Interim PWQO/CWQG-FAL

SUMMARY OF MERCURY CONCENTRATION PREDICTIONS

Although there is strong evidence that mercury concentrations in the water of Kenogamisis Lake and surrounding surface waters monitored in support of the Project are very low, and geochemical evidence that suggests the Project will not contribute mercury to the receiving environment, the water quality loading prediction method used in the EIS/EA conservatively predicts an increase in mercury concentrations in surface water at certain locations. The conservative data handling and modelling approaches used throughout the development of the EIS/EA have resulted in an over-estimation of Baseline conditions, resulting in a corresponding over-prediction of Future Case conditions.

METHYL MERCURY

As discussed in Section 10.4.2.2 of the Final EIS/EA, the Goldfield Creek diversion to the Southwest Arm Tributary will increase the flow in the Southwest Arm Tributary and result in an increase of the permanently inundated area by approximately 15 ha. This is the limited area where the potential for mercury methylation to occur exists. While this area is accustomed to periodic flooding under baseline conditions and is not expected to be an appreciable source of mercury, the Ministry of the Environment and Climate Change (MOECC) requested that this be evaluated in the Final EIS/EA.

Reference: GGM Hardrock Project - Mercury in Surface Water, Fish Tissue and associated Human Health and Ecological Risk Assessment

The generation of methylmercury has been investigated through many studies at the Experimental Lakes Area of northern Ontario. The most applicable study was completed by St Louis et al. (2004) where it was reported that the net yield of methylmercury in the wetland complex increased from 1.7 mg/ha/yr under pre-flooding conditions to approximately 70 mg/ha/yr in the first year of loading. The net yield of methylmercury in the wetland complex declined (10 to 50 mg/ha/yr) during the subsequent flooding periods. The mercury methylation rates were observed to be the highest in the first 1 to 2 years of flooding and to decrease in subsequent years due to microbial demethylation.

Based on the studies discussed above, using the highest methylmercury net yield of 70 mg/ha/yr, the estimated methylmercury yield from the increased permanently inundated area around the Southwest Arm Tributary is approximately 1,050 mg/yr. Based on the mean annual flow estimated for the Southwest Arm Tributary after the diversion, the conservatively estimated increase in methyl-mercury concentration in the Southwest Arm Tributary is 0.0001 µg/L (0.1 ng/L). The CWQG-FAL limit for methylmercury is 0.004 µg/L, which is 40 times higher than the maximum predicted methylmercury concentration.

The findings presented by St Louis et al. (2004) were the result of a multi-disciplinary project undertaken at the Experimental Lakes Area (ELA) in northwestern Ontario to study how the construction of a reservoir over a wetland affects the surrounding ecosystem, including the reservoirs' cycling of mercury. To confirm the relevancy of the St Louis et al. (2004) study to the proposed work surrounding the Southwest Arm Tributary and Goldfield Creek diversion, a review of additional studies was undertaken. In addition to the St Louis et al. (2004) study, two additional studies resulting from this project (known as the Experimental Lakes Area Reservoir Project – ELARP) addressed the cycling of mercury and methylmercury in the constructed reservoir. Kelly et al. (1997) reported on fluctuations of methylmercury in the two years prior to and the two years following the reservoir's flooding. The St Louis et al. (2004) study was a follow up to the Kelly et al. (1997) study and analysed long-term (9-year) effects following reservoir flooding. The final study prepared by Paterson et al. (1998) studied the effects of methylmercury in zooplankton for a period of three years following the reservoir flooding for the ELARP.

While the ELARP project was carried out in a flooded wetland area because it was thought the high organic carbons in peat would present a worst-case scenario, researchers also wanted to study the various effects of reservoir construction, including methylmercury circulation, over boreal forest surfaces varying in stored organic carbon. The Flooded Upland Dynamics Experiment (FLUDEX) consisted of building dykes along low-lying contours at 3 sites with varying levels of stored organic carbon and ultimately flooding the sites. The operation of a reservoir at these sites was simulated through v-notch weirs acting as outfalls. The first study in FLUDEX prepared by Hall and St. Louis (2004) had a primary objective of observing among other variables, plant tissues' methylmercury concentrations, however the study was unable to identify impacts resulting from the varying levels of stored organic carbon between sites. A study by Hall et al. (2005) however, concluded that greater quantities of initial stored organic carbon generally coincided with greater yields of methylmercury in the water after flooding. Similar to findings from the various ELARP studies, methylmercury production in the FLUDEX study was highest in the first two years of the study, after which net demethylation began to reduce the water's methylmercury concentrations. Yields of methylmercury were found to be highest in the reservoir with medium quantities of initial organic carbon at 131 mg/ha/yr, which was nearly two times higher than the 70 mg/ha/yr peak found in the ELARP.

The proposed Goldfield Creek diversion to the Southwest Arm Tributary involves the inundation of an aggregate pit and Goldfield Creek to form the Goldfield Diversion Pond, the construction of a new diversion channel and the construction of low head weirs in the lower reaches of the Southwest Arm in areas dominated by riparian wetlands. As such, the proposed works are considered most comparable to the wetland inundation studies conducted in the ELARP research program. However, as some aspects of the FLUDEX study may also be relevant, the higher maximum mercury methylation rate observed in the FLUDEX study was also applied to the proposed Goldfield Creek diversion works. Based on the mean annual flow estimated for the Southwest Arm Tributary after the diversion, the conservatively estimated increase in methylmercury concentration in the Southwest Arm Tributary using the 131 mg/ha/yr FLUDEX maximum rate is <0.0002 µg/L (<0.2 ng/L). The CWQG-FAL limit for methyl mercury is 0.004 µg/L (4 ng/L), over 20 times higher than the maximum predicted methylmercury concentration.

In recognition of the possible effects on water quality from the construction of a new small hydro reservoir, the Ontario Waterpower Association, in consultation with the MOECC, developed a Best Management Practice (BMP) (Hutchinson 2016) for managing the uncertainties regarding methylmercury prediction. Referencing the previously mentioned studies, the BMP provides a descriptive explanation of possible factors affecting the presence of methylmercury and how to minimize its possible effects.

MERCURY MITIGATION

Despite negligible effects under a conservatively modelled scenario, the following proposed Project activities and mitigation measures are expected to reduce the potential for mercury release and methylation:

- Clearing and grubbing of organic vegetation prior to inundation to reduce potential mercury methylation. This is particularly relevant for the diversion aggregate pit area in the Goldfield Creek Diversion pond and the diversion channel from the pond to Lahtis Road.
- Removal and collection of organic soils, where feasible, for subsequent use in progressive rehabilitation to reduce potential mercury methylation. This is feasible where constructability and access permits in the upper section of the diversion channel and aggregate pit area in the Goldfield Creek Diversion Pond.
- The proposed inundation areas specifically reduce shoreline erosion, which is otherwise known to accelerate potential mercury methylation release.
- The proposed inundation zones are riverine in the upper diversion channel section and more lacustrine in the Southwest Arm Tributary lowland. The diversion increases the catchment area of Southwest Arm Tributary by more than 200% and will flush more water through the system than under baseline conditions reducing the potential for concentration increase over time under static or low flow conditions.
- Water quality monitoring of the streams and lakes in the local assessment area including the Goldfield Creek Tributary, Goldfield Creek diversion channel, Southwest Arm Tributary inflow to the Southwest Arm of Kenogamisis Lake and Mosher Lake.

MERCURY IN FISH TISSUE

Health concerns related to mercury in fish tissue are generally related to exposure to methylmercury, which is formed from mercury by microorganisms in waterbodies and can eventually accumulate in fish tissue. Methylmercury bioaccumulates in fish tissue resulting in the highest concentrations generally being found in large predatory fish (e.g., walleye) that prey on smaller fish.

For the characterization of baseline conditions in the Project area for the EIS/EA (i.e., Baseline Case), three species of fish were collected to determine concentrations of metals in fish tissue: Spottail Shiner, Trout-

Perch, and Walleye. In total, 31 samples of wholebody small fish (Spottail Shiner and Trout-Perch) from Goldfield Creek, Southwest Arm of Kenogamisis Lake, Kenogamisis Lake (historical Hardrock Tailings), and Kenogamisis Lake (historical MacLeod tailings) were analyzed for metals (including mercury and methylmercury). The data from the wholebody analysis of these small fish were used to estimate health risks in the ecological risk assessment (ERA) for piscivorous species because smaller fish rather than larger fish are expected to be a food source. In total, 55 samples of Walleye liver and Walleye fillet from Goldfield creek, Southwest Arm of Kenogamisis Lake and Kenogamisis River Outlet were analyzed for metals (including mercury and methylmercury) and the results were used in the human health risk assessment (HHRA). Walleye is a target species for fishing in Kenogamisis Lake.

The 95% upper confidence limit of the mean (UCLM) concentrations of total mercury and methylmercury in both whole body fish tissue and combined fillet and liver tissue are provided in Table 2. The concentration of methylmercury in tissue from large fish is approximately four times greater than in small fish (bioaccumulation). In both the HHRA and ERA, mercury in fish tissue was conservatively assumed to be 100% methylmercury. Based on the results provided in Table 2, this assumption results in an overestimation of the methylmercury concentration by approximately two times, which in turn results in an approximately two times overestimation of health risks for both human and ecological receptors exposed to methylmercury in fish tissue.

Table 2: Concentration of Mercury and Methylmercury in Fish Tissue.

Fish	Number of Samples	Parameter	95% UCLM Concentration (mg/kg wwt)	% Methylmercury
Large Fish (i.e., Walleye)- Analysis of Fillet and Liver	55	Total Mercury	0.586	44.4%
		Methylmercury	0.260	
Small Fish (i.e., Spottail Shiner, Trout-Perch)- Analysis of Wholebody	31	Total Mercury	0.151	44.5%
		Methylmercury	0.0672	

HHERA AND MERCURY

The baseline surface water sampling shows that mercury and methylmercury levels in surface water in Kenogamisis Lake are generally below the method detection limits as well as below the levels that represent an environmental concern for human or ecological receptors. The geochemical leach data supports the conclusion that the Project will not alter mercury or methylmercury levels in the lake or in the tissues of fish that reside in the lake. The conservative assumptions used in predicting the changes in mercury levels in the lake and those used in predicting the potential human health and ecological risks associated with these changes overestimate the potential Project-related risks associated with mercury. Potential health risks are further overestimated by assuming mercury in fish tissue is 100% methylmercury. Even with these over-predictions, the Project-related health risks associated with the methylmercury are considered negligible. The multiple conservative assumptions used in these predictions provide a high degree of confidence in this conclusion.

Reference: GGM Hardrock Project - Mercury in Surface Water, Fish Tissue and associated Human Health and Ecological Risk Assessment

STANTEC CONSULTING LTD.

<Original signed by>

Tony McKnight-Whitford, Ph. D.
Risk Assessor
Phone: (905) 381-3296
Fax: (905) 385-3534
Tony.mcknight-whitford@stantec.com

<Original signed by>

Sheldon Smith, MES P.Geo.
Senior Hydrologist
Phone: (905) 415-6405
Fax: (905) 474-9889
Sheldon.smith@stantec.com

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HARDROCK PROJECT – Requirements Under CEAA 2012 Section 5(1)(c) – In Accordance with Section 6.3.4 of the EIS Guidelines issued by the CEA Agency – February 2018 Update

Prepared for:
Greenstone Gold Mines GP Inc.
365 Bay St, Suite 500
Toronto ON M5H 2V1

Prepared by:
Stantec Consulting Ltd.
1-70 Southgate Drive
Guelph ON N1G 4P5

File No. 160961223
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Executive Summary

In this report, Stantec Consulting Ltd. (Stantec) provides an assessment of the effects of changes to the environment on Aboriginal peoples that may result from the construction, operation, and eventual closure of the Hardrock project, an open pit gold mine and mill to be developed by Greenstone Gold Mines GP Inc. (GGM) in the Municipality of Greenstone (Municipality), Ward of Geraldton, approximately 275 km northwest of Thunder Bay, Ontario.

The Final Environmental Impact Statement/Environmental Assessment (EIS/EA) for the Hardrock Project, prepared to meet the requirements of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) as well as the Ontario *Environmental Assessment Act* (EAA), was submitted to the federal and provincial government agencies in July 2017. This report was submitted as Appendix O of the Final EIS/EA and was specifically intended to address the requirements of Section 6.3.4 of the "Guidelines for the Preparation of an Environmental Impact Statement pursuant to the *Canadian Environmental Assessment Act, 2012* – Hardrock Deposit Project: Premier Gold Mines Hardrock Inc." (EIS Guidelines; CEA Agency 2014, 2016) issued by the Canadian Environmental Assessment Agency (CEA Agency).

This assessment was conducted in accordance with the requirements of Section 5(1)(c) of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and Section 6.3.4 of the EIS Guidelines.

Overall Project Context

The Hardrock property is a historical mine site that was actively mined from the 1930s to the 1970s, and in later years was known as the MacLeod-Mosher complex. The historical underground operations at the Hardrock property included multiple mining operations, and the mine site was subject to mine closure work and rehabilitation in the late 1990s. Much of the Project site and surrounding area has been affected by historical activities from mining, forestry, aggregate extraction, highway transportation, mineral exploration, and residential and industrial land uses over the past 90 years.

The Project is thus largely a brownfield redevelopment that will enable the resumption of mining operations at the Hardrock property for a period of up to 15 years. In so doing, it will provide benefits, employment, and business opportunities to the Geraldton and surrounding areas for both Aboriginal and non-Aboriginal persons alike during this period, in addition to providing mining revenue to GGM and its shareholders and generating taxes and royalties for governments. Commitments and mitigation made by GGM will also promote the involvement of local Aboriginal communities in the Project including providing opportunities for environmental monitors, environmental committees, and supporting local Aboriginal cultural practices through community driven initiatives, among others.

Approach and Methods

In accordance with Section 5(1)(c) of CEAA 2012, the assessment was carried out by assessing environmental effects on:

- Aboriginal health conditions,
- Aboriginal socio-economic conditions,
- Aboriginal physical and cultural heritage (including structures, sites or things of historical, architectural, archaeological, or palaeontological significance), and
- the current use of lands and resources for traditional purposes by Aboriginal persons (or "current use", for short).

Collectively, these were referred to as the "Section 5(1)(c) Factors", for brevity.

The following steps were followed to consolidate the assessment of Section 5(1)(c) Factors into this report, as informed by information obtained through consultation with fourteen Aboriginal communities that have an interest in the Project, traditional land and resource use studies, and secondary sources of information:

- Identifying the Key Topics for each of the Section 5(1)(c) Factors.
- Determining the valued components (VCs) assessed in the EIS/EA which are relevant to the Section 5(1)(c) Factors, and associated Key Topics.
- Identifying spatial and temporal boundaries for assessing the effects of changes to the environment on the Section 5(1)(c) Factors.
- Discussing the potential mechanisms, that in the absence of mitigation, by which changes to the environment identified in the assessment of VCs in the EIS/EA may occur, and the Section 5(1)(c) Factors resulting from such changes as they relate to the Key Topics.
- Identifying mitigation measures for addressing potential changes to Section 5(1)(c) Factors.
- Discussing and characterizing the residual effects of changes to the environment identified in the assessment of related VCs on Aboriginal peoples, and the potential residual changes to Section 5(1)(c) Factors.
- Discussing cumulative environmental effects on the Section 5(1)(c) Factors as presented in the individual VCs.
- Identifying follow-up measures that are relevant to the Section 5(1)(c) Factors.

Environmental Planning, Management, and Mitigation to Avoid or Reduce Environmental Effects

In considering the effects of changes to the environment on Aboriginal peoples as outlined in Section 5(1)(c) of CEAA 2012 and the EIS Guidelines, it is helpful to consider the overall project planning and management approaches that GGM has adopted in developing the Project, to provide additional context on how environmental effects of the Project have been avoided or mitigated, thereby further benefiting Aboriginal peoples in the context of effects of changes they may experience in relation to the Section 5(1)(c) Factors. As was outlined in Section 1.5 of the Final EIS/EA, GGM has planned the Project in a careful manner to avoid or mitigate possible environmental effects including delivering positive environmental outcomes by addressing historical tailings issues within the PDA. The following guiding principles, planning and management strategies have been followed to avoid or reduce environmental effects:

- Adherence to federal and provincial regulatory requirements, and meeting or exceeding all applicable industry codes and standards.
- Adopting guiding principles for design and implementation of the Project, including the use of proven and applicable technologies (e.g., water treatment), best management practices, limiting the Project footprint, and designing for closure and end land use objectives.
- Implementing environmental protection, mitigation, and management strategies and concepts that avoid or limit adverse environmental effects, and enhance positive ones including addressing historical tailings within the PDA.
- Addressing feedback received from stakeholders, government agencies and Aboriginal communities to limit environmental effects and address concerns to the extent possible.

With the exception of the open pit (for which the location is fixed by the location of the mineral resource), GGM has emphasized Project design and siting so that the location and configuration of the Project facilities considers the above measures, wherever possible, to avoid or limit the potential environmental effects of the Project to the benefit of Aboriginal and non-Aboriginal persons alike. Comments received from stakeholders, government agencies, and Aboriginal communities on the Draft EIS/EA, and throughout the entire EA process, have influenced the Project and helped to refine the location of Project components and improve the development of mitigation measures to avoid or reduce potential environmental effects. To the extent possible, Project facilities have been located to avoid and reduce interactions with lakes and watercourses, and other sensitive environmental features. Where avoidance was not possible, mitigation has been developed as part of the EA process. Some of the key features of the Project that avoid or reduce environmental effects of the Project, many of which also reduce the effects of potential changes to the environment on Aboriginal persons, include the following:

- Minimizing the Project footprint by maximizing the use of the brownfield area of the PDA to limit the area of new disturbance and exclusion zones associated with the Project, thereby minimizing potential effects to current use as well as Aboriginal health conditions, Aboriginal socio-economic conditions, and Aboriginal physical and cultural heritage. This includes avoidance of Goldfield Lake Road, which is a key access road to land use areas west and south of Kenogamisis Lake.
- Relocating a portion of the historical MacLeod and Hardrock tailings to the new TMF, and implementing an enhanced cover, stability measures and seepage collection for the remaining historical MacLeod tailings to reduce seepage, provide safety and long-term

stability of structures, thereby substantially reducing environmental effects to groundwater and surface water quality from these historical tailings during operation through post closure When compared with present day baseline conditions, arsenic concentrations in the water of the Southwest Arm of Kenogamisis Lake would increase slightly during operation, returning to near baseline thereafter. This slight increase would be more than offset by substantial decreases in total arsenic concentrations in the waters of Barton Bay East, the Central Basin, and the Outflow Basin during operation, and continuing through post closure.

- Building and operating an effluent treatment plant (ETP) to collect and treat (as required) surplus contact water before discharge to the environment, with effluent to meet the effluent criteria specified in the *Metal Mining Effluent Regulations (*MMER), Ontario Regulation (O.Reg.) 560/94, and the Ontario Ministry of Environment and Climate Change (MOECC) environmental compliance approval (ECA) effluent criteria requirements.
- Use of tailings management facility (TMF) reclaim water and Project contact water to supply process water, thereby eliminating direct discharge from the TMF, and reducing the need for obtaining fresh water from Kenogamisis Lake during operation, thereby limiting potential effects on Aboriginal health conditions and on current use.
- Use of equipment that operates efficiently to limit air and noise effects, thereby limiting sensory disturbance to wildlife, minimizing potential deposition onto vegetation, country foods and drinking water that could otherwise affect Aboriginal health conditions and current use.
- Limit Project footprint and maximize use of existing brownfield area to reduce disturbance to surrounding areas such as fen/wetlands, watercourses and important habitat types, and to reduce the size and number of natural drainage features that may be affected so as to limit potential effects on Aboriginal health conditions, Aboriginal socio-economic conditions, and current use. This includes avoidance of Goldfield Road, which is a key access road to land use areas west and south of Kenogamisis Lake.
- Contact water collection system (i.e., ponds and ditching) to collect seepage and runoff from Project components and provide additional water for the mill and process plant, mitigating contact-water effects, and freshwater use that could otherwise affect Aboriginal health conditions.
- Inclusion of a temporary camp to house construction works during construction and early operation to limit potential effects on Community Services and Infrastructure that could, in turn, affect Aboriginal socio-economic conditions.
- Relocating Goldfield Creek using natural design principles incorporating offsets for effects on fish and fish habitat, and maintain natural flow through Goldfield Lake and the outlet to the Southwest Arm Tributary, to maintain habitat and water flow connectivity with the Southwest Arm of Kenogamisis Lake, thereby limiting potential effects on current use and Aboriginal socio-economic conditions.
- Sequencing of waste rock disposal in the waste rock disposal areas (WRSAs) to facilitate progressive rehabilitation during mine life, and with closure in mind for effective water management without the need for perpetual care, thereby reducing potential effects on

Aboriginal health conditions, Aboriginal socio-economic conditions, Aboriginal physical and cultural heritage, and current use.

Other key design mitigation features of the Project are highlighted in Section 1.5.2 of the Final EIS/EA. The avoidance of adverse environmental effects by design was, and continues to be, an important principle of the Project's design process. Where avoidance is not possible, environmental protection, mitigation, and management measures have been incorporated into the design of the Project.

Benefits of the Project

In considering the effects of changes to the environment on Aboriginal peoples as outlined in Section 5(1)(c) of CEAA 2012 and the EIS Guidelines, it is helpful to consider the overall benefits of the Project, to provide additional context on the environmental effects and mitigation for the Project that could, in turn, benefit the Section 5(1)(c) Factors for Aboriginal peoples. As discussed in Section 1.2 of the Final EIS/EA for the Project, the Project presents a number of benefits and opportunities, including:

- Reducing current environmental effects from historical mining activities through rehabilitation measures to address the historical MacLeod and Hardrock tailings, including: relocating a portion of the historical MacLeod and Hardrock tailings to the new TMF; and implementing an enhanced cover, stability measures and seepage collection for the remaining historical MacLeod tailings to reduce seepage, provide safety and long-term stability of structures. These rehabilitation measures will improve water quality in Kenogamisis Lake compared to existing conditions.
- Positively affect employment and skills development, through the creation of full-time employment in Northern Ontario in each of the approximately 23 years from construction through active closure.
- Contribution to government revenues and economic activity, including:
- the anticipated creation of $242 million in revenues (undiscounted) for Ontario, and $215 million for Canada
- the anticipated increase in Gross Domestic Product by $3.1 billion in revenues (undiscounted) for Ontario and $6.3 billion for Canada.
- Project expenditures on labour, goods and services of approximately $480 million locally and $1.9 billion regionally over the life of the Project. Job creation, training opportunities, and business opportunities would be available for both non-Aboriginal and Aboriginal persons that wish to participate in Project development.
- Establishment of productive local partnerships that contribute to achieving development goals identified by the community, to address local priorities and concerns, and to have communities derive benefits from the Project, including increased labour force capacity, reduced unemployment, increased personal and family income, and increased income for regional businesses.

- Specifically, for local Aboriginal communities, GGM will also promote the involvement of local Aboriginal communities in the Project including:
  - working to support the capacity of Aboriginal business to participate in mine procurement, as well as supporting training of Aboriginal people through agreements with communities, seeking joint funding of programming, preparedness training, and providing on-the-job training.
  - maximizing hiring of local and Aboriginal people.
  - supporting the use of local Aboriginal environmental monitors and/or technicians.
  - providing opportunities to local Aboriginal communities to review and comment on permits, the Closure Plan, Environmental Management Plans, and monitoring.
  - consulting with local Aboriginal communities prior to engaging an archaeologist for any further archaeology work that may be required, as well as regarding disposition and treatment of any heritage resources that may be found.
  - meeting regularly (or at least annually) with local Aboriginal communities to share information about the Project.
  - supporting local Aboriginal cultural practices through community driven initiatives.

Other benefits of the Project are provided in Chapter 25 of the Final EIS/EA. These benefits and opportunities would be available to non-Aboriginal and Aboriginal persons alike (either through direct participation in Project development or indirectly as a result of local and regional prosperity arising from the Project). The Project will also contribute significantly to local and regional businesses through direct and indirect employment as well as from Project expenditures, as well as the municipal, provincial, and federal governments through the generation of tax and mining royalty revenue.

To minimize the effects of changes to the environment on Aboriginal persons, GGM will implement various mitigation measures as part of the Project; some of those key mitigation measures are outlined below.

- To minimize effects on the practice of traditional activities caused by loss of access to traditional land and resource use (TLRU) sites due to access restrictions to the PDA (including the closure of Lahtis Road), access via Goldfield Road and access to the Southwest Arm of Kenogamisis Lake will be maintained.
- Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek diversion. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas as a result of the Project. More than half of the 6.58 ha of fish habitat that will be altered or lost is comprised of artificial golf course pond and poor quality habitat such as roadside ditches.
- Where there is interest, GGM will provide opportunities to local communities for harvesting of plants for traditional purposes prior to construction.

- During construction, clearing of the PDA will result in a loss of wildlife habitat. In particular, wetland and forest areas will have some irreversible loss of associated wildlife habitat. During operation, hunted and trapped species will be affected because of indirect loss or alteration by sensory disturbance (habitat avoidance or under-utilization due to human activity); however, this is not predicted to affect the continued viability of wildlife within the RAA.

With respect to cultural and spiritual sites, LLFN reported four campsite or cabin areas within the PDA, and MNO reported a tent or temporary structure south of Mosher Lake and a route connecting Highway 11 with Mosher Lake, both conservatively assumed to be located within the PDA. In addition, comments made by AFN to the CEA Agency confirmed they use snowmobile trails, which are operated by the Ontario Federation of Snowmobile Clubs and maintained by the Greenstone Snowmobile Club, along Highway 11 in the PDA for hunting. Though construction will affect these locations, and mitigation measures discussed throughout this report will minimize the effects of changes to the environment on Aboriginal persons to the extent that they are not significant.

Finally, GGM remains committed to continuing its outreach activities, to keep Aboriginal communities informed of the Project and to provide transparency about GGM's environmental management and monitoring performance as well as to continue to provide opportunities to discuss interests and comments, and resolve issues, related to the Project.

Overall Summary and Determination of Significance

In consideration of the above, and in consideration of identified mitigation, information provided by Aboriginal communities, and specific consideration of how the effects of those changes to the environment might affect Aboriginal persons, the residual effects on Section 5(1)(c) Factors (including Aboriginal health conditions, Aboriginal socio-economic conditions, Aboriginal socio-economic conditions, and current use) are characterized as not significant for all Project phases. Additionally, considering the effects analyses and conclusions of the Final EIS/EA, the mitigation to be employed to reduce environmental effects, and GGM's commitment to ongoing engagement with and support to local Aboriginal communities, the effects of the Project on the Section 5(1)(c) Factors have therefore been characterized as not significant. As a result, it is anticipated that Aboriginal communities will continue to have the ability to exercise Aboriginal and treaty rights outside of the PDA.

Through the planned involvement of Aboriginal communities in the Project, GGM anticipates that it will be able to address comments and concerns that may arise from Aboriginal communities from time to time as the Project advances through development.

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LIST OF TABLES

1.0 INTRODUCTION

Greenstone Gold Mines GP Inc. (GGM, the Proponent) proposes the construction, operation, and closure of an open pit gold mine and associated ancillary activities, collectively known as the Hardrock Project (the Project). The Project is located in northwestern Ontario, approximately 275 kilometres (km) northeast of Thunder Bay, in the Municipality of Greenstone, Ward of Geraldton.

The Project components include an open pit, ore processing facilities including crushing and process plants, waste rock storage areas (WRSAs), tailings management facility (TMF), natural gas-fuelled power plant, and other associated buildings and processes. Project activities include the removal or relocation of existing infrastructure currently located within the Project development area (PDA). The Project is situated in a rural area and partially within a historical mine site. The historical mine site was actively mined from the 1930s to the 1970s, and in later years was known as the MacLeod-Mosher complex. The historical underground operations included multiple mining operations, and the mine site was subject to mine closure work and rehabilitation in the late 1990s. The Project is thus largely a brownfield redevelopment that will enable the resumption of mining operations at the Hardrock property.

In February 2016, GGM submitted a Draft Environmental Impact Statement/Environmental Assessment (EIS/EA) (Stantec 2016) to government agencies, Aboriginal communities and stakeholders for review and comment. The Draft EIS/EA was intended to meet the requirements of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) as well as the Ontario *Environmental Assessment Act* (EAA). A number of follow-up meetings were held to present the Project and discuss comments/responses received.

As a result of follow-up meetings with the Canadian Environmental Assessment Agency (CEA Agency) in August and October 2016, GGM was required to develop this report in relation to the effects of changes to the environment on Aboriginal peoples, as required by Section 5(1)(c) of CEAA 2012. This report consolidates the assessment of effects of the changes to the environment on Aboriginal peoples found throughout the Final EIS/EA (Stantec 2017d) into a single document for ease of readership, and focuses the assessment on the effects identified in Section 6.3.4 of the "Guidelines for the Preparation of an Environmental Impact Statement pursuant to the *Canadian Environmental Assessment Act, 2012* – Hardrock Deposit Project: Premier Gold Mines Hardrock Inc." (EIS Guidelines; CEA Agency 2014, 2016).

The Final EIS/EA for the Hardrock Project was submitted to the federal and provincial government agencies in July 2017. This report was submitted as Appendix O of the Final EIS/EA and was specifically intended to supplement the requirements of Section 6.3.4 of the EIS Guidelines. Comments from reviewers, and in particular the CEA Agency, on the Final EIS/EA identified additional information requests for this report, aimed primarily at including more comprehensive discussions of environmental effects within this report so that the report can be considered essentially standalone outside of the Final EIS/EA and to include more information on environmental effects to specific Aboriginal communities, where such information exists elsewhere in the Final EIS/EA.

It is important to note that, in accordance with the requirements of the EIS Guidelines, the discussions and conclusions of this document are provided from the perspective of GGM as the proponent of the Project, as well as from the perspective the environmental practitioners at Stantec as having conducted the environmental assessment of the Project. These views are intended to inform and complement (rather than supplement) the views and determinations of the Government of Canada in respect of the Project.

2.0 REGULATORY AND POLICY SETTING

2.1 CANADIAN ENVIRONMENTAL ASSESSMENT ACT, 2012

As set out in Section 5(1)(c) of *Canadian Environmental Assessment Act, 2012* (CEAA 2012), the environmental effects that are to be considered with respect to Aboriginal peoples include "…*an effect occurring in Canada of any change that may be caused to the environment on*

i. health and socio-economic conditions,
ii. physical and cultural heritage,
iii. the current use of lands and resources for traditional purposes, or
iv. *any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.*"

2.2 EIS GUIDELINES

In addition to the requirements set out in CEAA 2012, the CEA Agency released the EIS Guidelines (CEA Agency 2014) on August 5, 2014 which specify the nature, scope and extent of the information required in the Environmental Impact Statement (EIS). On February 12, 2016, the CEA Agency provided an addendum update to the EIS Guidelines for the Project. The revision to the EIS Guidelines (CEA Agency 2016) describes the changes to the CEA Agency's list of Aboriginal communities with which GGM is expected to engage for the environmental assessment (EA). This list of Aboriginal communities is included in Section 2.4 of this report.

2.2.1 Environmental Effects Assessment -Aboriginal Peoples

This report consolidates the assessment of effects of the changes to the environment on Aboriginal peoples required by Section 6.3.4 of the EIS Guidelines (addressed throughout the Final EIS/EA) into a single document, for ease of readership. Section 6.3.4 of the EIS Guidelines requires: "…*with respect to Aboriginal peoples, a description and analysis of how changes to the environment caused by the Project will affect:*

- *the current uses of land and resources for traditional purposes, including, but not limited to:*
  - *any effects on resources (fish, wildlife, birds, plants or other natural resources) used for traditional uses (e.g. hunting, fishing, trapping, collection of medicinal plants, use of sacred sites;*
  - *any effects of alterations to access into the areas used for traditional uses, including development of new roads, deactivation or reclamation of access roads and changes to waterways that affect navigation;*

  - *any effects on cultural value or importance associated with traditional uses or areas affected by the project (e.g. inter-generational teaching of language or traditional practices, communal gatherings);*
  - *how project construction timing correlates to the timing of traditional practices, and any potential impacts resulting from overlapping periods;*
  - *the regional value of traditional use of the project area and the anticipated effects to traditional practice of the Aboriginal group, including alienation of lands from Aboriginal traditional use;*
  - *indirect effects such as avoidance of the area by Aboriginal peoples due to increased disturbance (e.g. noise, presence of workers); and*
  - *an assessment of the potential to return affected areas to pre-disturbance conditions to support traditional practices.*
- *human health, considering, but not limited to potential changes in air quality, quality and availability of country foods, drinking water quality, and noise exposure. When risks to human health due to changes in one or more of these components are predicted, a complete Human Health Risk Assessment (HHRA) examining all exposure pathways for pollutants of concern may be necessary to adequately characterize potential risks to human health;*
- *socio-economic conditions, including but not limited to:*
  - *the use of navigable waters;*
  - *forestry and logging operations;*
  - *commercial fishing, hunting, trapping, and gathering activities;*
  - *commercial outfitters; and*
  - *recreational use.*
- *physical and cultural heritage, and structure, site or thing of historical, archaeological, paleontological or architectural significance to Aboriginal groups, including, but not limited to:*
  - *the loss or destruction of physical and cultural heritage;*
  - *changes to access to physical and cultural heritage; and,*
  - *changes to the cultural value or importance associated with physical and cultural heritage*" (CEA Agency 2014).

2.2.2 Aboriginal Engagement

Section 5 of the EIS Guidelines identifies the Aboriginal communities with whom GGM is expected to engage, the topics upon which GGM should obtain Aboriginal community's views (including Aboriginal and treaty rights and information about Aboriginal engagement), and concerns which should be included in the EIS/EA. As identified in EIS Guidelines Concordance Table (Appendix B1 of the Final EIS/EA), the requirements of Section 5 Aboriginal Engagement and Concerns of the EIS Guidelines are addressed primarily in Chapters 3 and 18 of the Final EIS/EA.

In Annex 1 of the CEA Agency's Technical Review of the Final EIS/EA, issued on November 10, 2017, the CEA Agency requested that the scope of this report be expanded to include impacts to Aboriginal and treaty rights, from the Proponent's perspective, as follows:

CEAA IR Number HE(1)-01

"Specific Question / Request for Information:
A. For responses to comments HE(1)-02 to HE(1)-11, revise Appendix O to contain separate complete assessments for Aboriginal peoples with respect to:

a. health and socio-economic conditions;
b. physical and cultural heritage;
c. current use of lands and resources for traditional purposes;
d. any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and
e. potential severity of impacts on Aboriginal and Treaty rights." (CEA Agency 2017)

This report has been revised to address the CEA Agency's request. The following components of Section 5 of the EIS Guidelines were considered when developing in this revised report.

"…the EIS will document:

- *"…based on the proponent's perspective, the potential adverse impacts of each of the project components and physical activities, in all phases, on potential or established Aboriginal or Treaty rights. This assessment is to be based on a comparison of the exercise of the identified rights between the predicted future conditions with the project and the predicted future conditions without the project. Include the perspectives of Aboriginal groups where these were provided to the proponent by the groups;*

- *based on the proponent's perspective, the measures identified to mitigate or accommodate potential adverse impacts of the project on the potential or established Aboriginal or Treaty rights. These measures will be written as specific commitments that clearly describe how the proponent intends to implement them;*

- *based on the proponent's perspective, the effects of changes to the environment on Aboriginal peoples or potential adverse impacts on potential or established Aboriginal or Treaty rights that have not been fully mitigated or accommodated as part of the environmental assessment and associated engagement with Aboriginal groups, including the potential adverse effects that may result from the residual and cumulative environmental effects…"* (CEA Agency 2014)

In a subsequent discussion with the CEA Agency on December 14, 2017, it was acknowledged that engagement, from the Proponent's perspective, may serve to inform the CEA Agency's environmental assessment report and corroborate or refute the information gained by the Agency in its own consultation with Aboriginal communities. The CEA Agency also acknowledged that GGM may not have specific information from all communities or on all topics to provide their views on all aspects of Section 5(1)(c) of CEAA 2012, but GGM should nonetheless highlight these views where such information exists, and related implications to the exercise of Aboriginal and treaty rights, on a best efforts basis in the updated version of this report.

In accordance with the EIS Guidelines and the guidance provided by the CEA Agency, Sections 2.3 and 7.4.6 of this report are relevant to the discussion of potential effects on the ability to exercise Aboriginal and treaty rights.

2.3 DEFINING ABORIGINAL AND TREATY RIGHTS

The EIS Guidelines require the EIS/EA to assess potential adverse impacts of the Project on potential or established Aboriginal or treaty rights and where appropriate identify measures to mitigate or accommodate potential adverse impacts.

The EIS Guidelines for the Project, citing the *Updated Guidelines for Federal Officials to Fulfill the Duty to Consult* (AANDC 2011), explain that Aboriginal rights can be understood as "*practices, traditions and customs integral to the distinctive culture of the Aboriginal group claiming the right that existed prior to contact with the Europeans (Van de Peet). In the context of Métis, Aboriginal rights means practices, traditions, and customs integral to the distinctive culture of the Métis group that existed prior to effective European control, that is, prior to the time when Europeans effectively established political and legal control in the claimed area (Powley). Generally, these rights are fact and site specific. For greater certainty, the Guidelines also define Aboriginal title as an Aboriginal right*" (AANDC 2011).

In Canada, treaties between Aboriginal peoples and the Crown are constitutionally recognized agreements. The Project is located within Treaty No. 9, and First Nations engaged on the Project are members of Treaty No. 9 as well as the Robinson-Huron and Robinson-Superior Treaties. Treaty terms vary, but for the Robinson-Huron Treaty, the Robinson-Superior Treaty, and Treaty No. 9 the treaties generally stipulate that reserve lands would be set aside for each Aboriginal group and the region's Aboriginal inhabitants would continue to be able to hunt, trap, fish, and gather resources in their traditional territory until lands were taken up for development or settlement (INAC 2010a, INAC 2010b, INAC 2010c). The Robinson-Huron, Robinson-Superior Treaties, and Treaty No. 9 provided the Canadian Government with the ability to expand settlement and carry out development on Aboriginal traditional territory. Treaty terms included the exchange of payments, tools, and farming supplies by government officials in exchange for the ceding of Aboriginal interest or title to land (INAC 2010a, INAC 2010b, INAC 2010c).

Information on the Aboriginal communities engaged on the Project is provided in Section 2.4 of this report and overviews of the Robinson-Huron Treaty, the Robinson-Superior Treaty, and Treaty No. 9 are provided in Section 3.6 of the Final EIS/EA.

Since the scope and content of Aboriginal and Treaty rights remain largely undefined in Canadian law, the Final EIS/EA and this report assess the degree to which the Project affects the use of land and resources upon which the exercise of Aboriginal or treaty rights depend. Traditional land and resource use (TLRU) includes various traditional activities, practices, sites, areas and resources. Impacts on the exercise of Aboriginal and treaty rights may be considered to occur to the extent that the Project has adverse residual effects on traditional harvesting (i.e., hunting, trapping, fishing, plant or materials gathering) or on physical activities associated with traditional use (i.e., travel and navigation, use of habitation, cultural and spiritual areas). This approach recognizes a correspondence between practice-based rights and the TLRU.

2.4 IDENTIFICATION OF ABORIGINAL COMMUNITIES

The regulatory guidance documents addressed in Section 2.2 above refer to Aboriginal people, groups and communities. For the purposes of this report, the term "Aboriginal peoples" will be used to refer to Indigenous people generally, regardless of cultural or political affiliation. The term "Aboriginal communities" incorporates Aboriginal groups, and will be used to refer to more than one Aboriginal community identified as potentially interested in, or affected by, the Project. Individual Aboriginal communities will be referred to by their official titles.

GGM has carried out consultation with Aboriginal communities, including those identified by the provincial and federal agencies, as described below.

2.4.1 Crown's Direction to GGM on Duty to Consult

The Crown has a duty to consult and, where appropriate, accommodate Aboriginal communities when it has knowledge of established or asserted Aboriginal or treaty rights that might be adversely affected by a Crown decision or action. At the provincial level, although the ultimate responsibility for consultation rests with the Crown, certain procedural aspects of this consultation, such as information sharing and engagement for the Project, may be delegated to project proponents. At the federal level, the CEA Agency has indicated that the Crown retains all responsibilities under the duty to consult during the EA process. However, in both cases GGM's consultation record and outcomes will help to inform the Crown's assessment of whether its duty to consult has been met.

2.4.1.1 Federal Direction on Aboriginal Consultation

The federal Crown has directed GGM to consult with fourteen Aboriginal communities. The Crown's direction to GGM about which Aboriginal communities to consult with on the Project was set out in the following documents:

- "Guidelines for the Preparation of an Environmental Impact Statement pursuant to the *Canadian Environmental Assessment Act, 2012* – Hardrock Deposit Project: Premier Gold Mines Hardrock Inc." (EIS Guidelines) Part 2, section 5, August 2014
- Letter to GGM from the CEA Agency, dated December 17, 2015
- Addendum to the EIS Guidelines, February 12, 2016.

The cumulative direction from the CEA Agency based on these documents identified that GGM is required to "*hold meetings with the following potentially affected Aboriginal groups and facilitate these meetings by making key EA summary documents (baseline studies, EIS, key findings, plain language summaries) accessible*" (EIS Guidelines Addendum; CEA Agency 2016):

- Animbiigoo Zaagi'igan Anishinaabek (AZA)
- Aroland First Nation (AFN)
- Ginoogaming First Nation (GFN)
- Long Lake #58 First Nation (LLFN)
- Métis Nation of Ontario (MNO)

For the above communities, GGM is required to "*ensure there are sufficient opportunities for individuals and groups to provide oral input in the language of their choice, and ensure that these Aboriginal groups' views are heard and recorded*" (EIS Guidelines Addendum; CEA Agency 2016). These five communities are collectively referred to as the "local Aboriginal communities".

The CEA Agency also identified that "*there are additional Aboriginal groups that are expected to be less affected by the project and its related effects*" (EIS Guidelines Addendum; CEA Agency 2016). GGM is required to "*make key EA summary documents (draft/final EIS, key findings, plain language summaries) accessible to these Aboriginal groups and ensure their views are heard, and recorded*" (EIS Guidelines Addendum; CEA Agency 2016). These Aboriginal communities include:

- Biigtigong Nishnaabeg (BN)
- Biinjitiwaabik Zaaging Anishinaabek (BZA)
- Bingwi Neyaashi Anishinaabek (BNA)
- Constance Lake First Nation (CLFN)
- Eabametoong First Nation (EFN)
- Marten Falls First Nation (MFFN)

- Pays Plat First Nation (PPFN)
- Pic Mobert First Nation (PMFN)
- Red Sky Métis Independent Nation (RSMIN).

2.4.1.2 Provincial Direction on Aboriginal Consultation

This report focuses on demonstrating how the requirements of Section 6.3.4 of the EIS Guidelines issued by the CEA Agency have been met in the Final EIS/EA. Though this document is intended solely to address the requirements of Section 5(1)(c) of CEAA 2012 and the EIS Guidelines, since the provincial Crown has also provided direction with regard to Aboriginal consultation, the information below is provided for further context.

The provincial Crown has directed GGM to consult with thirteen Aboriginal communities. The provincial Crown's direction to GGM about which Aboriginal communities to consult with on the Project was set out in the following documents:

- Letter to Premier Gold Mines from the Ministry of the Environment and Climate Change (MOECC), dated November 7, 2014
- Terms of Reference – Notice of Approval, July 24, 2015 (MOECC 2015)
- Letter to GGM from MOECC, dated April 5, 2017

On November 7, 2014, the MOECC notified GGM that three communities "hold or claim Aboriginal or treaty rights" that "may be adversely impacted by the Project":

- AFN
- GFN
- LLFN

MOECC delegated procedural aspects of consultation with these three communities to GGM, generally including:

- providing Project information to Aboriginal communities and following up with those communities to confirm they received the information
- gathering information on potential impacts to Aboriginal and/or treaty rights
- providing potentially affected communities with opportunities to comment about the Project, considering and responding to those comments, and where appropriate discussing potential mitigation strategies with the communities
- maintaining a record of all consultation activities.

On November 7, 2014 (letter), the MOECC also indicated that in addition to GGM's "*consultation obligations and delegation of procedural aspects with the Aboriginal communities discussed above, the Environmental Assessment Act also requires consultation with people and/or groups who may have an interest in the Project*". The MOECC identified that consultation activities should include, "*at a minimum notifying communities about the Project at key milestones, providing information about the Project, considering comments provided by the communities and providing responses, and maintaining a Consultation Record for each community*". The communities identified on November 7, 2014 are listed below. In addition, on April 5, 2017, the MOECC added the MNO (in addition to the Greenstone Métis Council) to this list:

- AZA
- BZA
- CLFN
- Greenstone Métis Council /MNO
- PPFN
- Biigtigong Nishnaabeg
- BNA
- EFN
- MFFN
- RSMIN

A discussion of how GGM has met the Crown direction on Aboriginal Consultation is presented in Section 3.6.1 of the Final EIS/EA (Stantec 2017d).

3.0 METHODS

The methods used to carry out the assessment of effects of a change to the environment on Aboriginal peoples, as required by Section 5(1)(c) of CEAA 2012 and as supplemented by the EIS Guidelines, and the scope of the assessment of effects of a change of the environment on Aboriginal peoples, are described in this section.

For the purposes of this report, requirements under CEAA 2012 Section 5(1)(c) are collectively referred to as the "Section 5(1)(c) Factors". The assessment of the Project environmental effects on "health and socio-economic conditions" are divided into two separate subsections: "Aboriginal health conditions" and "Aboriginal socio-economic conditions", due to the difference in the nature of these environmental effects. In addition, the assessment of the Project environmental effects on "physical and cultural heritage" and "any structure, site or thing of historical, archaeological, paleontological or architectural significance" will be contained in a single subsection because of similar subject matter between these requirements. Structures, sites, or things of historical, archaeological, paleontological, or architectural importance are a part of Aboriginal communities' physical heritage. Therefore, this subsection reflecting both Section 5(1)(c) Factors is referred to as "Aboriginal physical and cultural heritage". For the remainder of this report, "current use of lands and resources for traditional purposes" is referred to simply as "current use" for brevity, and the assessment of this factor is drawn largely from Chapter 18.0 of the Final EIS/EA, Traditional Land and Resource Use.

This report is structured to reflect how Section 6.3.4 of the EIS Guidelines was addressed in the main body of the Final EIS/EA and includes sub-sections to address.

- Aboriginal health conditions,
- Aboriginal socio-economic conditions,
- Aboriginal physical and cultural heritage, and
- current use.

3.1 METHODS AND SCOPE

The following steps were followed to consolidate the assessment of Section 5(1)(c) Factors into this report:

- Identifying the Key Topics for each of the Section 5(1)(c) Factors.
- Determining the valued components (VCs) assessed in the EIS/EA which are relevant to the Section 5(1)(c) Factors and associated Key Topics.

- Identifying spatial and temporal boundaries for assessing the effects of changes to the environment on the Section 5(1)(c) Factors.
- Discussing the potential mechanisms that, in the absence of mitigation, by which changes to the environment identified in the assessment of VCs in the EIS/EA may occur, and the Section 5(1)(c) Factors resulting from such changes as they relate to the Key Topics.
- Identifying mitigation measures for addressing potential changes to Section 5(1)(c) Factors.
- Discussing and characterizing the residual effects of changes to the environment identified in the assessment of related VCs on Aboriginal peoples, and the potential residual changes to Section 5(1)(c) Factors.
- Discussing cumulative environmental effects on the Section 5(1)(c) Factors as presented in the individual VCs.
- Identifying follow-up measures that are relevant to the Section 5(1)(c) Factors.

Each of these steps is discussed further below.

3.1.1 Identification of Key Topics Associated with the Section 5(1)(c) Factors

Section 6.3.4 of the EIS Guidelines subdivides each of the Section 5(1)(c) Factors into further Key Topics. The Key Topics have been identified in Table 3-1 of this report. Additional Key Topics have been identified because of the information provided by Aboriginal communities, or that emerged through completion of the Final EIS/EA. A total of 12 Key Topics have been identified and are used to structure and inform this report.

Table 3-1: Section 5(1)(c) Factors and Related Key Topics

Section 5(1)(c) Factors	Key Topics	Rationale for Inclusion
Aboriginal health conditions	Change in air quality	As required by Section 6.3.4 of the EIS Guidelines
	Change in quality and availability of country foods	As required by Section 6.3.4 of the EIS Guidelines
	Change in drinking water quality or quantity	As required by Section 6.3.4 of the EIS Guidelines
	Change in noise or vibration exposure	As required by Section 6.3.4 of the EIS Guidelines
Aboriginal socio-economic conditions	Change in use of navigable waters	As required by Section 6.3.4 of the EIS Guidelines
	Change in forestry and logging operations	As required by Section 6.3.4 of the EIS Guidelines

Table 3-1: Section 5(1)(c) Factors and Related Key Topics

Section 5(1)(c) Factors	Key Topics	Rationale for Inclusion
	Change in commercial fishing, hunting, trapping, gathering, and guide outfitting activities	As required by Section 6.3.4 of the EIS Guidelines
	Change in recreation	As required by Section 6.3.4 of the EIS Guidelines
	Change in labour and economy	Key issue identified because of information provided by Aboriginal communities
	Change in community services and infrastructure	Key issue identified because of information provided by Aboriginal communities
Aboriginal physical and cultural heritage	Change in physical or cultural heritage	As required by Section 6.3.4 of the EIS Guidelines this includes: loss or destruction of physical and cultural heritage, and changes to access to physical and cultural heritage; sensory disturbance, and changes to the cultural value or importance associated with physical cultural heritage
Current use	Change in current use	As required by Section 6.3.4 of the EIS Guidelines, including: effects on resources; effects of alterations to access into the areas used for traditional uses; sensory disturbance, effects on cultural value or importance associated with traditional uses or areas affected by the Project; and how Project construction timing correlates to the timing of traditional practices

3.1.2 Identification of Related Valued Components

The assessment of the Section 5(1)(c) Factors focuses on the interactions between changes to VCs and change in conditions, attributes, sites, lands, resources, or structures of relevance for Aboriginal peoples. Although environmental assessments (EAs) tend to focus their analysis on discrete VCs, the interdependency between VCs plays an important role in how changes to the environment may affect conditions and material circumstances of Aboriginal peoples. For example, changes in surface water quality may influence fish health, which could, in turn, affect Aboriginal health conditions or Aboriginal socio-economic conditions.

Table 3-2 in this report shows where the most direct relationships exist between biophysical and socio-economic VCs and Section 5(1)(c) Factors, with recognition that most VCs are inter-dependent and the assessment of effects of changes to the environment on Aboriginal peoples as defined in Section 5(1)(c) of CEAA 2012 is considered in that context throughout this report.

Table 3-2: Valued Components Related to Section 5(1)(c) Factors

Valued Component	Aboriginal health conditions	Aboriginal socio-economic conditions	Aboriginal physical and cultural heritage	Current Use	Section Number of Final EIS/EA
Atmospheric Environment	■	-	✹	✹	07
Acoustic Environment	✹	-	✹	✹	08
Groundwater	■	-	-	-	09
Surface Water	■	-	-	-	10
Fish and Fish Habitat	◆	-	-	-	11
Vegetation Communities	◆	-	-	-	12
Wildlife and Wildlife Habitat	◆	-	-	-	13
Labour and Economy	-	✹	-	-	14
Community Services and Infrastructure	-	✹	-	-	15
Land and Resource Use	-	✹	◆✹	✹	16
Heritage Resources	-	-	✹	-	17
Traditional Land and Resource Use	✹	-	✹	✹	18
Human and Ecological Health	✹	-	-	-	19

LEGEND:

✹ Interaction between changes to VCs and Section 5(1)(c) Factors

■ Interaction between changes to VCs and Section 5(1)(c) Factors integrated into the assessment of Human and Ecological Health VC

◆ Interaction between changes to VCs and Section 5(1)(c) Factors integrated into the assessment of Traditional Land and Resource Use VC

\- No interaction between changes to VCs and Section 5(1)(c) Factors

The assessment of environmental effects on Human and Ecological Health (Chapter 19 of the Final EIS/EA) and Traditional Land and Resource Use (Chapter 18 of the Final EIS/EA) incorporate information from several other related 'source VC's'. Source VC's are identified in Table 3-2 with the following symbols ■ and ◆, in recognition of the fact that the assessment and conclusions of the Human Health and Ecological Health and Traditional Land and Resource Use VCs have relied upon the information presented in other source VCs, thus providing an encompassing assessment of environmental effects.

For example, the Human and Ecological Health VC incorporates the assessment of a change in air quality from the Atmospheric Environment VC, a change in groundwater quality from the Groundwater VC, and a change in surface water quality from the Surface Water VC as direct and indirect pathways that could affect human or ecological health. Similarly, the Traditional

Land and Resource Use VC relies on information presented in the Fish and Fish Habitat VC, Vegetation Communities VC, and Wildlife and Wildlife Habitat VC in terms of the continued viability of those plant and animal populations to enable traditional use to occur. In this manner, consideration of effects of those changes on Aboriginal peoples is carried out in a holistic manner by focusing the discussion of effects on a single encompassing VC for each key topic, rather than having to source information from several VCs individually. Thus, this report relies on the information and analysis presented in Human and Ecological Health and Traditional Land and Resource Use VC rather than reinterpreting the findings of source VC's.

3.1.3 Identification of Spatial and Temporal Boundaries

3.1.3.1 Spatial Boundaries

The spatial boundaries for the assessment of each Section 5(1)(c) Factors were developed by considering the spatial extent of the Local Assessment Areas (LAAs) or Regional Assessment Areas (RAAs) for the relevant VCs, considering information gathered through Project specific engagement and available traditional knowledge (TK) and TLRU information.

As the referenced VCs, spatial boundaries capture the extent of expected environmental effects, the combination of these boundaries are sufficient for capturing these effects as they relate specifically to the Section 5(1)(c) Factors. Given the differences in the conditions for each Section 5(1)(c) Factors, four different LAA and RAAs (one for each Section 5(1)(c) Factor) are used in this analysis. These are described in Table 3-3.

Table 3-3 Spatial Boundaries for Each Section 5(1)(c) Factors

Spatial Boundary	Description and Rationale for Selection
Aboriginal health conditions	
LAA	The LAA for Aboriginal health conditions includes the maximum combined extent of the LAAs for the Acoustic Environment, Traditional Land and Resource Use, and Human and Ecological Health VCs.
RAA	The RAA for Aboriginal health conditions includes the maximum combined extent of the RAAs for the Acoustic Environment, Traditional Land and Resource Use, and Human and Ecological Health VCs.
Aboriginal socio-economic conditions	
LAA	The LAA for Aboriginal socio-economic conditions includes the maximum combined extent of the LAAs for the Labour and Economy, Community Services and Infrastructure, and Land and Resource Use VCs.
RAA	The RAA for Aboriginal socio-economic conditions includes the maximum combined extent of the RAAs for the Labour and Economy, Community Services and Infrastructure, and Land and Resource Use VCs.

Table 3-3 Spatial Boundaries for Each Section 5(1)(c) Factors

Spatial Boundary	Description and Rationale for Selection
Aboriginal physical and cultural heritage	
LAA	The LAA for Aboriginal physical and cultural heritage includes the maximum combined extent of the LAAs for the Atmospheric Environment, Acoustic Environment, Land and Resource Use, Heritage Resources and Traditional Land and Resource Use VCs.
RAA	The RAA for Aboriginal physical and cultural heritage includes the maximum combined extent of the RAAs for the Atmospheric Environment, Acoustic Environment, Land and Resource Use, Heritage Resources and Traditional Land and Resource Use VCs.
Current use	
LAA	The LAA for current use includes the maximum combined extent of the LAAs for the Atmospheric Environment, Acoustic Environment, Land and Resource Use, and Traditional Land and Resource Use VCs.
RAA	The RAA for current use includes the maximum combined extent of the RAAs for the Atmospheric Environment, Acoustic Environment, Land and Resource Use, and Traditional Land and Resource Use VCs.

3.1.3.2 Temporal Boundaries

The temporal boundaries used in this report are based on the timing and duration of Project activities and the nature of predicted interactions with Section 5(1)(c) Factors.

Based on the current Project schedule, the temporal boundaries for the assessment are:

- 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, creating a pit lake.

The temporal boundary for current use also considers each local Aboriginal community's current and future use of lands and resources for traditional purposes during the Project construction, operation, and closure. Current use was defined as extending back from the present time to within the last 25 years (or one generation); therefore, information regarding existing conditions, with associated temporal details is limited to 1990 to present and into the reasonably foreseeable future. Twenty-five years was chosen as the temporal boundary for considering effects of a change in the environment on Aboriginal people because knowledge about traditional practices or locales may be lost or may not be passed on to younger members of the community if it goes unused for a generation. Future use pertains to the opportunities for generations of descendants to practice traditional activities (in modern form) and maintain traditional cultural and spiritual values.

3.1.4 Discussion of Potential Project-Effect Mechanisms Related to Section 5(1)(c) Factors Prior to Mitigation

There are multiple pathways or mechanisms through which changes to the environment may take place and affect Section 5(1)(c) Factors. For each Key Topic, a summary of the effect mechanisms through which a change to the environment may affect Section 5(1)(c) Factors (individually or in combination with other changes to the environment) is provided (see Section 5.0 of this report).

3.1.5 Identification of Mitigation Measures Applicable to the Section 5(1)(c) Factors

Extensive mitigation measures have been developed in each VC chapter of the Final EIS/EA (Stantec 2017d) to address potential changes to the environment as a result of Project activities. These mitigation measures help to avoid or reduce residual environmental effects and subsequently can help to avoid or reduce effects of changes Section 5(1)(c) Factors. To consolidate information assessed in multiple VCs into this report, key mitigation measures from each relevant VC have been identified, including consideration of recommendations for mitigation identified through consultation activities (see Section 6.0 of this report).

3.1.6 Characterization of Residual Effects and Significance of Changes to Section 5(1)(c) Factors After the Application of Mitigation

For each Key Topic, this section summarizes residual environmental effects for each related VC chapter and discusses how these residual effects may affect Section 5(1)(c) Factors after mitigation has been applied. In some cases, there is a direct relationship between a VC and a particular Key Topics (e.g., air quality). In other cases, multiple VC assessments contribute information to the analysis for a single Key Issue (e.g., quality and availability of country foods will include the results of interactions from multiple VCs). Each discussion of residual environmental effects incorporates, to the extent possible, information from Aboriginal communities and considers the unique background and context in which individual Aboriginal communities may experience Project related effects of changes to the environment on Section 5(1)(c) Factors. If no information was provided specifically by an Aboriginal community, effects of changes to the environment are discussed for Aboriginal peoples as a collective, as a conservative approach.

This report will also identify linkages to monitoring and follow-up commitments made for other VCs (see Section 6.3 of this report).

3.1.6.1 Determination of Significance

The determination of significance for Aboriginal health conditions, Aboriginal socio-economic conditions, and Aboriginal physical and cultural heritage, and current use relies on the characterizations and determinations presented in the assessment of related source VCs and their associated environmental effects, and relates those determinations specifically to each of the Section 5(1)(c) Factors.

f residual effects on a related VC (see Table 3-2 of this report) were identified as significant and would have a substantial effect on Aboriginal people's health, socio-economic conditions, cultural and physical heritage, or current use, the resulting effects of changes to the environment on these Section 5(1)(c) Factors would also be considered to be significant. The determination of significance is also guided by information provided by Aboriginal communities and applying professional judgment applied to the Project context. The significance determination will consider the magnitude, geographic extent, and duration of effects on valued components related to 5(1)(c) Factors.

3.1.7 Cumulative Environmental Effects

Changes to the environment may also take place as a result of cumulative effects of the Project in combination with other past, present, and reasonably foreseeable future projects or physical activities. These changes have the potential to affect the VCs that are related Section 5(1)(c) Factors. A discussion of how cumulative effects may affect Section 5(1)(c) Factors is provided (see Section 8.0 of this report).

3.1.8 Follow-Up

Where applicable, a discussion of the applicable follow-up programs that will be implemented as part of the Project that are related to the Section 5(1)(c) factors is provided.

3.2 INFORMATION SOURCES

The sources of information from Aboriginal communities considered in this chapter are the same as those used in the preparation of the Final EIS/EA and include:

- Project-specific engagement and consultation including site visits, community meetings, and meetings with community leadership
- Project-specific TK and TLRU studies or assessments, completed by local Aboriginal communities, where Aboriginal communities have allowed such information to be used (i.e., not considered confidential)
- Project-specific socio-economic studies completed by local Aboriginal communities
- comments on the Draft EIS/EA and the Final EIS/EA completed by independent experts retained by local Aboriginal communities
- cultural impact assessments completed for the exploration phase of the Project by local Aboriginal communities
- TLRU studies completed by local Aboriginal communities for other developments located near the Project
- Aboriginal communities' websites
- government databases.

GGM recognizes the proprietary nature of certain information provided by Aboriginal communities regarding current use of lands and resources for traditional purposes, and that Aboriginal communities may stipulate one time use of some TLRU information. Confidential studies regarding current use of lands and resources for traditional purposes, or those stipulating one-time use, were excluded from the literature review conducted for the EIS/EA. AFN has indicated that their Traditional Knowledge and Land Use Study (TKLU Study) conducted for the Project is confidential. AFN has agreed to allow use of a summary document that omits confidential information to inform the effects assessment, but has not approved any documentation to be appended to the Final EIS/EA.

Where applicable, information from Aboriginal communities has been incorporated in the Final EIS/EA. For the VCs, the influence of consultation and consideration of information from Aboriginal communities is summarized at the beginning of each VC chapter.

3.3 TANGIBLE AND INTANGIBLE VALUES

Effects on Section 5(1)(c) Factors may incorporate both tangible values (e.g. biophysical or socio-economic resources and sites) and intangible values (e.g., spiritual, cultural, artistic, aesthetic, and educational elements).

There are two elements of Section 6.3.4 of the EIS Guidelines that require information about intangible values:

- cultural value or importance associated with physical and cultural heritage

- cultural value or importance associated with traditional uses or areas

Aboriginal communities have also cited intangible values related to mental, social and spiritual well-being that may be affected by the Project.

Tangible values include specific resources, physical sites, and observable activities that can be more readily considered in an effects assessment. For example, tangible values often have a demonstrable link to a biophysical VC (e.g., traditional hunting linked to wildlife and biodiversity) and are measurable. In Chapter 18.0 of the Final EIS/EA, potential Project effects on tangible values have been subjected to a conventional environmental assessment methodology that characterizes residual effects. Intangible values relate to the experience of Aboriginal peoples on the land, cultural identity, opportunities for cultural transmission, and spiritual connections, among others. Intangible values encompass individual beliefs, perceptions, values, and qualitative experiences and are not quantifiable in the same way as tangible effects. However, addressing effects on tangible effects can also be effective in addressing some intangible effects. Intangible values will be considered in the following sections of this report:

- Section 7.1.3.5, Change in Well-being
- Section 7.3.4, Change in Cultural Value or Importance Associated with Aboriginal Physical and Cultural Heritage
- Section 7.4.4, Change in Cultural Value or Importance Associated with Current Use.

3.4 CONSERVATIVE APPROACH

As this report has consolidated information from sections of the Final EIS/EA, the assumptions and conservative approach associated with each related VC are also applicable to this discussion. The information sources listed above provide a snapshot of use and indicate areas or topics that are particularly important to Aboriginal communities. A conservative approach has been applied, whereby if it is uncertain if an activity is practiced, it is assumed to be practiced and activities with a degree of uncertainty have been assumed to contribute to effects on Section 5(1)(c) Factors. Where the conservative approach identified the effects of changes to the environment on Aboriginal people, mitigation and follow-up have been recommended to reduce these effects.

Where the discussion of environmental effects includes reference to spatial areas such as the Project Development Area (PDA), local assessment area (LAA), and regional assessment area (RAA), these refer to the spatial areas associated with the effects assessments for various individual VCs.

4.0 SUMMARY OF ABORIGINAL COMMUNITY COMMENTS AND KEY TOPICS RELATED TO SECTION 5(1)(C) FACTORS

This section summarizes the input received through consultation with Aboriginal communities as it pertains to the Key Topics identified for each of the potential effects of changes to the environment on Aboriginal people. Additional information about how input from Aboriginal communities influenced GGM's engagement activities and the assessment process of individual VCs is presented in Chapter 3.0 of the Final EIS/EA (Stantec 2017d) and as part of the scope of assessment outlined in each VC chapter (Chapters 7.0 to 19.0; Stantec 2017d).

At the direction of AFN, the locations and nature of current use activities, including species relied upon to exercise current use activities, identified in the AFN TKLU Study are confidential. A summary document provided by AFN was considered in the Final EIS/EA and in this report.

The following sections summarize key comments and information received from Aboriginal communities related to each of Key Topics identified in Table 3-2. It is intended to provide a summary of key comments or information provided by Aboriginal communities through engagement and should not be construed as an all-inclusive discussion of all issues that might have been raised—more detailed information is provided in the Record of Consultation (Appendix C3 of the Final EIS/EA). The description of how each of these comments has been addressed by GGM and considered in the EIS/EA is not presented here, as that information is the focus of Chapter 5.0 of this report. The spatial boundaries and potential Project interactions associated with these comments from Aboriginal communities are also not presented here as that information is afforded a fulsome discussion in Chapter 5.0 of this report.

The Key Topics identified in Table 3-2 are not mutually exclusive categories. For example, a comment from an Aboriginal community about hunting moose may be related to Aboriginal health conditions, Aboriginal socio-economic conditions, and current use. It is acknowledged that there is overlap in the way comments and information received from Aboriginal communities is presented in Sections 4.1 to 4.4. This was approach was taken to provide a summary of the comments and information received from Aboriginal communities.

4.1 ABORIGINAL HEALTH CONDITIONS

4.1.1 Change in Air Quality

Through the consultation process, the following Aboriginal communities provided key comments on changes to the atmospheric environment, including a change in air quality: AZA, AFN, CLFN, GFN, LLFN, and MNO.

The following key comments relating to a change in air quality were identified.

4.1.1.1 Aroland First Nation

- potential dust effects on local communities and the environment
- potential metals deposition in nearby lakes
- potential effects of disturbing historical tailings on air quality
- cumulative effects of air contaminant emissions on vegetation, and completion of air quality monitoring for parameters of potential concern affecting vegetation
- the importance of including areas used for traditional purposes in the assessment of the atmospheric environment

4.1.1.2 Ginoogaming First Nation

- potential dust effects on local communities and the environment
- potential metals deposition in nearby lakes
- the importance of including areas used for traditional purposes in the assessment of the atmospheric environment
- identified potential for chronic long-term health effects from reduced water quality and ecosystem health, including the contamination of fish, wildlife and waterfowl

4.1.1.3 Long Lake #58 First Nation

- potential dust effects on local communities and the environment
- potential metals deposition in nearby lakes
- cumulative effects of air contaminant emissions on vegetation, and completion of air quality monitoring for parameters of potential concern affecting vegetation
- potential effects on humans, fish and wildlife from air quality criteria exceedances
- identified potential for chronic long-term health effects from reduced water quality and ecosystem health, including the contamination of fish, wildlife and waterfowl

4.1.1.4 Métis Nation of Ontario

- potential effects on humans, fish and wildlife from air quality criteria exceedances
- the importance of including areas used for traditional purposes in the assessment of the atmospheric environment
- Identified potential for chronic long-term health effects from reduced water quality and ecosystem health, including the contamination of fish, wildlife and waterfowl

4.1.1.5 Constance Lake First Nation

- cumulative effects of air contaminant emissions on vegetation, and completion of air quality monitoring for parameters of potential concern affecting vegetation

4.1.2 Change in Quality and Availability of Country Foods

Through the consultation process, the following Aboriginal communities provided key comments in relation to a change in quality and availability of country foods: AZA, AFN, BN, CLFN, GFN, LLFN, and MNO.

The following key comments relating to a change in quality and availability of country foods were identified.

4.1.2.1 Animbiigoo Zaagi'igan Anishinaabek

- potential for chronic long-term health effects from reduced water quality and ecosystem health, including the contamination of fish, wildlife and waterfowl
- potential loss of plant harvesting sites
- potential loss of habitat for fish and wildlife
- potential Project effects on fish and wildlife that are fished and hunted by local communities in the area
- harvesting of bald eagle, waterfowl/ducks, and moose

4.1.2.2 Aroland First Nation

- potential effects on community fishing, plant harvesting, hunting and trapping
- potential disruption to important wildlife habitat, including moose
- potential loss and degradation of the quality of lands and resources for fish, wildlife and traditional purposes
- potential loss of access/use of lands and resources for traditional purposes
- consideration of dietary preference of Aboriginal communities
- potential effects on humans, fish and wildlife from contamination of food and medicine sources
- elevated metal concentrations in walleye populations
- potential effects on fish and fish habitat from blasting, including potential mitigation

- inclusion of wild game and fish tissue samples in monitoring programs for human and ecological health consumption limits identified the harvesting of walleye, lake sturgeon, suckers, trout, whitefish, dace and minnows
- potential loss or contamination of plant species of importance including wild rice and winkes/wike (sweet flag)
- identified harvesting moose and wolverine

4.1.2.3 Ginoogaming First Nation

- potential effects on community fishing, plant harvesting, hunting and trapping
- identified fishing occurs at Kenogamisis Lake, Burrows Lake, Twin Lakes, Chipman Lake, Long Lake and the waterways that connect them
- fish consumption, including related to exposure pathways, potential risks to humans who harvest fish, and using fish consumption predictions that are representative of local Aboriginal consumption of fish harvested
- project effects on fish and wildlife that are fished and hunted by local communities
- identified the harvesting of northern pike, yellow perch, trout and walleye
- identified harvesting of bear root, blueberries, bull rush, cedar, juniper, lowbush cranberry, sweetgrass, and red willow (note: consumption, medicinal use, or lifestyle use was not specified)
- identified harvesting deer, geese, marten, moose, and rabbit

4.1.2.4 Long Lake #58 First Nation

- potential effects on community fishing, plant harvesting, hunting and trapping
- potential loss of access to traditional areas
- consideration of dietary preference of Aboriginal communities in the EA
- potential effects on humans, fish and wildlife from contamination of food
- potential effects to fish and fish habitat
- potential disruption to wildlife habitat and abundance of wildlife
- elevated metal concentrations in walleye populations
- fish consumption, including related to exposure pathways, potential risks to humans who harvest fish, and using fish consumption predictions that are representative of local Aboriginal consumption of fish harvested

- potential Project effects on fish and wildlife that are fished and hunted by local communities in the area
- inclusion of wild game and fish tissue samples in monitoring programs for human and ecological health consumption limits
- identified the harvesting of northern pike, rainbow smelt, walleye, lake sturgeon, trout, and lake whitefish
- identified the use of fishing areas including under the bridge, dump road, any lake except Long Lake #58, Nakina Lakes, Kenogamisis Lake, Seagram Lake, Camp #20, Ranier Lake, Kenogamisis River, Suckle Creek, Fernel Lake, and Eldee Lake.
- identified harvesting of balsam fir, birch, black ash, black spruce, blueberries, cedar, currant, Labrador tea, lowbush cranberry, mint, mountain ash, raspberries, strawberries, sweetgrass, wild rice, and yarrow (note: consumption, medicinal use, or lifestyle use was not specified)
- identified harvesting for geese, ruffed grouse, marten, and moose

4.1.2.5 Métis Nation of Ontario

- potential effects on humans, fish and wildlife from contamination of food
- potential effects on community fishing, plant harvesting, hunting and trapping
- potential effects on abundance and distribution of hunted species
- potential effects on humans, fish and wildlife from contamination of food
- potential effects on fish and fish habitat
- potential loss of access to traditional use areas
- identified harvesting of bass, burbot, northern pike, walleye, salmon, rainbow smelt, lake sturgeon, suckers, trout, lake whitefish and other non-commercial fish
- identified harvesting of birch, birch mushroom, black spruce, blueberries, chaga, chanterelle, ferns, highbush cranberry, lowbush cranberry, mint, mushrooms, pin cherry, Saskatoon berry, shaggy mane, strawberries, white spruce, willow, and wild rice (note: consumption, medicinal use, or lifestyle use was not specified)
- identified harvesting beaver, black bear, deer, waterfowl/ducks, geese, ruffed grouse, lynx, mink, marten, moose, partridge, and rabbit

4.1.2.6 Biigtigong Nishnaabeg

- potential effects on community fishing, plant harvesting, hunting and trapping
- consideration of dietary preference of Aboriginal communities

- potential effects on humans, fish and wildlife from contamination of food
- elevated metal concentrations in walleye populations
- effects on fish and fish habitat from blasting, including potential mitigation
- fish consumption, including related to exposure pathways, potential risks to humans who harvest fish, and using fish consumption predictions that are representative of local Aboriginal consumption of fish harvested
- inclusion of wild game and fish tissue samples in monitoring programs for human and ecological health consumption limits in the EA

4.1.2.7 Biinjitiwaabik Zaaging Anishinaabek

- potential loss of habitat for fish and wildlife
- identified the harvesting of blueberries, highbush cranberries, lowbush cranberries, maple, raspberries, Saskatoon berries, strawberries, and wild rice (note: consumption, medicinal use, or lifestyle use was not specified)

4.1.2.8 Constance Lake First Nation

- potential effects on humans, fish and wildlife from contamination of food
- potential effects on fish and fish habitat
- project effects on fish and wildlife that are fished and hunted by local communities
- identified the harvesting of northern pike, yellow perch, walleye, trout and lake whitefish
- identified harvesting beaver, lynx, marten, mink, moose, muskrat, and rabbit

4.1.2.9 Eabametoong First Nation

- potential change to plant harvesting
- potential loss of fish harvesting and hunting areas
- potential loss of habitat for fish and wildlife
- identified the harvesting of northern pike, walleye, lake sturgeon, suckers, lake whitefish and Northern Pikeminnow
- identified harvesting beaver, black bear, waterfowl/ducks, ruffed grouse, partridge, marten, mink, otter, rabbit, and wolf

4.1.2.10 Marten Falls First Nation

- potential effects on water quality, harvesting of wild life and ability to access traditional use areas
- identified harvesting moose

4.1.2.11 Pays Plat First Nation

- potential effects on community fishing, plant harvesting, hunting and trapping
- identified harvesting of northern pike, and walleye
- identified fishing areas including Dickson Lake, Campsite Lake, Long Lake, Aguasabon Lake, Chorus Lake, and Troupe Lake
- Identified harvesting moose

4.1.2.12 Pic Mobert First Nation

- Identified harvesting moose

4.1.3 Change in Drinking Water Quality or Quantity

Through the consultation process, the following Aboriginal communities provided key comments in relation to a change in drinking water quality or quantity: AZA, AFN, GFN, LLFN, MNO, BN, and CLFN.

The following key comments relating to a change in drinking water quality or quantity were identified.

4.1.3.1 Animbiigoo Zaagi'igan Anishinaabek

- identified potential effects of the Project on groundwater
- identified Kenogamisis Lake as an area traditionally used by its members and reported that Elders drink the water from Kenogamisis Lake
- potential for chronic long-term health effects from reduced water quality

4.1.3.2 Aroland First Nation

- groundwater movement in the area and potential effects on water supply that is groundwater-fed
- potential effects on humans from water quality changes as a result of the Project
- potential effects on fish and wildlife from water quality changes

- potential effects of the Project on drinking water

4.1.3.3 Ginoogaming First Nation

- potential effects on humans from water quality changes as a result of the Project
- drinking water ingestion for typical residential receptors
- potential effects on fish and wildlife from water quality changes
- potential effects of the Project on drinking water

4.1.3.4 Long Lake #58 First Nation

- potential for effects on humans from water quality changes as a result of the Project
- potential for effects on fish and wildlife from water quality changes
- include sources of drinking water in the environmental assessment
- potential effects of the Project on drinking water
- identified the importance of potable water security

4.1.3.5 Métis Nation of Ontario

- potential effects on fish and wildlife from water quality
- potential effects on humans from water quality changes as a result of the Project

4.1.3.6 Biigtigong Nishnaabeg

- potential effects on humans from water quality changes as a result of the Project
- potential effects on fish and wildlife from water quality changes
- comparison of surface water quality results against drinking water standards rather than Provincial Water Quality Objectives (PWQO) in the EA

4.1.3.7 Constance Lake First Nation

- potential effects on fish and wildlife from water quality changes

4.1.3.8 Marten Falls First Nation

- identified the importance of the protection of water quality in surface water features

4.1.3.9 Pays Plat First Nation

- potential effects on humans from water quality changes as a result of the Project

4.1.4 Change in Noise or Vibration Exposure

Through the consultation process, the following Aboriginal communities provided key comments on a change in noise or vibration exposure: AFN, GFN, MNO, and BN.

The following key comments relating to a change in noise or vibration exposure were identified.

4.1.4.1 Aroland First Nation

- importance of including areas used for traditional purposes by Aboriginal communities in the assessment of the acoustic environment
- potential effects on fish and fish habitat from blasting

4.1.4.2 Ginoogaming First Nation

- effects on drivers along Highway 11 both from a noise and vibration perspective, startling or distracting drivers and causing hazardous driving conditions
- importance of including areas used for traditional purposes in the assessment of the acoustic environment

4.1.4.3 Métis Nation of Ontario

- importance of including areas used for traditional purposes in the assessment of the acoustic environment

4.1.4.4 Biigtigong Nishnaabeg

- effects on fish and fish habitat from blasting

4.2 ABORIGINAL SOCIO-ECONOMIC CONDITIONS

4.2.1 Change in Use of Navigable Waters

Through the Aboriginal consultation process, no issues were recorded pertaining specifically to Project interactions with the use of waterways for navigation. However, Aboriginal communities have identified travel routes that make use of navigable waterways outside the PDA.

The following travel routes were identified by Aboriginal communities and GGM has considered the potential for these navigable waterways to be affected by Project activities.

4.2.1.1 Long Lake #58 First Nation

- along the Southwest Arm of Kenogamisis Lake
- north end of Wildgoose Lake, through the Southwest Arm of Kenogamisis Lake, and continuing through Kenogamisis Lake

4.2.1.2 Métis Nation of Ontario

- along the Southwest Arm of Kenogamisis Lake

4.2.1.3 Pays Plat First Nation

- "there is a canoe route that goes from Pays Plat First Nation to Dickison Lake and eventually to Geraldton"

4.2.2 Change in Forestry and Logging Operations

Through the Aboriginal consultation process, no comments were recorded pertaining specifically to potential Project interactions with forestry and logging operations. However, the PDA overlaps areas of Crown timber located within the Kenogami forest management unit (FMU). The Kenogami FMU is administered by the Ministry of Natural Resources and Forestry (MNRF) and managed by Ne-Daa-Kii-Me-Naan Inc., a First Nation-owned forest management company that is operated by a Board of Directors representing seven Aboriginal communities in the region (GFN, LLFN, AFN, CLFN, PPFN, AZA, and Red Rock Indian Band) (Nedaak 2016).

4.2.3 Change in Commercial Fishing, Hunting, Trapping, Gathering, and Guide Outfitting Activities

Through the consultation process, the following Aboriginal communities provided key comments on a potential change in commercial fishing, hunting, trapping, gathering, and guide outfitting activities: AZA, AFN, GFN, LLFN, MNO, CLFN, and PMFN. Commercial bait harvesting is the only form of commercial fishing which was identified in the Final EIS/EA.

The following key comments relating to a change in commercial fishing, hunting, trapping, gathering, and guide outfitting activities were identified.

4.2.3.1 Animbiigoo Zaagi'igan Anishinaabek

- potential effects on trapline GE021 and which is held by a member of AZA [Editorial note: GE021is partially overlapped by the PDA; for additional information see Table 16-6 of the Final EIS/EA].
- fishing occurs in an area approximately 7.5 km from the PDA

4.2.3.2 Aroland First Nation

- recognizing Aboriginal fisheries and fishing practices in the EA
- in hard economic times, fishing and hunting provide valuable economic input and invaluable cultural, spiritual, and recreational opportunity
- additional information potential effects to community harvesting and traditional foods, snowmobile trails and commercial trapline licences in the area
- potential loss and degradation of the quality of lands and resources for fish, wildlife and traditional purposes
- potential loss of access/use of lands and resources for traditional purposes
- identified Kenogamisis Lake and Long Lake as commercial and subsistence fishing areas
- identified the harvesting of dace and minnows

4.2.3.3 Ginoogaming First Nation

- in hard economic times, fishing and hunting provide valuable economic input and invaluable cultural, spiritual, and recreational opportunity

4.2.3.4 Long Lake #58 First Nation

- trapline areas within the Project currently held by community members include GE034, GE023 and GE009 [Editorial note: GE023 and GE009 are located outside of the PDA; for additional information see Table 16-6 of the Final EIS/EA]
- potential loss of access to traditional use areas
- identified the use of fishing areas including Wig Lake, Rogers Lake, Burtt Lake, Wintering Lake, Gamsby Lake, Nakina Lakes, Kenogamisis Lake, Seagram Lake, Fernel Lake, Eldee Lake, Ranier Lake, Kenogamisis River, Burrows River and Suckle Creek.

4.2.3.5 Métis Nation of Ontario

- consideration of commercial, recreational, and Aboriginal (CRA) fisheries (as defined in the *Fisheries Act*), with specific reference to Goldfield Lake, Kenogamisis Lake, and Mosher Lake in the EA
- include detail on the location of Métis use, Métis regions and harvesting territories, specific uses under the Harvesting Agreement (established in 2004 between MNO and the MNRF), species of importance, key areas, and commercially-based activity specific to Métis
- potential loss of access to traditional use areas

4.2.3.6 Constance Lake First Nation

- in hard economic times, fishing and hunting provide valuable economic input and invaluable cultural, spiritual, and recreational opportunity

4.2.3.7 Marten Falls First Nation

- potential effects on water quality, harvesting of wild life and ability to access traditional use areas

4.2.3.8 Pays Plat First Nation

- potential effects on community fishing, plant harvesting, hunting and trapping
- identified potential loss of access to traditional use areas and Kenogamisis Lake through Lahtis Road

4.2.3.9 Pic Mobert First Nation

- Potential effects to commercial trapline licence holders near Caramat Road [For additional information, see Appendix C3 of the Final EIS/EA]

In addition to those mentioned above, the MNRF and CEA Agency identified additional commercial trapline areas held by Aboriginal peoples include GE035, GE008, GE009, GE120, and NG089 which are located within and beyond the RAA. The location in relation to the PDA is discussed in Section 5.10. The CEA Agency also identified commercial baitfish licence areas held by Aboriginal peoples including areas NI5007, NI5013, NI5019, NI5020, NI5034, NI5035, and NI5055.

4.2.4 Change in Recreation

Through the consultation process, the following Aboriginal communities provided key comments on a potential change in recreation: AFN, GFN, LLFN, MNO, and BNA.

The following key comments relating to a change in recreation were identified.

4.2.4.1 Aroland First Nation

- potential access restrictions and controls
- changes to lands currently used for recreation, firewood collection, fishing, and hunting
- the golf course and OPP station have the potential to be affected by the Project

4.2.4.2 Ginoogaming First Nation

- potential access restrictions and controls

- changes to lands currently used for recreation, firewood collection, fishing, and hunting
- the Discover Geraldton Interpretive Centre, the Hydro One transformer station, the OPP station, the golf course and the MacLeod-Cockshutt Mining Headframe have the potential to be affected by the Project
- recreation services and infrastructure could potentially be affected by the Project
- community and recreation services for children could potentially be affected by the Project

4.2.4.3 Long Lake #58 First Nation

- potential access restrictions and controls
- changes to lands currently used for recreation, firewood collection, fishing, and hunting
- the Discover Geraldton Interpretive Centre, the Hydro One transformer station, the OPP station, the golf course and the MacLeod-Cockshutt Mining Headframe have the potential to be affected by the Project
- community and recreation services for children could potentially be affected by the Project

4.2.4.4 Métis Nation of Ontario

- potential access restrictions and controls

4.2.4.5 Bingwi Neyaashi Anishinaabek

- the Discover Geraldton Interpretive Centre, the Hydro One transformer station, the OPP station, the golf course and the MacLeod-Cockshutt Mining Headframe have the potential to be affected by the Project changes to lands currently used for recreation, firewood collection, fishing, and hunting

4.2.5 Change in Labour and Economy

Through the consultation process, the following Aboriginal communities provided key comments on changes to labour and economy: AZA, AFN, GFN, LLFN, MNO, and PPFN.

The following key comments relating to a change in labour and economy were identified.

4.2.5.1 Animbiigoo Zaagi'igan Anishinaabek

- the need for employment opportunities with the Project, including required trades, timelines, training, hiring processes and third party business opportunities

4.2.5.2 Aroland First Nation

- the need for employment opportunities with the Project, including required trades, timelines, training, hiring processes and third party business opportunities and GGM's to support transition during project closure

4.2.5.3 Ginoogaming First Nation

- some community participants indicated that employment in the resource extraction sector provides cash for food and gasoline, which alleviates the pressure to procure food by traditional means
- the need for employment opportunities with the Project, including required trades, timelines, training, hiring processes and third party business opportunities
- potential increased costs of purchased foods and travel arising from decreased quantity and quality of traditional foods

4.2.5.4 Long Lake #58 First Nation

- the need for employment opportunities with the Project, including required trades, timelines, training, hiring processes and third party business opportunities

4.2.5.5 Métis Nation of Ontario

- the need for employment opportunities with the Project, including required trades, timelines, training, hiring processes and third party business opportunities
- unique labour force values in relation to the Métis, including labour force participation and unemployment rates, employment by industry and occupation, labour force skill levels, labour availability, income levels and business and economic activities

4.2.5.6 Bingwi Neyaashi Anishinaabek

- the need for Aboriginal members to have direct or indirect employment opportunities with the Project, including required trades, timelines, training, hiring processes and third party business opportunities

4.2.5.7 Biinjitiwaabik Zaaging Anishinaabek

- the need for Aboriginal members to have direct or indirect employment opportunities with the Project, including required trades, timelines, training, hiring processes and third party business opportunities

4.2.5.8 Marten Falls First Nation

- the need for Aboriginal members to have direct or indirect employment opportunities with the Project, including required trades, timelines, training, hiring processes and third party business opportunities

4.2.5.9 Pays Plat First Nation

- the need for Aboriginal members to have direct or indirect employment opportunities with the Project, including required trades, timelines, training, hiring processes and third party business opportunities

4.2.6 Change in Community Services and Infrastructure

Through the consultation process, the following Aboriginal communities provided key comments on changes to community services and infrastructure: AFN, GFN, LLFN, and BNA.

The following key comments relating to a change in community services and infrastructure were identified.

4.2.6.1 Aroland First Nation

- the Discover Geraldton Interpretive Centre, the Hydro One Longlac Transmission Station, the Ontario Provincial Police (OPP) station and the historical MacLeod-Cockshutt Mining Headframe have the potential to be affected by the Project
- the golf course and Highway 11 have the potential to be affected by the Project
- identified the importance of potable water security

4.2.6.2 Ginoogaming First Nation

- the Discover Geraldton Interpretive Centre, the Hydro One Longlac Transmission Station, the Ontario Provincial Police (OPP) station and the historical MacLeod-Cockshutt Mining Headframe have the potential to be affected by the Project
- the golf course and Highway 11 have the potential to be affected by the Project
- health care services and infrastructure could potentially be affected by the Project

4.2.6.3 Long Lake #58 First Nation

- the golf course and Highway 11 have the potential to be affected by the Project
- health care and emergency services, housing / rental stock, and traffic on the highway and railroads could potentially be affected by the Project
- identified the importance of potable water security

4.2.6.4 Bingwi Neyaashi Anishinaabek

- the golf course and Highway 11 have the potential to be affected by the Project
- Michael Power Boulevard, the OPP Station, historical MacLeod-Cockshutt Mining Headframe and the Discover Geraldton Interpretive Centre have the potential to be affected by the Project

4.3 ABORIGINAL PHYSICAL AND CULTURAL HERITAGE

4.3.1 Change in Physical or Cultural Heritage

Through the consultation process, the following Aboriginal communities provided key comments on a change in physical or cultural heritage or associated access: AFN, GFN, LLFN, and MNO.

The following key comments relating to a change in physical or cultural heritage were identified.

4.3.1.1 Aroland First Nation

- the importance of considering heritage resources as significant or of interest to Aboriginal communities in the effects assessment
- the inclusion of First Nation land use and occupancy studies in the archaeological assessments
- requests Aboriginal community participation in development of mitigation measures, monitoring, archaeological and heritage resource identification and communication relative to new archeological finds

4.3.1.2 Ginoogaming First Nation

- the importance of considering heritage resources as significant or of interest to Aboriginal communities in the effects assessment
- further discussion of existing conditions, including related to areas of archaeological potential that are not tied to modern water sources, and consideration of heritage resources that may be affected by water level changes

4.3.1.3 Long Lake #58 First Nation

- further detail to be included in the assessment on heritage sites of importance to LLFN and consideration of TK for sites in the highway footprint

4.3.1.4 Métis Nation of Ontario

- consideration of the Métis perspective when assessing heritage resources

- identifies potential for restricted access to cultural and spiritual sites (where they may exist)

4.4 CURRENT USE OF LANDS AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PEOPLES

To simplify editorial components of the Final EIS/EA, current use of lands and resources for traditional purposes is referred to as TLRU in chapter 18.0 of the Final EIS/EA (Stantec 2017d).

4.4.1 Change in Current Use

Through the consultation process the following Aboriginal communities provided key comments regarding a change to current use areas, activities, and associated resources: AZA, AFN, BN, GFN, LLFN, MFFN, MNO, BZA, BNA, CLFN, EFN, MFFN, PPFN, PMFN and RSMIN.

The following key comments relating to a change to current use were identified.

4.4.1.1 Animbiigoo Zaagi'igan Anishinaabek

- ability to exercise Aboriginal and/or treaty rights and continued use of traditional territories and historical land use effects on harvesting areas and resources through Project activities or contamination
- potential effects on cultural and spiritual areas
- importance of traditional land use practices for subsistence and economic purposes
- potential effects on Aboriginal fisheries, fishing practices and fish and fish habitat
- potential loss of plant harvesting sites
- potential loss of habitat for fish and wildlife
- identified the harvesting of bald eagle, waterfowl/ducks, and moose
- identified Kenogamisis Lake and Long Lake as commercial and subsistence fishing areas

4.4.1.2 Aroland First Nation

- ability to exercise Aboriginal and/or treaty rights and continued use of traditional territories and historical land use
- potential loss of individual and community traditional knowledge skills due to loss of lands and resources
- potential restrictions on harvesting and access to current use areas

- potential effects on harvesting areas and resources through Project activities or contamination
- potential effects on cultural and spiritual areas
- importance of traditional land use practices for subsistence and economic purposes
- potential effects on Aboriginal fisheries, fishing practices and fish and fish habitat
- potential loss and degradation of the quality of lands and resources for fish, wildlife and traditional purposes
- potential loss of access/use of lands and resources for traditional purposes
- potential loss or contamination of harvested plant species of importance including wild rice and winke/wike (sweet flag)
- identified the harvesting of walleye, lake sturgeon, suckers, trout, whitefish, dace and minnows
- identified harvesting moose and wolverine

4.4.1.3 Ginoogaming First Nation

- ability to exercise Aboriginal and/or treaty rights and continued use of traditional territories and historical land use
- expressed a concern that a decrease in health and availability of harvested plants, wildlife and fish will diminish the strong connection with the land and traditional practices
- potential restrictions on harvesting and access to current use areas
- potential effects on cultural and spiritual areas
- importance of traditional land use practices for subsistence and economic purposes
- potential effects on Aboriginal fisheries, fishing practices and fish and fish habitat
- identified fishing occurs at Kenogamisis Lake, Burrows Lake, Twin Lakes, Chipman Lake, Long Lake and the waterways that connect them
- identified the harvesting of northern pike, yellow perch, trout and walleye
- identified harvesting of bear root, blueberries, bull rush, cedar, juniper, lowbush cranberry, sweetgrass, red willow (note: consumption, medicinal use, or lifestyle use was not specified)
- identified harvesting deer, geese, marten, moose, and rabbit
- recommend developing mitigation measures to control hunting, trapping and fishing by mine workers

- some Elders avoid harvesting in disturbed areas and cease to use areas treated with herbicide

4.4.1.4 Long Lake #58 First Nation

- The LLFN Traditional Knowledge Assessment noted "no uses were highlighted which create a potential no-go area."
- ability to exercise Aboriginal and/or treaty rights and continued use of traditional territories and historical land use
- potential restrictions on harvesting and access to current use areas
- potential effects on harvesting areas and resources through Project activities or contamination
- potential effects on cultural and spiritual areas
- potential effects on Aboriginal fisheries, fishing practices and fish and fish habitat
- identified the harvesting of northern pike, rainbow smelt, walleye, lake sturgeon, trout, and lake whitefish
- identified the use of fishing areas including Wig Lake, Rogers Lake, Burtt Lake, Wintering Lake, Gamsby Lake, Nakina Lakes, Kenogamisis Lake, Seagram Lake, Fernel Lake, Eldee Lake, Ranier Lake, Kenogamisis River, Burrows River and Suckle Creek
- identified harvesting of balsam fir, birch, black ash, black spruce, blueberries, cedar, currant, Labrador tea, lowbush cranberry, mint, mountain ash, raspberries, strawberries, sweetgrass, wild rice, and yarrow (note: consumption, medicinal use, or lifestyle use was not specified)
- identified harvesting geese, ruffed grouse, marten, and moose
- cultural or spiritual sites in the LAA include one gathering site, four campsites/cabins, six cabins, one travel route and four sacred areas. [Editorial note: Within the PDA, cultural or spiritual sites that will be affected include four campsites or cabin areas reported by LLFN, and a tent or temporary structure south of Mosher Lake and a route connecting Highway 11 with Mosher Lake reported by MNO) both conservatively assumed to be located within the PDA. In addition, comments made by AFN to the CEA Agency confirmed they use snowmobile trails, which are operated by the Ontario Federation of Snowmobile Clubs and maintained by the Greenstone Snowmobile Club, along Highway 11 in the PDA for hunting.]

4.4.1.5 Métis Nation of Ontario

- ability to exercise Aboriginal or treaty rights and continued use of traditional territories and historical land use
- potential restrictions on harvesting and access to current use areas

- potential effects on harvesting areas and resources through Project activities or contamination
- potential effects on cultural and spiritual areas (where they may exist)
- potential effects on Aboriginal fisheries, fishing practices and fish and fish habitat
- potential loss of access to traditional use areas
- identified harvesting of bass, burbot, northern pike, walleye, salmon, rainbow smelt, lake sturgeon, suckers, trout, lake whitefish and other non-commercial fish
- identified harvesting of birch, birch mushroom, black spruce, blueberries, chaga, chanterelle, ferns, highbush cranberry, lowbush cranberry, mint, mushrooms, pin cherry, Saskatoon berry, shaggy mane, strawberries, white spruce, willow, and wild rice (note: consumption, medicinal use, or lifestyle use was not specified)
- identified harvesting beaver, black bear, deer, waterfowl/ducks, geese, ruffed grouse, lynx, mink, moose, prairie chicken, and rabbit
- cultural and spiritual sites within the LAA include two bush camps, five tents/temporary structures, eight habitation areas, five boat launches, two land or water routes, 17 sites/areas of Métis cultural practices and one route of Métis cultural practices. [Editorial note: Within the PDA, cultural or spiritual sites that will be affected include four campsites or cabin areas reported by LLFN, and a tent or temporary structure south of Mosher Lake and a route connecting Highway 11 with Mosher Lake reported by MNO) both conservatively assumed to be located within the PDA. In addition, comments made by AFN to the CEA Agency confirmed they use snowmobile trails, which are operated by the Ontario Federation of Snowmobile Clubs and maintained by the Greenstone Snowmobile Club, along Highway 11 in the PDA for hunting.]

4.4.1.6 Biigtigong Nishnaabeg

- ability to exercise Aboriginal and/or treaty rights and continued use of traditional territories and historical land use
- potential effects on harvesting areas and resources through Project activities or contamination)
- importance of traditional land use practices for subsistence and economic purposes
- potential effects on Aboriginal fisheries, fishing practices and fish and fish habitat

4.4.1.7 Biinjitiwaabik Zaaging Anishinaabek

- potential effects on Aboriginal fisheries, fishing practices and fish and fish habitat

- identified the harvesting of blueberries, highbush cranberries, lowbush cranberries, maple, raspberries, Saskatoon berries, strawberries, and wild rice (note: consumption, medicinal use, or lifestyle use was not specified)

4.4.1.8 Bingwi Neyaashi Anishinaabek

- potential restrictions on harvesting and access to current use areas
- potential effects on harvesting areas and resources through Project activities or contamination

4.4.1.9 Constance Lake First Nation

- potential effects on harvesting areas and resources through Project activities or contamination
- importance of traditional land use practices for subsistence and economic purposes
- potential effects on Aboriginal fisheries, fishing practices and fish and fish habitat
- identified the harvesting of northern pike, yellow perch, walleye, trout and lake whitefish
- identified harvesting beaver, lynx, marten, mink, moose, muskrat, and rabbit

4.4.1.10 Eabametoong First Nation

- potential disruption of the landscape and fears of contamination resulting in a decreased spiritual connection toward the landscape
- potential loss and degradation of the quality of lands and resources for fish, wildlife leading to decreased time spent on the land and decreased transmission of knowledge
- potential effects on harvesting areas and resources through Project activities or contamination
- potential effects on Aboriginal fisheries, fishing practices and fish and fish habitat
- identified the harvesting of northern pike, walleye, suckers, lake whitefish and Northern Pikeminnow
- identified harvesting beaver, black bear, waterfowl/ducks, ruffed grouse, marten, mink, partridge, otter, rabbit, and wolf
- potential change to plant harvesting
- potential loss of fish harvesting and hunting areas
- potential loss of access to/use of traditional use areas leading to decreased time spent on the land and transmission of knowledge

- noted one site of cultural continuity within the LAA and five within the RAA

4.4.1.11 Marten Falls First Nation

- potential effects on harvesting areas and resources through Project activities or contamination
- potential effects on water quality, harvesting of wild life and ability to access traditional use areas
- identified harvesting moose

4.4.1.12 Pays Plat First Nation

- potential effects on community fishing, plant harvesting, hunting and trapping
- identified potential loss of access to traditional use areas and Kenogamisis Lake through Lahtis Road
- noted the harvesting of northern pike, and walleye
- identified fishing areas including Dickson Lake, Campsite Lake, Long Lake, Aguasabon Lake, Chorus Lake, and Troupe Lake
- identified harvesting moose
- continue to use long-established trails and travelways that connect communities harvesting areas, and gathering places in a network of traditional use and cultural patterns
- traditional gathering places in the region are used for gathering, socializing, harvesting or ceremonial purposes; cultural transmission occurs at these locales

4.4.1.13 Red Sky Métis Independent Nation

- effects on harvesting areas and resources through Project activities or contamination
- effects on Aboriginal fisheries, fishing practices and fish and fish habitat

5.0 DISCUSSION OF POTENTIAL PROJECT-EFFECT MECHANISMS RELATED TO SECTION 5(1)(C) FACTORS PRIOR TO MITIGATION

The following sections provide a high-level summary of the mechanisms by which the Project may interact with the VCs assessed in Chapters 7.0 to 19.0 of the Final EIS/EA (Stantec 2017d), as summarized directly from the key observations made in those specific VC chapters.

In the sub-sections below, we summarize the mechanisms by which a potential effect could occur in the absence of mitigation, as elaborated in each of the VC chapters of the Final EIS/EA. We then relate those mechanisms from the individual VCs by identifying how they could affect Aboriginal persons for each of the Section 5(1)(c) Factors. Following the summary, a table is provided which outlines the mechanisms by which the Project may interact (prior to mitigation) with Section 5(1)(c) Factors.

It is important to note that this Chapter focuses only on mechanisms of potential effects and how they relate to Aboriginal peoples, without mitigation or discussion of residual effects. Subsequent to this Chapter, Chapter 6.0 of this report will then discuss mitigation for the Project that would address those mechanisms. Finally, residual effects after mitigation has been applied will be discussed in Chapter 7.0 of this report, in relation to the Section 5(1)(c) Factors.

5.1 POTENTIAL CHANGES IN ATMOSPHERIC ENVIRONMENT PRIOR TO MITIGATION

Project-effect mechanisms for a change in the atmospheric environment were discussed in Sections 7.4.2.1, 7.4.3.1, and 7.4.4.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

During Project construction, in the absence of mitigation, emissions of air parameters of potential concern (PoPC) may result from site preparation activities and the construction of Project components. These emissions would include particulate matter and combustion gases from construction equipment, and particulate matter (dust) emissions caused by the operation of heavy earth-moving equipment and wind erosion. Construction emissions are expected to occur intermittently during daytime hours over the duration of the construction phase.

During Project operation, in the absence of mitigation, emissions of air PoPC and volatile organic compounds may result from: the combustion of diesel fuel; natural gas combustion in the power plant; emissions from mill reagents; and particulate or dust emissions generated by operation of the open pit, mining fleet traffic, and the stockpiling, handling and transport of ore, historical tailings, waste rock and overburden.

Active closure emissions are expected to be less than construction emissions, and therefore the construction assessment will implicitly address the active closure phase emissions as well. The post-closure phase is expected to generate limited air contaminant emissions.

A summary of how, in the absence of mitigation, a Project-related change in atmospheric environment may potentially affect Aboriginal health conditions is provided in Table 5-1 below.

Table 5-1: Potential Effects of a Change in Atmospheric Environment on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal health conditions – change in air quality	Aboriginal health conditions can be affected by a change in atmospheric environment through a change in air quality and associated inhalation-related health risks. Potential air quality issues associated with the Project that can potentially affect Aboriginal people's health include airborne particulate matter or dust (i.e., total suspended particulate, particulate matter with diameter of 10 micrometers or less (inhalable particulate matter) [PM_{10}], particulate matter with diameter of 2.5 micrometers or less (respirable particulate matter) [$PM_{2.5}$] and associated metals in particulate), emissions from the combustion of diesel and natural gas, and emissions from the operation of an open pit mine and ore processing. Aboriginal peoples can be exposed to Project-related emissions and particulate matter while engaged in recreational activities and using lands and resources for traditional purposes. AFN, MNO, and GFN noted the importance of including areas used for traditional purposes by Aboriginal communities in the assessment of the atmospheric environment. In response, 17 special receptors representing areas of TLRU were included in the assessment to provide additional information about a potential change in air quality to which Aboriginal people can be exposed (Figure 7-1 in the Final EIS/EA; Stantec 2017d).
Aboriginal Physical and Cultural Heritage – sensory disturbance	Changes in air quality and lighting may result in indirect sensory disturbance to Aboriginal land users that could adversely affect the experience of using culturally or spiritually important locations or landscapes, or deter individuals from using affected areas or locations.
Current Use – sensory disturbance	Changes in air quality and lighting may result in indirect sensory disturbance to Aboriginal land users that could adversely affect the experience of traditional use or deter individuals from using affected areas or locations.

5.2 POTENTIAL CHANGES IN ACOUSTIC ENVIRONMENT PRIOR TO MITIGATION

Project-effect mechanisms for a change in the acoustic environment were discussed in Sections 8.4.2.1 and 8.4.3.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

The primary sources of noise during construction include trucks and trailers, portable air compressors, bulldozers, front end loaders, excavators, graders, gravel and rock trucks, scrapers, compactors, mobile cranes, and concrete pumps. Similar to noise, vibration is caused as a result of construction vehicles, typical machinery for a mining site and roadway realignment work.

The main noise-generating sources associated with operation include blasting in the open pit, process plant equipment such as rock breakers, feeders, and conveyors, moving sources such as trucks, excavators, and dozers, as well as power generation. The main vibration-generating sources associated with Project operation include equipment such as rock breakers and feeders, and moving sources such as trucks, excavators, and bulldozers. Blasting within the open pit will also produce vibration.

Noise generated during active closure is expected to be equal or less than during construction.

A summary of how, in the absence of mitigation, a Project-related change in acoustic environment may potentially Aboriginal health conditions is provided in Table 5-2 below.

Table 5-2: Potential Effects of a Change in Acoustic Environment on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal health conditions – change in vibration or noise exposure	Aboriginal health conditions can be affected by a change in acoustic environment through Project-related increase in noise or vibration levels. Aboriginal peoples can be exposed to Project-related noise or vibration while engaging in recreational activities and using lands and resources for traditional purposes. AFN, MNO, and GFN noted the importance of including areas used for traditional purposes by Aboriginal communities in the acoustic assessment. In response, Points of Interest (PoIs) representing areas of TLRU were included in the assessment to provide additional information about potential Project-related increases in noise or vibration to which Aboriginal people can be exposed. GFN also identified the potential for Project-related blasting to startle or distract drivers and cause hazardous driving conditions.
Aboriginal physical and cultural heritage – sensory disturbance	Changes in noise and vibration may result in indirect sensory disturbance to Aboriginal land users that could adversely affect the experience of using culturally or spiritually important locations or landscapes or deter individuals from using affected areas or locations.
Current use – sensory disturbance	Changes in noise and vibration may result in indirect sensory disturbance to Aboriginal land users that could adversely affect the experience of using traditional use locations or deter individuals from using affected areas or locations.

5.3 POTENTIAL CHANGES IN GROUNDWATER PRIOR TO MITIGATION

Project-effect mechanisms for a change in groundwater were discussed in Sections 9.4.2.1 and 9.4.3.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

During construction, in the absence of mitigation, groundwater quantity and/or flow will primarily be affected by dewatering of the historical underground workings, the Borrow Pit Phase of the open pit, the development and dewatering of aggregate source areas and the diversion of Goldfield Creek. During operation, if left unmitigated, drawdown resulting from open pit dewatering may potentially affect local groundwater users if located within the predicted zone of influence (ZOI). The removal of portions of historical tailings and changes in groundwater flow during operation has the potential to improve groundwater quality by reducing loadings of PoPC to the environment. During closure, in the absence of mitigation, groundwater levels will slowly rise and changes to groundwater flow direction and discharge locations are expected. These changes will affect groundwater flow patterns and discharge to surface water features and wetlands. The effects of these changes on surface water and wetlands are further assessed in chapters 10.0 (surface water VC) and 12.0 (vegetation communities VC) of the Final EIS/EA (Stantec 2017d).

A summary of how, in the absence of mitigation, a Project-related change in groundwater may potentially affect Aboriginal health conditions is provided in Table 5-3 below.

Table 5-3: Potential Effects of a Change in Groundwater on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal health conditions – change in drinking water quality or quantity	The health conditions of Aboriginal people can be affected by a change in groundwater through changes in drinking water quality or quantity. Aboriginal people can be affected by dewatering activities if groundwater wells used by Aboriginal peoples are located within the predicted ZOI.

5.4 POTENTIAL CHANGES IN SURFACE WATER PRIOR TO MITIGATION

Project-effect mechanisms for a change in surface water were discussed in Sections 10.4.2.1 and 10.4.3.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

In the absence of mitigation, construction activities and the continued expansion of Project facilities have the potential to affect surface water quantity and drainage patterns through: changes in runoff, evapotranspiration and infiltration characteristics; changes in effective contributing catchment areas; watercourse realignment; and surface water extraction. Specific construction activities of note include: treated effluent discharge, site preparation and ground disturbance; realignment of Highway 11; dewatering of the historical underground workings, the Borrow Pit Phase and aggregate sources; temporary dewatering for installation of Project infrastructure; construction of watercourse crossings; diversion/realignment of Goldfield Creek, trenches and excavations; and the development of water management infrastructure.

During operation, in the absence of mitigation, surface water quantity may be affected by the development of the WRSAs and TMF, ongoing water management, dewatering of the open pit and historical underground workings, meeting mill demand by internal recycling of contact water, water withdrawals from the Southwest Arm of Kenogamisis Lake to meet processing needs, and linear facilities with accompanied drainage infrastructure.

During construction and operation, surface water quality could be affected by erosion and sedimentation, and contact water, in the absence of mitigation. In addition, during operation, discharge of treated effluent may potentially affect surface water quality. Project activities which result in erosion and sedimentation and discharge to surface water features may also affect surface water quality during closure if left unmitigated.

Closure activities with the potential to affect surface water quantity include the decommissioning and removal of Project components including water management facilities, the re-establishment of drainage patterns, and the filling of the open pit with water, if left unmitigated.

A summary of how, in the absence of mitigation, a Project-related change in surface water may potentially affect Aboriginal health conditions is provided in Table 5-4 below.

Table 5-4: Potential Effects of a Change in Surface Water on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal health conditions – change in drinking water quantity or quality	Aboriginal health conditions can be affected by a change in surface water through a change in drinking water quality or quantity. Aboriginal peoples who rely on municipal water sources will not experience a change in drinking water quality or quantity as the water supply for Geraldton is obtained from Cecile Lake, which is located within the Burrows River watershed, and will not be affected by the Project. Aboriginal peoples can experience a change in drinking water quality or quantity if drinking water is affected from streams and lakes in areas where lands and resources are used consumption. AZA reported that Elders drink the water from Kenogamisis Lake. LLFN and GFN identified Long Lake, which is located downstream of the Project RAA, as a drinking water supply for both communities. LLFN and GFN are serviced by Longlac Water Treatment Plant which draws water from Long Lake. The potable water supply for MacLeod Provincial Park is sourced from a shallow dug groundwater well located just south of the lagoon that connects to Kenogamisis Lake. The Park water supply system is classified as a Groundwater Under the Direct Influence of Surface Water (GUDI) well because the groundwater supply is in direct hydraulic connection with surface water. As

Table 5-4: Potential Effects of a Change in Surface Water on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
	a result, a change in surface water quantity and quality of Kenogamisis Lake has the potential to affect this drinking water source.

5.5 POTENTIAL CHANGES IN FISH AND FISH HABITAT PRIOR TO MITIGATION

Project-effect mechanisms for a change in fish and fish habitat were discussed in Sections 11.4.2.1, 11.4.3.1, and 11.4.4.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

During construction, operation, and closure, in the absence of mitigation, potential mechanisms for effects on fish include: the mobilization and transport of sediment to fish habitat; changes to flow; dewatering; destruction of fish eggs; stranding of fish; the introduction of deleterious materials to fish habitat from point (i.e., treated effluent discharge) and non-point sources (i.e., surface run-off, groundwater seepage, and dustfall); and shock waves from explosives usage.

If left unmitigated, a permanent alteration of fish habitat may occur through changes to water characteristics from treated effluent, groundwater discharge, physical changes, extraction of surface water, changes to the riparian vegetation and structure, and changes to flow regime related to construction, operation, and closure activities.

Fish habitat may be lost as a result of the placement of materials or structures in water during construction, in the absence of mitigation. No operation or closure activities have been identified that would results in a loss of fish habitat. Loss of fish habitat that cannot be avoided will be addressed through the implementation of the Fisheries Offset Plan.

A summary of how, in the absence of mitigation, a Project-related change in fish and fish habitat may potentially affect Aboriginal health conditions is provided in Table 5-5 below.

Table 5-5: Potential Effects of a Change in Fish and Fish Habitat on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal health conditions – change in the quality and availability of country foods	Aboriginal health conditions can be affected by a change in fish and fish habitat through changes in the quality and availability of country foods. Changes to the availability of fish could result from harm, permanent changes to fish habitat, and the permanent loss of fish habitat. This can reduce the numbers of fish that are available for harvest, as well as potentially changing the location of fishing areas, if these are permanently changed or removed as a result of the Project. Changes to access to fishing areas is discussed in Section 5.12 of this report.

Table 5-5: Potential Effects of a Change in Fish and Fish Habitat on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
	Changes to fish can result from the uptake of metals in fish tissue which could affect health conditions through a change in the quality of country foods. This potential is considered in Section 5.13 of this report.

5.6 POTENTIAL CHANGES IN VEGETATION COMMUNITIES PRIOR TO MITIGATION

Project-effect mechanisms for a change in vegetation communities were discussed in Sections 12.4.2.1, 12.4.3.1, and 12.4.4.1 of the Final EIS/EA. A summary follows.

The primary mechanism for change in vegetation communities is the removal of vegetation due to construction activities, if left unmitigated. Upland and wetland vegetation communities located in the PDA will be removed to accommodate Project components, resulting in the direct loss of approximately 1,133 hectares (ha) of upland and 810 ha of wetland vegetation communities. Additional vegetation clearing beyond that accomplished during construction will not take place during the operation and closure phases.

The function, connectivity, and quality of vegetation communities may be indirectly affected by dust deposition, changes in surface water and groundwater flow, the spread of invasive and exotic species, and fragmentation effects from introducing a large non-vegetated area into the landscape. Construction of Project components will remove wetlands and alter local topography and drainage patterns. Wetlands that are not directly affected by construction may be indirectly affected by changes in surface water flow.

Vegetation communities located within 30 metres (m) of Project components may be indirectly affected by increased dust. Sources of fugitive dust include clearing activities, vehicle traffic on unpaved surfaces, and the initial development of the open pit.

Invasive and exotic (non-native) plant species can displace native vegetation. Invasive species exist within the Highway 11 right-of-way; however, areas within the PDA and LAA not currently affected may be affected by the spread of these invasive species by new roads, construction equipment and vehicles, or imported fill.

The Project will fragment some vegetation communities by introducing a large non-vegetated area into the landscape. Fragmentation effects are expected to occur along edges of linear corridors and along the edge of the PDA.

A summary of how, in the absence of mitigation, a Project-related change in vegetation communities may potentially affect Aboriginal health conditions is provided in Table 5-6 below.

Table 5-6: Potential Effects of a Change in Vegetation Communities on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal health conditions – change in the quality and availability of country foods	Changes in vegetation and wetlands can potentially affect Aboriginal health conditions through changes in the availability of country foods. During construction, clearing of the PDA will result in a direct loss of existing vegetation, including plant species and potential plant harvesting sites identified by Aboriginal communities. Project actives will fragment vegetation communities, can spread invasive species and can increase dust all of which has the potential to affect availability of country foods. Access to these areas is considered in Sections 5.10 and 5.12 of this report. Changes to vegetation resulting in the uptake of metals in to berries and other plants harvested for consumption could affect health conditions through a change in the quality of country foods. This potential is considered in Section 5.13 of this report.

5.7 POTENTIAL CHANGES IN WILDLIFE AND WILDLIFE HABITAT PRIOR TO MITIGATION

Project-effect mechanisms for a change in wildlife and wildlife habitat were discussed in Sections 13.4.2.1, 13.4.3.1, and 13.4.4.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

Vegetation removal during site preparation will alter wildlife habitat if left unmitigated. The change in wildlife habitat will take place during the construction phase but will be evident throughout the life of the Project and into post-closure. Project activities may change the risk of mortality for wildlife, with traffic and adverse human-wildlife encounters being the primary effect mechanisms. Project features such as the TMF open pit, WRSAs, ditches, site roads and powerline corridors may act as a barrier to wildlife movement. Wildlife may be reluctant to cross these features because of high levels of human activity, sensory disturbance, or because the features are too high or wide to physically move across.

Construction and operation activities also have the potential to affect habitat indirectly as the result of sensory disturbance (through noise, light and vibration) and, to a lesser extent, other indirect effects such as edge effects, dust deposition, and changes to groundwater or surface water systems, in the absence of mitigation. Noise and light may cause wildlife to avoid or abandon habitat and may cause stress or other physiological effects. The extent of sensory disturbance experienced by wildlife as a result of Project operation will vary with the type of disturbance, the intensity of human use, season and spatial scale. Sensory disturbance may be most pronounced if experienced during key wildlife life cycle periods, such as early in the nesting cycle.

In the absence of mitigation, post-closure activities, such as revegetating areas where disturbance or removal of vegetation has occurred, will restore some wildlife habitat to the PDA. There will be some loss of wildlife habitat that will persist following post-closure, due to permanent Project components such as the open pit, WRSAs, and TMF.

Atmospheric emissions and water discharges (treated effluent and seepage) from Project activities can add concentrations of PoPC in ambient air, soil, surface water and sediment, which in turn may potentially affect the health of wildlife.

A summary of how, in the absence of mitigation, a Project-related change in wildlife and wildlife habitat may potentially affect Aboriginal health conditions is provided in Table 5-7 below.

Table 5-7: Potential Effects of a Change in Wildlife and Wildlife Habitat on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal health conditions – change in quality and availability of country foods	Aboriginal health conditions can be affected by a change in wildlife and wildlife habitat through changes in the quality and availability of country foods. Changes to wildlife habitat can potentially affect health conditions for Aboriginal people due to the potential related decrease in the availability of game species. These changes can be directly linked to the reduction in wildlife habitat within the PDA, and to changes in wildlife movement patterns as a result of Project activities (i.e., avoidance of the area). Changes to access to hunting areas is discussed in Section 5.12. Changes to wildlife resulting in the uptake of metals in wild meat could affect health conditions through a change in the quality of country foods. This potential is considered in Section 5.13.

5.8 POTENTIAL CHANGES IN LABOUR AND ECONOMY PRIOR TO MITIGATION

Project-effect mechanisms for a change in labour and economy were discussed in Sections 14.4.2.1 and 14.4.3.1of the Final EIS/EA (Stantec 2017d). A summary follows.

Labour conditions in the LAA will be affected by Project-related direct, indirect, and induced employment during all Project phases. The hiring of local and Aboriginal workers is expected to reduce the local unemployment rate but could reduce the availability of skilled and unskilled workers in the LAA for other employers. The labour force within both the LAA and RAA is expected to expand due to in-migration of Project workers (as well as spouses seeking employment), particularly during the operation phase.

The Project's effect on the economy will take place through two mechanisms:

- Project purchases of labour, goods and services from businesses, will result in increased income, and municipal government revenue.

- Businesses in the LAA and RAA stand to benefit from successful bids to supply the Project with goods and services.

If left unmitigated, Project activities, primarily during construction, have the potential to adversely affect other economic activities in the LAA and RAA, including the tourism and forest industries. The PDA will overlap the MacLeod-Cockshutt Mining Headframe, the Discover Geraldton Interpretive Centre, and the Kenogamisis Golf Club. The PDA is also situated in an area that is managed for forestry activities under the *Kenogami Forest Management Plan*.

A summary of how, in the absence of mitigation, a Project-related change in labour and economy may potentially affect Aboriginal socio-economic conditions is provided in Table 5-8 below.

Table 5-8: Potential Effects of a Change in Labour and Economy on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal socio-economic conditions – change in the local labour force and economy	Aboriginal socio-economic conditions can be affected by a change in the local labour force and economy. Aboriginal people are anticipated to be among the local workers hired for the Project (with corresponding incomes from good paying jobs that may assist in improving Aboriginal socio-economic conditions through increased income and greater access to funds that may enhance their ability to spend time on land carrying out traditional activities including hunting, fishing and trapping) and a reduction in the unemployment rate for both Aboriginal and non-Aboriginal people within the LAA for Labour and Economy is expected. Aboriginal-owned businesses within the LAA and RAA stand to benefit from successful bids to supply the Project with goods and services.

5.9 POTENTIAL CHANGES IN COMMUNITY SERVICES AND INFRASTRUCTURE PRIOR TO MITIGATION

Project-effect mechanisms for a change in community services and infrastructure were discussed in Sections 15.4.2.1, 15.4.3.1, and 15.4.4.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

An increase in population in the LAA is expected as a result of the Project, which has potential to place additional demands on the local availability of housing and accommodation, and provincial and municipal services and infrastructure (e.g., health services and infrastructure, police and fire services, power, water, education, waste services and recreation). Project construction and operation activities will also affect transportation infrastructure.

From 2001 to 2011, the population in the LAA/RAA declined by 938 people, from 5,662 to 4,724. The total Project-related population increase is anticipated to be 1,050 men, women and children. During construction, the number of personnel will average 650 workers, with a maximum of 975 workers during peak construction activities. During operation, an average total workforce of 450 workers is expected, with a peak of 545 workers in Years 3-6. Of this total, it is estimated that 350 workers will be in-migrant employees from outside the region, and many employees will bring family members with them, who will place additional demand on services and infrastructure. The addition of 1,050 in-migrant workers and family members during operation, has the potential to increase demands on the need for medical, educational, and recreation services in the area.

Other emergency services may be required by Project employees and their family members moving into LAA/RAA communities including the potential need for First Responder, fire department services, and policing services.

If left unmitigated, additional demands will also be placed on utilities, including power, water and waste services and infrastructure. Hydro One has confirmed there is insufficient capacity for the operation phase of the Project. Heat and power for the Project operation phase will be supplied by an onsite natural gas-fuelled power plant and power generation heat recovery distribution systems. GGM plans to install a water pipeline system that will provide service water to buildings on the mine site. Waste management for the Project is outlined in the "Hardrock Project Conceptual Waste Management Plan" (GGM 2017g) and will be established at the onset of site preparation and construction. In discussions between GGM and the Municipality, it has been confirmed that the Longlac landfill has sufficient capacity to accept anticipated non-hazardous, domestic waste from the Project.

Non-local workers during construction, and in-migrant workers and their families during operation, will also require recreation, education and other services. The following existing recreation facilities will be removed as a result of the Project: the historical MacLeod-Cockshutt Mining Headframe, the Discover Geraldton Interpretive Centre and a municipal park and playground which currently service the MacLeod and Hardrock townsites. The back nine holes of the Kenogamisis Golf Club will also be removed and the front nine holes and the club house will be maintained as long as possible.

Project construction and operation activities, in the absence of mitigation, will affect transportation and infrastructure. In addition to personnel, it is expected that four to eight semi-trailer truckloads of construction material and four to ten concrete mixer trucks will travel to the Project each day, via Highway 11. Lahtis Road will be closed to the public at Highway 11 at the start of construction for Project safety. At closure, Lahtis Road is anticipated to be re-opened to the Goldfield Creek diversion.

A summary of how, in the absence of mitigation, a Project-related change in community services and infrastructure may potentially affect Aboriginal socio-economic conditions is provided in Table 5-9 below.

Table 5-9: Potential Effects of a Change in Community Services and Infrastructure on Section 5(1)(c) Factors Prior to Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal socio-economic conditions – change in recreation	Aboriginal socio-economic conditions can be affected by a change in recreation. Recreation facilities such as the historical MacLeod-Cockshutt Mining Headframe, the Discover Geraldton Interpretive Centre, the municipal park and playground, and the Kenogamisis Golf Club can be utilised by Aboriginal peoples living on-reserve or in the Municipality of Greenstone. The closure or alteration of these facilities can potentially affect Aboriginal peoples.
Aboriginal socio-economic conditions – change in community services and infrastructure	Aboriginal socio-economic conditions can be affected by a change in local community services and infrastructure. Potential effects of changes in community services and infrastructure for Aboriginal people living off-reserve are anticipated to be the same as effects experienced by non-Aboriginal people. The Project-related population increase has the potential to place additional demands on accommodation, health and emergency services and infrastructure, and provincial and municipal services and infrastructure which are relied upon by Aboriginal people living off-reserve. Similarly, Aboriginal people living off-reserve can be affected by the Highway 11 realignment and the safety-related closure of Lahtis Road. For Aboriginal people living on-reserve, Project-related population increases are not expected to interact with availability of accommodation. It is anticipated that construction workers will mostly live in the temporary camp, while some in-migrant workers (and their families) may choose accommodation in the Municipality and will not seek accommodation on reserve lands. Aboriginal people living on-reserve could experience Project changes in health and emergency services and infrastructure. OPP Greenstone Detachment provides support to the Aboriginal Policing Services in Greenstone. In addition to the residents of Greenstone, the Geraldton District Hospital also provides health services to the surrounding Aboriginal communities. If the Project places additional demands on Geraldton District Hospital services and infrastructure or the support the Greenstone OPP Detachment provides to the Aboriginal Policing Services, these effects can be experienced by Aboriginal people living on-reserve.

5.10 POTENTIAL CHANGES IN LAND AND RESOURCE USE PRIOR TO MITIGATION

Project-effect mechanisms for a change in land and resource use were discussed in Sections 16.4.2.1, 16.4.3.1, and 16.4.4.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

None of the watercourses in the PDA or LAA are listed on the *Navigation Protection Act* schedule of navigable waters. Navigation has not been confirmed within the PDA through consultation input, TK and TLRU studies or observations made during extensive annual fieldwork; however, it is conservatively assumed that navigation is possible in the PDA on sections of Goldfield Creek, the Southwest Arm Tributary (downstream of Southwest Arm Tributary Pond 3 [SWP3]), and SWP3.

During construction, operation and active closure, in the absence of mitigation, access restrictions to the PDA could prevent use of waterbodies in the PDA where navigation is considered possible. Although there has been no confirmed use of Goldfield Creek for navigation, the diversion will change the channel alignment. SWP3 forms part of Goldfield Creek diversion. Navigation could also be affected by the construction (and removal at closure) of watercourse crossings across the Southwest Arm Tributary and Goldfield Creek Tributary - North Branch. In addition, navigation may also be temporarily affected during the installation and removal of treated effluent discharge and freshwater intake structures along the shoreline of the Southwest Arm of Kenogamisis Lake. Changes to navigation could alter access to areas used for land and resource activities.

Site clearing and access restrictions during construction, in the absence of mitigation, will result in a loss of commercial trapping, guide outfitting and bait harvesting in the PDA, which will persist through to the end of active closure. Disturbance effects on commercially-based uses outside of the PDA will include potential effects on the availability of wildlife resources of interest to trappers and guide outfitters and sensory disturbance to users within the LRU PDA. Potential Project-related effects on fish and fish habitat could reduce the availability of fisheries resources. Sensory disturbance, increased risk of mortality and disruption of existing wildlife movement patterns may decrease the presence of wildlife. Recreational users in the LAA, including visitors to MacLeod Provincial Park, may be affected by sensory disturbances including changes to: dust and light, noise and vibration, traffic, and the visual landscape.

Timber areas within the PDA would be cleared or flooded as part of site preparation, as well as through the construction of watercourse crossings and realignments, TMF, and linear facilities. The PDA overlaps 342 ha of planned harvesting area within the Kenogami FMU, which is licensed to Ne-Daa-Kii-Me-Naan, an Aboriginal-owned forest management company. These activities would remove Crown timber from future forest management activity. The removal of productive forest is considered permanent.

During construction, site clearing will remove areas used for recreational purposes such as hunting, snowmobiling, and hiking within the PDA. Access to the PDA or through the PDA via Lahtis Road will be restricted during construction and continue throughout operation, and active closure.

A summary of how, in the absence of mitigation, a Project-related change in land and resource use may potentially affect Aboriginal socio-economic conditions is provided in Table 5-10 below.

Table 5-10: Potential Effects of a Change in Land and Resource Use on Section 5(1)(c) Factors in the Absence of Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
Aboriginal socio-economic conditions - change in use of navigable waters	Aboriginal socio-economic conditions can be affected by a change in use of navigable waters. If the watercourses within the PDA are used by Aboriginal peoples, the safety-related access restrictions in the PDA will prevent use of watercourses where it has been conservatively assumed that navigation is possible during construction, operation and active closure. Following closure, the Goldfield Creek diversion will permit navigation between Goldfield Lake and the Southwest Arm of Kenogamisis Lake; the change in channel alignment, however, could pose inconveniences to potential users. LLFN identified the Southwest Arm of Kenogamisis Lake, outside of the PDA, as a travel route. The installation and removal of treated effluent discharge and freshwater intake structures in the Southwest Arm of Kenogamisis Lake can temporarily affect navigation for LLFN members or other Aboriginal people who navigate close to the shoreline in the Southwest Arm of Kenogamisis Lake including along the recreational canoe route (see Figure 16-3 in the Final EIS/EA; Stantec 2017d).
Aboriginal socio-economic conditions - change in forestry and logging operations	A Project-related change in commercially-based land and resource use would have potential to affect Aboriginal socio-economic conditions due to involvement in the management of Kenogami forest. Access to the PDA and the harvesting of Crown timber will be removed as part of site preparation. Clearing of the PDA will remove timber from the Kenogami FMU which is licensed to Ne-Daa-Kii-Me-Naan, an Aboriginal-owned forest management company. This 342 ha represents less than 1 percent (%) of the total planned harvesting area within the FMU. Planned harvest areas identified within the *Kenogami Forest Management Plan* have already received approval through a previous government planning process to allow for removal of the timber.
Aboriginal socio-economic conditions - change in commercial fishing, hunting, trapping, gathering, and guide outfitting activities	Some commercial plant harvesting by Aboriginal peoples can occur. Changes in the abundance of plant species of interest to Aboriginal communities or vegetation communities that support harvested species is assessed in chapter 12.0 of the Final EIS/EA (Stantec 2017d). Aboriginal socio-economic conditions can occur as a result of changes in fish and fish habitat as well as wildlife and wildlife habitat. Those changes to the environment can, in turn, affect socio-economic conditions for Aboriginal people through changes to commercial fishing, hunting, trapping, bear management areas and guide outfitting activities. Lethal and/or sub-lethal harm to fish, and the permanent alteration or loss of fish habitat, can affect the availability of fish for commercial fishing and guide outfitting activities. This can reduce the number of fish that are available for harvest, as well as potentially changing the location of fishing areas, if these are changed or removed as a result of the Project. Wildlife habitat changes can reduce the presence and availability of wildlife, including game species, within the PDA which could affect hunting and trapping outcomes in the surrounding area. Wildlife movement patterns can

Table 5-10: Potential Effects of a Change in Land and Resource Use on Section 5(1)(c) Factors in the Absence of Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
	also be affected, if wildlife species avoid Project activities. Hunters, trappers, and guides currently using the area may have knowledge of local wildlife movement patterns, and if these change, hunting and trapping success can be reduced, and guiding effectiveness can also be reduced. Trapline GE021 is held by a member of AZA. Twenty hectares of trapline GE021 (i.e., less than 1% of the total trapline area) is overlapped by the PDA and will be lost as a result of site clearing and access restrictions. Disturbance effects, potential effects on the availability of wildlife resources, and altered access conditions can potentially affect portions of trapline GE021 located outside of the PDA. Seven traplines are located outside of the PDA: tGE009, GE023 and GE034 are held by members of LLFN. MNRF and the CEA Agency identified GE035, GE008, GE120, and NG089 (note the Aboriginal communities with which the trapline holders are affiliated were not disclosed). These but can be affected by changes availability of wildlife resources, disturbance effects, and altered access conditions depending on proximity. The trapline identified by PMFN on Caramat Road falls outside of the RAA for the land and resource use VC and is not anticipated to be affected. Seven bait harvesting areas held by Aboriginal people are identified: NI5007, NI5013, NI5019, NI5020, NI5034, NI5035, and NI5055 (note the Aboriginal communities with which the baitfish licence holders are affiliated were not disclosed). One hundred and forty-one hectares of bait harvesting area NI5035 (i.e., approximately 1% of the total bait harvesting area) is overlapped by the PDA and will be lost as a result of site clearing and access restrictions. Disturbance effects and altered access conditions are anticipated to extend beyond the PDA and can potentially affect portions of NI5035 and the other six bait harvesting areas located outside of the PDA. In addition to changes to the resources required to conduct commercial trapping and bait harvesting, the quality of the experience of Aboriginal people engaging in these activities can be affected by creating sensory disturbance (e.g., increased dust, noise and lighting) if left unmitigated.
Aboriginal socio-economic conditions - change in recreation	Project-related changes in recreation has the potential to affect Aboriginal socio-economic conditions. The closure of Lahtis Road will prevent access for recreational land and resource use to the Southwest Arm of Kenogamisis Lake. LLFN and MNO use Lahtis Road for recreation and access to the Southwest Arm of Kenogamisis Lake. In comments made by AFN to the CEA Agency, AFN confirmed they use snowmobile trails, which are operated by the Ontario Federation of Snowmobile Clubs and maintained by the Greenstone Snowmobile Club. Most segments of the snowmobile trails in and near the PDA run parallel to Michael Power Boulevard, Lahtis Road and Old Arena Road. Geraldton Snowmobile Club has confirmed that the trail along Lahtis Road is no longer maintained. Lahtis Road can also be used by other Aboriginal communities. The removal of trails and presence of mining activities within the PDA is predicted to reduce the ability for Aboriginal people to undertake hiking and snowmobiling in the PDA.

Table 5-10: Potential Effects of a Change in Land and Resource Use on Section 5(1)(c) Factors in the Absence of Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects
	In addition to changes to the resources required to engage in recreational activities, the quality of the experience of Aboriginal people can be affected by creating sensory disturbance (e.g., increased dust, noise and lighting) and changes to the viewscape. The viewscape will be permanently altered to varying degrees due to the WRSAs and TMF. Aboriginal people are anticipated to be among the local workers hired for the Project, and the resulting increased income for Aboriginal workers will provide Aboriginal persons and greater access to funds that may enhance their ability to spend time on land carrying out traditional activities including hunting, fishing and trapping.
Aboriginal physical and cultural heritage – sensory disturbance	The quality of the cultural and/or spiritual use experience Aboriginal people can be negatively affected by industrial development. Changes in visual aesthetics or altered landscapes may result in indirect sensory disturbance to Aboriginal land users that could adversely affect the experience of using culturally or spiritually important locations or landscapes or deter individuals from using those affected areas or locations. In the context of a brownfield site where Aboriginal communities including GFN and LLFN have also expressed some avoidance the PDA and Kenogamisis Lake due to existing conditions and perceptions, the Project may also improve the quality of experience for Aboriginal people by addressing historical mining impacts, promoting Aboriginal involvement in the Project monitoring, and supporting local Aboriginal cultural practices through community driven initiatives,
Current use – sensory disturbance	The quality of the traditional use experience Aboriginal people can be negatively affected by industrial development. Changes in visual aesthetics or altered landscapes may result in indirect sensory disturbance to Aboriginal land users that could adversely affect the traditional use experience or deter individuals from using affected areas or locations.

5.11 POTENTIAL CHANGES IN HERITAGE RESOURCES PRIOR TO MITIGATION

Project-effect mechanisms for a change in heritage resources were discussed in Sections 17.4.2.1 and 17.4.3.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

No archaeological sites were identified within the PDA during the 2014 and 2015 archaeological field program. There is still the possibility, however, that archaeological resources could be recovered during the archaeological field work program that will be completed prior to construction; carrying forward the possibility of archaeological resources being present is a standard contingency approach and is conservative. During construction, the PDA will be subject to soil removal (including site preparation of the open pit area) and other activities that could affect existing archaeological resources that might be present. As areas of archaeological potential in the PDA will have been investigated prior to the construction phase and any chance finds or deeply buried archaeological resources (if they exist) will be documented during construction activities, it is not anticipated that archaeological resources will be affected during the operation or closure phases.

During the construction phase, the PDA will be subject to site preparation (including existing building removal, clearing/grubbing) and other activities that could affect existing architectural and/or historical resources. It is anticipated that the following architectural and/or historical resources will be removed during construction; MacLeod and Hardrock townsites, the MacLeod-Cockshutt Mining Headframe and the Discover Geraldton Interpretive Centre. The Kenogamisis Golf Club will undergo a change in land use as result of waste rock deposition. One identified Euro-Canadian architectural and/or historical resource, cultural heritage resource (CHR) 1 (the property located at 495 Hardrock Road), that is located outside of the PDA will be avoided.

Note that potential effects on Aboriginal cultural heritage such as sacred areas or habitation areas is incorporated in the assessment of effects on TLRU (see chapter 18.0 of the Final EIS/EA; Stantec 2017d) and is discussed in Section 5.12 of this report.

A summary of how, in the absence of mitigation, a Project-related change in heritage resources may affect Aboriginal physical and cultural heritage and current use is provided in Table 5-11 below.

Table 5-11: Potential Effects of a Change in Heritage Resources on Section 5(1)(c) Factors in the Absence of Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects on Aboriginal People
Physical and cultural heritage – change in physical or cultural heritage Current use-change in current use	Aboriginal physical and cultural heritage and current use can be affected by a change in heritage resources. Aboriginal people can be affected if archaeological resources are recovered during the pre-construction archaeological field work program or if previously undocumented archaeological resources are discovered during construction. The removal of MacLeod and Hardrock townsites, the MacLeod-Cockshutt Mining Headframe, and the Discover Geraldton Interpretive Centre, and the change in land use at the Kenogamisis Golf Club, can also affect Aboriginal people. Note that potential effects on Aboriginal cultural heritage such as sacred areas or habitation areas is discussed in Section 5.12 (TLRU).

5.12 POTENTIAL CHANGES IN TRADITIONAL LAND AND RESOURCE USE PRIOR TO MITIGATION

Project-effect mechanisms for a change in traditional land and resource use were discussed in Sections 18.4.2.1, 18.4.3.1, 18.4.4.1, and 18.4.5.1 of the Final EIS/EA (Stantec 2017d). A summary follows.

Project effects on TLRU are addressed in Chapter 18.0 of the Final EIS/EA (Stantec 2017d), which includes an assessment of changes to the environment on Aboriginal people's ability to engage in traditional activities included but not limited to: hunting, fishing, trapping, plant harvesting, and cultural or spiritual practices.

In the absence of mitigation, the availability of land, or species relied upon, to hunt, fish, trap, and harvest plants may be affected by the following Project activities:

- During construction, site clearing will result in the removal of plant species of interest to Aboriginal communities (including plants harvested for consumption/subsistence, plants harvested for medicinal purposes, and plants harvested for use as fuel), and/or plant harvesting sites in the PDA. The consequent absence of such plant species may also result in reduced availability of wildlife in the PDA (due to lack of habitat/food source).
- Wildlife habitat changes during construction, and changes in wildlife mortality risks during construction and operation, may reduce the presence and availability of wildlife in the Project area, which could affect hunting and trapping. Wildlife movement patterns may be affected, which could also affect the current use of wildlife resources, as hunting and trapping success may be reduced as a result of a change in knowledge of wildlife movement. These changes may take place as a result of:
  - site clearing, traffic, and adverse human-wildlife encounters
  - sensory disturbance caused during construction and operation
  - the presence of the open pit, TMF and other large Project components.
- Changes to fish habitat during construction and operation, and the permanent alteration or loss of fish habitat arising during construction and persisting through to closure could affect the availability of fish for traditional harvesting, well as potentially changing the location of fishing areas. These changes include:
  - During construction, operation, and closure potential mechanisms for effects on fish include: the mobilization and transport of sediment to fish habitat; changes to flow; dewatering; destruction of fish eggs; stranding of fish; the introduction of deleterious materials to fish habitat from point (i.e., treated effluent discharge) and non-point sources (i.e., surface run-off, groundwater seepage, and dustfall); and shock waves from explosives usage.
  - A permanent alteration of fish habitat may occur through changes to water characteristics from treated effluent, groundwater discharge, physical changes, extraction of surface water, changes to the riparian vegetation and structure, and changes to flow regime related to construction, operation, and closure activities.
  - Fish habitat may be lost as a result of the placement of materials or structures in water during construction. No operation or closure activities have been identified that would results in a loss of fish habitat. Loss of fish habitat that cannot be avoided will be addressed through the implementation of the Fisheries Offset Plan.

Project mechanisms that have potential to affect cultural and spiritual sites (where they may exist) include site preparation (e.g., removal of existing buildings, timber harvesting, vegetation clearing, earthworks, overburden and topsoil stockpiling, temporary effluent treatment and discharge), isolation due to positioning of Project components, and land use change due to mining. Limiting of Aboriginal communities' ability to engage in cultural or spiritual practices could reasonably be regarded as an effect on TLRU, and therefore changes to access to sites is also considered.

A summary of how, in the absence of mitigation, a Project-related change in TLRU may potentially affect current use and Aboriginal physical and cultural heritage is provided in Table 5-1212 below.

Table 5-12: Potential Effects of a Change in Traditional Land and Resource Use on Section 5(1)(c) Factors in the Absence of Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects on Aboriginal People
Current use - change in current use Physical and cultural heritage – change in physical or cultural heritage	Aboriginal communities gather plants, fish in the streams, rivers, and lakes, and harvest wildlife within the RAA. Based on the available sources (see section 18.2 of the Final EIS/EA; Stantec 2017d) the following Aboriginal communities identified site-specific TLRU within the RAA: • AFN, EFN, LLFN, and MNO identified plant harvesting sites • AFN, AZA, EFN, GFN, LLFN, and MNO identified fishing areas • AFN, AZA, EFN, GFN, LLFN, and MNO identified hunting and trapping areas • AFN, EFN, LLFN, MNO, and PPFN identified cultural or spiritual sites or areas. TLRU can be affected by the Project mechanisms outlined above. In addition to the TLRU identified by Aboriginal communities in the RAA, TLRU activities are assumed to occur within the RAA, even if the Aboriginal communities do not specifically identify these activities or site-specific uses.

5.13 POTENTIAL CHANGES IN HUMAN AND ECOLOGICAL HEALTH PRIOR TO MITIGATION

Project-effect mechanisms for a change in human and ecological health were discussed in Sections 19.4.2.1 and 19.4.3.1 of the Final EIS/EA (Stantec 2017d). A high-level summary follows.

In the absence of mitigation, atmospheric emissions (vehicle exhaust and ore dust) and water discharges (treated effluent discharge and seepage) from Project activities can increase chemicals of potential concern (COPCs) concentrations in ambient air, soil, groundwater, and surface water. This can lead to increases of these chemicals in various environmental media including vegetation, wild meat and fish tissue. In the absence of mitigation, these potential changes in air, water and country food quality can potentially affect the health of human receptors engaged in hunting, trapping, traditional and recreational activities within the LAA.

A summary of how, in the absence of mitigation, a Project-related change in human and ecological health may potentially affect Aboriginal health conditions is provided in Table 5-13 below.

Table 5-13: Potential Effects of a Change in Human and Ecological Health on Section 5(1)(c) Factors in the Absence of Mitigation

Section 5(1)(c) Factor and Key Topic	Summary of Potential Effects on Aboriginal People
Aboriginal health conditions – change in quality and availability of country foods; change in air quality; change in drinking water quality or quantity	In the absence of mitigation, Aboriginal people and local people alike can be exposed to COPCs through inhalation of COPCs from air emissions, contact with soil, ingestion and inhalation of soil, and ingestion of surface water, vegetation, wild meat and fish. However, Aboriginal peoples are assumed to consume higher levels of country foods compared to the rest of the population and consume surface water from the LAA. The Aboriginal/High Use Receptors assessed in the human health and ecological risk assessment (HHERA) were assumed to obtain their daily intake of water from Kenogamisis Lake, 100% of their intake of fish from the basins of Kenogamisis Lake, and 100% of their intake of wild meat and traditional plants from the Human and Ecological Health LAA. Tissue analysis was conducted on Walleye, small mammals, berries, forage, and browse to identify potential effects on species harvested for consumption by Aboriginal peoples. Drinking water guidelines were considered when identifying the assessed COPCs.

6.0 IDENTIFICATION OF MITIGATION MEASURES APPLICABLE TO SECTION 5(1)(C) FACTORS

In Chapter 5.0, the mechanisms or pathways by which the Project could result in an environmental effect on a valued component that could then cause an effect on Aboriginal peoples with respect to the Section 5(1)(c) Factors, the next step in the methodology for this report is to identify mitigation measures, design features, or other commitments that address those effects so that residual effects (Chapter 7.0) are not significant. Following this chapter, a discussion of residual effects on the VCs that could affect the Section 5(1)(c) Factors is provided in Chapter 7.0.

Mitigation measures proposed to reduce the potential environmental effects on the VCs assessed in the Final EIS/EA will also reduce the potential effects to Section 5(1)(c) Factors. A full list of mitigation measures is presented in Table 24-2 of Chapter 24.0 of the Final EIS/EA (Stantec 2017d). These mitigation measures are not entirely repeated here but have been considered in the characterization of residual effects presented in Section 7.0 of this report, specifically for their relevance to effects of a change in the environment on Aboriginal peoples.

6.1 KEY IN-DESIGN MITIGATION MEASURES

In considering the effects of changes to the environment on Aboriginal peoples as outlined in Section 5(1)(c) of CEAA 2012 and the EIS Guidelines, it is helpful to consider the overall project planning and management approaches that GGM has adopted in developing the Project, to provide additional context on how environmental effects of the Project have been avoided or mitigated, thereby further benefiting Aboriginal peoples in the context of effects of changes they may experience in relation to the Section 5(1)(c) Factors.

As was outlined in Section 1.5 of the Final EIS/EA, GGM has planned the Project in a careful manner to avoid or mitigate possible environmental effects including delivering positive environmental outcomes by addressing historical tailings issues within the PDA. The following guiding principles, planning and management strategies have been followed to avoid or reduce environmental effects:

- Adherence to federal and provincial regulatory requirements, and meeting or exceeding all applicable industry codes and standards.
- Adopting guiding principles for design and implementation of the Project, including the use of proven and applicable technologies (e.g., water treatment), best management practices, limiting the Project footprint, and designing for closure and end land use objectives.

- Implementing environmental protection, mitigation, and management strategies and concepts that avoid or limit adverse environmental effects, and enhance positive ones including addressing historical tailings within the PDA.

- Addressing feedback received from stakeholders, government agencies and Aboriginal communities to limit environmental effects and address concerns to the extent possible.

With the exception of the open pit (for which the location is fixed by the location of the mineral resource), GGM has emphasized Project design and siting so that the location and configuration of the Project facilities considers the above measures, wherever possible, to avoid or limit the potential environmental effects of the Project to the benefit of Aboriginal and non-Aboriginal persons alike. Comments received from stakeholders, government agencies, and Aboriginal communities on the Draft EIS/EA, and throughout the entire EA process, have influenced the Project and helped to refine the location of Project components and improve the development of mitigation measures to avoid or reduce potential environmental effects. To the extent possible, Project facilities have been located to avoid and reduce interactions with lakes and watercourses, and other sensitive environmental features. Where avoidance was not possible, primarily for Goldfield Creek, mitigation has been developed as part of the EA process. Some of the key features of the Project that avoid or reduce environmental effects of the Project, many of which also reduce the effects of potential changes to the environment on Aboriginal persons, include the following:

- Minimizing the Project footprint by maximizing the use of the brownfield area of the PDA to limit the area of new disturbance and exclusion zones associated with the Project, thereby minimizing potential effects to current use as well as Aboriginal health conditions, Aboriginal socio-economic conditions, and Aboriginal physical and cultural heritage. This includes avoidance of Goldfield Lake Road, which is a key access road to land use areas west and south of Kenogamisis Lake.
- Relocating a portion of the historical MacLeod and Hardrock tailings to the new TMF, and implementing an enhanced cover, stability measures and seepage collection for the remaining historical MacLeod tailings to reduce seepage, provide safety and long-term stability of structures, thereby substantially reducing environmental effects to groundwater and surface water quality from these historical tailings during operation through post closure When compared with present day baseline conditions, arsenic concentrations in the water of the Southwest Arm of Kenogamisis Lake would increase slightly during operation, returning to near baseline thereafter. This slight increase would be more than offset by substantial decreases in total arsenic concentrations in the waters of Barton Bay East, the Central Basin, and the Outflow Basin during operation, and continuing through post closure.
- Building and operating an effluent treatment plant (ETP) to collect and treat (as required) surplus contact water before discharge to the environment, with effluent to meet the effluent criteria specified in the *Metal Mining Effluent Regulations (*MMER), Ontario Regulation

(O.Reg.) 560/94, and the Ontario Ministry of Environment and Climate Change (MOECC) environmental compliance approval (ECA) effluent criteria requirements.

- Use of tailings management facility (TMF) reclaim water and Project contact water to supply process water, thereby eliminating direct discharge from the TMF, and reducing the need for obtaining fresh water from Kenogamisis Lake during operation, thereby limiting potential effects on Aboriginal health conditions and on current use.
- Use of equipment that operates efficiently to limit air and noise effects, thereby limiting sensory disturbance to wildlife, minimizing potential deposition onto vegetation, country foods and drinking water that could otherwise affect Aboriginal health conditions and current use.
- Limit Project footprint and maximize use of existing brownfield area to reduce disturbance to surrounding areas such as fen/wetlands, watercourses and important habitat types, and to reduce the size and number of natural drainage features that may be affected so as to limit potential effects on Aboriginal health conditions, Aboriginal socio-economic conditions, and current use. This includes avoidance of Goldfield Road, which is a key access road to land use areas west and south of Kenogamisis Lake.
- Contact water collection system (i.e., ponds and ditching) to collect seepage and runoff from Project components and provide additional water for the mill and process plant, mitigating contact-water effects, and freshwater use that could otherwise affect Aboriginal health conditions.
- Inclusion of a temporary camp to house construction works during construction and early operation to limit potential effects on Community Services and Infrastructure that could, in turn, affect Aboriginal socio-economic conditions.
- Relocating Goldfield Creek using natural design principles incorporating offsets for effects on fish and fish habitat and maintain natural flow through Goldfield Lake and the outlet to the Southwest Arm Tributary, to maintain habitat and water flow connectivity with the Southwest Arm of Kenogamisis Lake, thereby limiting potential effects on current use and Aboriginal socio-economic conditions.
- Sequencing of waste rock disposal in the waste rock disposal areas (WRSAs) to facilitate progressive rehabilitation during mine life, and with closure in mind for effective water management without the need for perpetual care, thereby reducing potential effects on Aboriginal health conditions, Aboriginal socio-economic conditions, Aboriginal physical and cultural heritage, and current use.

Other key design mitigation features of the Project are highlighted in Section 1.5.2 of the Final EIS/EA. The avoidance of adverse environmental effects by design was, and continues to be, an important principle of the Project's design process. Where avoidance is not possible, environmental protection, mitigation, and management measures have been incorporated into the design of the Project.

6.2 MITIGATION ARISING FROM THE ENVIRONMENTAL EFFECTS ANALYSES IN THE FINAL EIS/EA

Mitigation applicable to effects of a change in the Section 5(1)(c) Factors are summarized in Table 6-1 below. For more information about the specific effects which will be eliminated or reduced through the application of these mitigation measures, please see the mitigation sections of Chapters 7-19 in the Final EIS/EA.

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
Atmospheric Environment (Chapter 07)	**Change in ambient air quality** • Project design includes minimizing haul distances by locating the process plant on site adjacent to the open pit, located the ore stockpile in proximity to the plant site, and minimizing the TMF haul road length. • Implementation of a best management plan (BMP) to control fugitive dust from the Project. • Use of dust suppressants (e.g., water) during situations that have an increased potential to generate airborne dust. • Limit vehicle speeds. • Effective and timely equipment maintenance to maintain mining equipment in good working condition. • Where possible, reduce haul routes to and within the PDA. • Administrative controls, including a no idling policy to reduce mobile equipment and other-use vehicle emissions.	✓	✓	✓	**Aboriginal health conditions** **Aboriginal physical and cultural heritage** **Current use**
	• Equipping primary crusher with a dust collection system (baghouse or equivalent) to control fugitive emission during ore crushing. • Equipping secondary crusher with a dust collection system (baghouse or equivalent) and protective covers, to control potential dust emissions during secondary crushing and ore transferring. • Enclosing mill feed ore storage area. • Equipping high pressure grinding rolls (HPGR) with wet scrubbers (or equivalent) to		✓		

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	control dust emissions from the grinding operations. • Using a wet scrubber (or equivalent) on the induction furnace to control emissions. • New mobile equipment onsite will meet applicable Transport Canada off-road vehicle emission requirements. Tier 4 emissions standards are anticipated to come into effect in 2018, coinciding with early Project construction. GGM will look to acquire equipment that meets the new standard where available and feasible. • Manage fugitive dust generated during the transport of historical tailings. • Fugitive dust emission control from roads, material handling and storage areas/stockpile may include, application of water sprays, use of surfactants (as a contingency), dust sweeping, gravel application, truck wheel washing stations, and enclosure of dust sources. The site roads will be maintained in good condition, with regular inspections and maintenance to limit the loose dust on the roads.				
	Climate change (as measured by change in greenhouse gas emissions) • Many of the same mitigation procedures provided under "change in ambient air quality" above to mitigate levels of combustion gases would also aid in reducing GHG emissions. • GGM is also committed to the implementation of a GHG Management and Monitoring Plan (GHGMMP) to reduce where possible, GHG emissions from the Project. A Conceptual GHGMMP is presented in Appendix M6 of the Final EIS/EA.	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	Change in lighting • Construction lighting will be specified to use only as much lighting as is necessary for safe and efficient construction activities, and to locate portable lighting equipment where, to the extent feasible, it is not visible at nearby receptors. • Use of directional light fixtures to avoid the transmission of light outside of the PDA.	✓		✓	
	• Design exterior lighting systems for Project operation to include directional lighting to limit light trespass and to avoid glare. • Incorporate proper shielding via the use of full horizontal cutoff fixtures into the Project lighting plan (where practicable). • Position portable lighting to limit visibility at surrounding residences. • Most of the routes for haul trucks and service vehicles onsite will be shielded by topography and vegetation along their length. In the detailed roadway design, tree cover will be left in place where practicable to reduce the line-of-sight from receptors to the onsite roads. • Lighting of the realigned Highway 11 will be implemented according to current MTO standards. • Vehicle movements on WRSAs, main overburden storage area, and ore stockpile may be restricted during the nighttime as much as practicable to avoid travel on the sides of the WRSAs/ore stockpile facing off-property or the peak.		✓		
Acoustic Environment (Chapter 08)	**Change in noise levels** • Noise mitigation measures (e.g., muffler systems) will be installed on construction and other mobile equipment and equipment will be properly maintained.	✓	✓	✓	**Aboriginal health conditions**

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Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Select equipment and/or design acoustical enclosures to limit overall noise emissions. • Limits on the overall noise emissions transferring through doors for building enclosures. • Air inlet and discharge silencers for exhaust stacks associated with diesel or natural gas-fueled generators.		✓		**Aboriginal physical and cultural heritage** **Current use**
	• GGM commits to the following in order to further reduce potential environmental effects: o Advise nearby residents of major noise generating activities. o Implement a complaint response procedure to address noise complaints should they arise. o Where possible, GGM will conduct blasting primarily on weekdays, typically mid-day. o GGM will endeavor to avoid blasting on statutory holidays. o Where possible, major construction activities will be scheduled to take place during daytime hours (i.e., 07:00 h to 19:00 h) to avoid sensitive night-time periods. o If the total area of ventilation openings exceeds 4% of the total façade area, an acoustical louver will be provided. o Follow-up and monitoring, and adaptive management as outlined in Chapter 23.0 and Appendix M10 of the Final EIS/EA	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	Change in vibration levels • Preliminary blast design meets the MOECC's criteria and all blasting will occur during the daytime as required by MOECC Guideline NPC 119.	✓	✓		
	• GGM commits to the following in order to further reduce the potential for environmental effects: o Advise nearby residents of planned blasting activities. o Implement a complaint response procedure to address vibration complaints should they arise. o Where possible, GGM will conduct blasting primarily on weekdays, typically mid-day. GGM will also endeavor to avoid blasting on statutory holidays. o With respect to effects on highway drivers, consideration of moving receptors is not typical in an assessment however as a precautionary measure GGM will discuss with MTO the possibility of posting warning signs along Highway 11. o GGM will work with a blasting contractor to refine the Conceptual Explosives Management Plan to minimize vibration effects on points of reception. o Follow-up and monitoring as outlined in Chapter 23.0 and Appendix M10 of the Final EIS/EA. o Blasting events will be monitored in accordance with the MOECC requirements for the selected sound and vibration limits due to blasting.	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
Groundwater (Chapter 09)	**Change in groundwater levels and/or flow** • Use standard management practices throughout the Project, including drainage control and excavation and open pit dewatering.	✓	✓	✓	**Aboriginal health conditions**
	• Limit construction footprint (i.e., PDA) to the extent possible to reduce the potential for reductions in groundwater recharge and limit the number of watersheds overprinted by the PDA.	✓			
	• Use standard construction methods, such as seepage cutoff collars, where trenches extend below the water table to mitigate preferential flow paths.	✓	✓		
	• Return water generated from historical underground dewatering (with treatment at the ETP as required) to Kenogamisis Lake during operation to offset a reduction in groundwater discharge.		✓		
	• Consider accelerating open pit filling at closure to return groundwater levels to baseline conditions in a shorter timeframe.			✓	
	Change in groundwater quality • Removal of contaminated soils from the historical process plant areas and manage them in accordance with the Soil Management Plan (SMP). A Conceptual SMP is provided in Appendix M9. • Installation of a subsurface seepage collection system at the base of the historical MacLeod high tailings to collect seepage and groundwater recharge from the tailings. For the purposes of this effects assessment, and to maintain a conservative approach, the collection of groundwater within the subsurface seepage collection ditches around the historical MacLeod high tailings was not considered as a mitigation measure in the	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	modelling and water quality predictions. • Design of the WRSAs to increase the amount of runoff and reduce the amount of infiltration through the WRSAs, thereby reducing the recharge and loading to groundwater. • Installation of contact water collection ditches around the overburden storage area, ore stockpile and WRSAs to collect toe seepage and groundwater recharge from these Project components. For the purposes of this effects assessment, and to maintain a conservative approach, the collection of groundwater within the contact water collection ditches around the overburden storage area, ore stockpile and WRSAs was not considered as a mitigation measure in the modelling and water quality predictions. • Installation of seepage collection ditches around the TMF to collect seepage from the TMF dam and groundwater recharge originating from the TMF. A conservative design depth of 1.5 m bgs was used in the modelling to predict seepage collection and the assessment of water quality effects. Seepage collection is an integral component of the TMF design, and is therefore included in the effects assessment as mitigation.				
	• Limit construction footprint (i.e., PDA) to the extent possible to reduce the potential for reductions in groundwater recharge, and limit the number of watersheds overprinted by the PDA.	✓			
	• Removal of approximately 22% of the historical MacLeod tailings and 77% of the historical Hardrock tailings and their placement within the new TMF. This will reduce the chemical loading from the historical tailings to groundwater and surface water and result in an improvement to groundwater quality. • Installation of an enhanced cover over the remaining historical MacLeod high tailings to reduce infiltration and increase runoff, thereby further reducing loadings to		✓		

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	groundwater and surface water. • Implementation of cyanide detoxification technology to reduce cyanide concentrations and precipitate metals in the process plant, resulting in an improvement in water quality within the TMF.				
	• Implementation of progressive rehabilitation (placement of a vegetated soil cover) to reduce infiltration into the WRSAs and TMF, thereby reducing the amount of water and loading to groundwater and improvements to groundwater quality.		✓	✓	
Surface Water (Chapter 10)	**Change in surface water quantity** • Reduce Project effluent discharge by reusing contact water in Project processes. • Maintain existing drainage patterns with the use of culverts. • Maintain access roads by periodically regrading and ditching to improve water flow, reduce erosion and manage vegetation growth.	✓	✓	✓	**Aboriginal health conditions**

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	• Inspect culverts periodically. Remove accumulated material and debris upstream and downstream of the culverts to prevent erosion, flooding, habitat damage, property damage and mobilization of sediment. • Attenuate peak discharges to the environment through use of Project water storage features (i.e., historical underground workings, and contact water collection ponds). • Design and construction of the Goldfield Creek diversion channel extending easterly from the north end of the TMF into the Southwest Arm Tributary to convey the peak flow from the EDF (the more severe of a 100 year 24-hour rainfall event and a 100 year 30-day freshet). The diversion channel floodplain has been sized to accommodate the flows from the TMF spillway and Goldfield Creek in events greater than the 100 year storm, and has the capacity to pass flows up to and including the PMF event. The diversion dam will be constructed on Goldfield Creek south of Lake GFP4 and north of the ultimate TMF dam. The diversion channel design accounts for the post-closure condition when runoff from the TMF will be directed (through the closure spillway) in to the diversion channel (Greenstone Gold Mines Tailings Management Facility Design Hardrock Feasibility Study; Appendix K1.2 of the Final EIS/EA). • Habitat offsetting through natural channel design for changes in drainage alignment for the Goldfield Creek diversion and to accommodate increased flows in the Southwest construction of a new approximately 2.7 km Goldfield Creek (bankfull channel Arm Tributary from the Goldfield Creek diversion (Draft Fisheries Offset Plan; Appendix F10). The compensatory measures including: - development of approximately 7.5 ha of new pond habitat at the interface between the existing Goldfield Creek and the new diversion channel (referred to				

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	as the Goldfield Creek diversion pond) • dimension) diversion channel between the Goldfield Creek diversion pond and the existing Southwest Arm Tributary watercourse (SWP1) - reconstruct the existing Southwest Arm Tributary channel between SWP2 and SWP3 to convey larger flows and facilitate the replacement of the existing Lahtis Road crossing - construct two valley wide grade control structures within the existing Southwest Arm Tributary to impound and attenuate flows, and reduce water velocities to mitigate erosion due to increased flows.				
	• Limit construction footprint (i.e., PDA) to the extent practicable.	✓			
	• Dewatering the historical Macleod-Mosher and Hardrock underground workings and maintaining approximately 25 m dewatered condition between the active open pit floor and the water level in the underground workings. • Drawing potable water from a connection to the Greenstone municipal water supply system. • Construction and use of perimeter runoff and contact water collection ditches to collect overland flow, seepage, and intercept shallow groundwater flow, and divert freshwater away from Project components. • Contact water collection ditches designed to convey the 1:100 year storm event. • Contact water collection ditches with positive gradients to limit standing water, maintain positive flow and act as interception ditches for groundwater. • Contact water collection ponds designed to provide onsite storage of local runoff with the size and residence times designed to provide sediment removal to meet the MMER		✓		

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	effluent TSS criterion of 15 mg/L.. • Contact water collection ponds designed to contain (without discharge) flows resulting from the 1:100 year, 24-hour storm event, including emergency spillways and maintaining minimum freeboard of 0.5 m. The emergency spillways will enable the collection ponds to attenuate and manage larger storms than the 1:100 year up to the Timmins regulatory storm event (which is a larger runoff event than the 1:500 year event). • Contact water collection ponds designed with active water storage that considers ice thickness during winter. Under an extreme storm event, such as Timmins storm, only the stormwater in excess of the available storage at that time will be discharged to the environment via the emergency spillway to protect the collection ponds. • Pond inlet and outlet structures configured to reduce inlet velocity and scour and meet sedimentation requirements. • Pond outlets designed with subsurface inlets to mitigate against chemical stratification in ponds, thermal heating of discharge and ice blockage of outlets. • Design and construction of the temporary ditch to divert clean runoff from Goldfield Creek watershed between the Goldfield Creek diversion dam and the TMF inner dam towards the upper drainage area of watercourse WC-O.				
	• Mitigation measures for the construction phase are also applicable to the operation phase except limiting the construction footprint. • Implement progressive rehabilitation (e.g., placement of soil cover and vegetation) to reduce infiltration into the WRSA and TMF by increasing the evapotranspiration capacity • Collection of runoff and groundwater seepage from the open pit, with water directed to the historical underground workings associated with the historical MacLeod-Mosher				

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	and Hardrock mines via drainage shafts bored through the active open pit floor. • Excess water will be pumped to pond M1 and then to the Southwest Arm of Kenogamisis Lake following treatment. • Perimeter grading and access roads to divert runoff away from the open pit. • Recycling of contact water for ore processing. • Taking process water, in order of preference, from the TMF, pond M1, and excess water from the historical underground workings and open pit dewatering. • Balancing the timing of recycling from sources, which will relieve storage pressures on contact water collection ponds, provide a more sustainable, seasonally attenuated mill demand system, and moderate the flows to the ETP. • TMF designed with two cells to allow progressive development and rehabilitation of the TMF during operation to reduce water management requirements. • TMF dam designed to maintain water storage to contain the Environmental Design Flood (EDF), a 100-year return hydrologic event (24-hour storm or freshet event) with no discharge through the spillway (Greenstone Gold Mines Tailings Management Facility Design Hardrock Feasibility Study; Appendix K1.2). To address extreme weather events, an emergency spillway will be maintained to safely pass the Inflow Design Flood while maintaining minimum freeboards requirements to protect the structural integrity of the dam. The Inflow Design Flood is taken as the PMF event generated by the theoretical maximum precipitation that could fall in the area which is 361 mm. The PMF runoff exceeds the Timmins Storm event (193 mm) by nearly two the total. • Dam runoff and seepage captured in seepage collection ditches downstream of the dams and pumped back to the TMF via three seepage collection ponds (T1, T2 and T3, Figure 10-34 of the Final EIS/EA). The normal operation levels in the seepage collection				

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	ponds are designed to be lower than those of the surrounding water table, creating a positive (reverse) hydraulic gradient such that minimal seepage will escape the collection system. The collection ponds have been sized to contain runoff from the EDF (a 1:100 year, 24-hour storm). • Design and operate the TMF with no discharge to the environment during operation through reclaiming and recycling surplus water from the TMF to meet mill demand during operation.				
	Change in surface water quality • Implement progressive erosion and sediment control measures during construction. • Implement progressive water management over the life of the mine including development of drainage controls for areas only prior to the development and expansion of these features. • In addition to the Water Management and Monitoring Plan (WMMP), implementation of the Soil Management Plan, Waste Rock Management Plan, Waste Management Plan and Spill Prevention and Response Plan.		✓	✓	
	• Limit construction footprint (i.e., PDA) to the extent possible. • Third party sewage disposal contractor to provide portable washroom facilities with offsite disposal until the STP and sewage discharge line are set-up and during active closure when facilities are decommissioned.	✓		✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	• Treat the dewatering water from the historical underground workings prior to the discharge to the Southwest Arm of Kenogamisis Lake using the construction ETP during construction until the permanent ETP has been constructed and commissioned for use. • Treat effluent discharge to the receiving water environment where required to effluent criteria developed through the receiving water Assimilative Capacity TDR (Appendix F6 of the Final EIS/EA). • Maintain access roads by periodically regrading and ditching to improve water flow, reduce erosion and manage vegetation growth. • Maintain culverts to avoid debris and sediment accumulation. • Implement dust suppression measures for exposed ground areas of the PDA. • The subsurface seepage system will address both short term seepage anticipated during construction and highway embankment pre-loading and long term seepage (operation and closure/post-closure) from the historical MacLeod high tailings. Seepage collected will drain by gravity to two collection ponds located west and east side of the tailings. The collection ponds will be lined with a 40 mil high density polyethylene geomembrane and designed to contain the 100-year 24 hour rainfall event and 7 days of seepage accumulation to account for possible power outrage and prolonged maintenance. • The subsurface collection system for the historical MacLeod high tailings will separate seepage from surface water runoff that will be collected within the seepage collection ditches. • Water from the seepage collection ponds will be pumped to the construction ETP for treatment prior to discharge during construction and either to the process plant to meet reclaim demands or the permanent ETP during operation.	✓	✓		

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	• Use perimeter berms to divert non-contact runoff from disturbed areas. • Removal of approximately 22% of the historical MacLeod tailings and 77% of the historical Hardrock tailings and their placement within the new TMF. • Promote the collection, storage and reuse of contact water (runoff and seepage), only discharging excess water after reuse and treatment as necessary. • Use site-distributed contact water collection ponds and historical underground workings to store runoff and provide initial sedimentation. • Provide storage capacity in contact water collection ponds to the 1:100 year return period event to reduce the potential for pond overflow from extreme events. • Implement progressive rehabilitation and closure plans, including progressive rehabilitation (placement of soil cover and vegetation) to reduce infiltration by increasing the evapotranspiration capacity and control runoff. • A subsurface seepage collection system consisting of a French drain system incorporated into the stabilization berm along the toe of the historical MacLeod high tailings during the initial construction works. • Design of the TMF with a system to collect dam seepage and runoff, with pumping back to the TMF (Appendix M1). • Cyanide detoxification within the mill using the SO2/air oxidation process resulting in the degradation of cyanide and precipitation of metals, iron, arsenic and antimony in particular, to the extent practical (Appendix M1). • Building and operating an ETP to collect and treat (as required) surplus contact water before discharge to the environment, with effluent to meet MMER/O.Reg. 560/94 effluent criteria and MOECC ECA effluent criteria requirements.		✓		

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Reduction in atmospheric deposition to surface water due to the implementation of air emission and dust controls. • A sewage treatment and disposal system to serve the mine site. Effluent treated to meet regulatory requirements and co-discharge through a diffuser with the treated effluent to the Southwest Arm of Kenogamisis Lake				
	• Implement progressive rehabilitation and closure plans, including progressive rehabilitation (placement of soil cover and vegetation) to reduce infiltration by increasing the evapotranspiration capacity and control runoff.	✓	✓		
Fish and Fish Habitat **(Chapter 11)**	**Lethal and sub-lethal effects on fish** • Limit duration of in-water work. • Conduct instream work during periods of low flow (e.g., summer, fall, or winter) to further reduce the risk to fish and their habitat or to allow work in water to be isolated from flows. • Design and plan activities and works in waterbodies such that loss or disturbance to aquatic habitat is limited and sensitive habitats are avoided. • Comply with spring timing window for in-water work. The timing window for Northwestern Ontario restricts in-water work from April 1 to June 20 for spring spawning species (e.g., Northern Pike and Walleye). This timing restriction would apply to work within and adjacent to water (i.e. within 30 m of water) for the entire PDA. Where a timing window exemption may be required, work with MNRF and DFO to seek an exemption and avoid adverse effects on fish. • Comply with coldwater timing window for in-water work. The timing window for Northwestern Ontario restricts in-water work between September 1 and May 31 for fall	✓	✓	✓	**Aboriginal health conditions**

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	spawning species present in the LAA (e.g., Cisco and Lake Whitefish). This timing restriction would will apply to work within and adjacent to Kenogamisis Lake (i.e. within 30 m) and other work areas with the potential to affect Cisco and Lake Whitefish spawning activity. Work in Kenogamisis Lake would will follow both the spring and fall avoidance periods, unless approved beforehand by the MNRF and DFO, resulting in an in-water construction window of June 21 to August 30. Where a timing window exemption may be required, work with MNRF and DFO to seek an exemption and avoid adverse effects on fish. • Plan activities near water such that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, or other chemicals do not enter the watercourse. • Follow the "Hardrock Project Conceptual Water Management and Monitoring Plan" (Conceptual WMMP; Appendix M1 of the Final EIS/EA), which been developed to divert noncontact water around Project components and to collect and manage contact water. • Implement a Spill Prevention and Response Plan (SPRP) immediately in the event of a sediment release or spill of a deleterious substance and an emergency spill kit will be kept onsite. • Promptly stabilize shoreline or banks disturbed by activities associated with the Project to prevent erosion and/or sedimentation, preferably through revegetation with native species appropriate for the site. • Undertake all instream activities in isolation of open or flowing water to maintain the natural flow of water downstream and avoid introducing sediment into the watercourse. • Design the effluent treatment plant (ETP) to treat effluent to levels that will not be acutely toxic in the effluent, will not have chronic toxicity outside the mixing zone, and				

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	will meet applicable guidelines outside the mixing zone. • Limit access to waterbodies and banks to protect riparian vegetation and limit bank erosion. • Maintain equipment to be used in water in a clean condition, free of fluid leaks and aquatic invasive species. • Whenever possible, operate machinery on land above the high water mark, on ice, or from a floating barge in a manner that limits disturbance to the banks and bed of the waterbody. • Limit machinery fording of the watercourse to a one-time event (i.e., over and back), and only if no alternative crossing method is available. If repeated crossings of the watercourse are required, construct a temporary crossing structure. • Use temporary crossing structures or other practices to cross streams or waterbodies with steep and highly erodible banks and beds (e.g., dominated by organic materials and silts). For fording equipment without a temporary crossing structure, use stream bank and bed protection methods (e.g., swamp mats, pads) if minor rutting is likely to occur during fording. • Wash, refuel, and service machinery and store fuel and other materials for the machinery in such a way as to prevent deleterious substances from entering the water. • Implement an ESCP for the site to reduce risk of sedimentation of waterbodies during all phases of the Project. ESC measures will be maintained until all disturbed ground has been permanently stabilized, suspended sediment has resettled to the bed of the waterbody or settling basin and runoff water is clear. The ESCP will be based on standard specifications such as Ontario Provincial Standard Specifications (OPSS), in particular, OPSS 805 (Construction Specification for temporary ESC measures), OPPS,				

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	PROV 182 (General Specification for Environmental Protection for construction in Waterbodies and on Waterbody Banks) and OPSS 206 (Grading).				
	• Within the construction timing window, schedule in-water work to avoid wet, windy, and rainy periods that may increase erosion and sedimentation. • Treat and handle building material used in water in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish. • Design and construct approaches to waterbodies such that they are perpendicular to the watercourse to reduce loss or disturbance to riparian vegetation. • Undertake all in-water activities, or installation of associated in-water structures, such that interference with fish passage, reduction in channel width, or reduction in flows is limited. • Retain a qualified environmental professional to confirm that applicable permits for relocating fish are obtained and to capture fish trapped within an isolated/enclosed area at the work site and relocate them to an appropriate location in the same waters. Fish may need to be relocated again, should flooding occur on the PDA. • Avoid using explosives in or near water where possible. To mitigate potential blasting effects on fish, a blasting plan will be developed if and as required. DFO provides guidelines for the use of explosives on their website (http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/index-eng.html). • Design water intake and treated effluent discharge location to prevent entrainment or impingement of fish and to prevent scour erosion. This includes temporary intakes for dewatering during construction. Water intake structures will be designed following the Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995). Designs will be based on site-specific parameters including anticipated fish use and resident fish species.	✓			

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Follow the WRMP; a conceptual version is provided in Appendix M2.				
	• Keep clearing of riparian vegetation to a minimum: use existing trails, roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. When practicable, prune or top the vegetation instead of grubbing/uprooting. • Limit the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or the bed of the waterbody below the ordinary high water mark. If material is removed from the waterbody, set it aside and return it to the original location once construction activities are completed. • Undertake all in-water activities, or installation of associated in-water structures, such that interference with fish passage, reduction in channel width, or reduction in flows is limited. • Design water intake and treated effluent discharge location to prevent entrainment or impingement of fish and to prevent scour erosion. This includes temporary intakes for dewatering during construction. Water intake structures will be designed following the Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995). Designs will be based on site-specific parameters including anticipated fish use and resident fish species. • Implement a Blasting Plan for the Project to reduce risk of lethal or sub-lethal effects on fish, changes in bank stability and composition and sedimentations within Kenogamisis Lake. Blasting Plan measures would be followed for the construction and operation phases of the Project.		✓		

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Within the construction timing window, schedule in-water work to avoid wet, windy, and rainy periods that may increase erosion and sedimentation. • Treat and handle building material used in water in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish. • Design and construct approaches to waterbodies such that they are perpendicular to the watercourse to reduce loss or disturbance to riparian vegetation. • Undertake all in-water activities, or installation of associated in-water structures, such that interference with fish passage, reduction in channel width, or reduction in flows is limited. • Retain a qualified environmental professional to capture fish trapped within an isolated/enclosed area at the work site and relocate them to an appropriate location in the same waters. Fish may need to be relocated again, should flooding occur on the PDA. • Avoid using explosives in or near water where possible. To mitigate potential blasting effects on fish, a blasting plan will be developed if and as required. DFO provides guidelines for the use of explosives on their website (http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/index-eng.html).			✓	
	Permanent alteration of fish habitat • Design and plan activities and works in waterbodies such that loss or disturbance to aquatic habitat is limited and sensitive habitats are avoided. • Undertake all in-water activities, or installation of associated in-water structures, such that interference with fish passage, reduction in channel width, or reduction in flows is limited.	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Implement an Erosion and Sediment Control Plan (ESCP) for the site to reduce risk of sedimentation of waterbodies during all phases of the Project. Erosion and sedimentation control measures will be maintained until all disturbed ground has been permanently stabilized, suspended sediment has resettled to the bed of the waterbody or settling basin and runoff water is clear. The ESCP will be based on standard specifications such as Ontario Provincial Standard Specifications (OPSS), in particular, OPSS 805 (Construction Specification for temporary ESC measures), OPPS, PROV 182 (General Specification for Environmental Protection for construction in Waterbodies and on Waterbody Banks) and OPSS 206 (Grading).				
	• Keep clearing of riparian vegetation to a minimum: use existing trails, roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. When practicable, prune or top the vegetation instead of grubbing/uprooting. • Limit the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or the bed of the waterbody below the ordinary high water mark. If material is removed from the waterbody, set it aside and return it to the original location once construction activities are completed. • Design and construct approaches to waterbodies such that they are perpendicular to the watercourse to reduce loss or disturbance to riparian vegetation. • Promptly stabilize shoreline or banks disturbed by activities associated with the Project to prevent erosion and/or sedimentation, preferably through revegetation with native species appropriate for the site. • Restore bed and banks of the waterbody to their original contour and gradient; if the original gradient cannot be restored due to instability, a stable gradient that does not	✓			

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	obstruct fish passage would be restored. • Where replacement rock reinforcement or armouring is required to stabilize eroding or exposed areas, use appropriately-sized, clean rock, and install rock at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment. • Remove all construction materials from site upon Project completion. • Undertake all instream activities in isolation of open or flowing water to maintain the natural flow of water downstream and avoid introducing sediment into the watercourse. • Avoid using explosives in or near water where possible. To mitigate potential blasting effects on fish, a blasting plan will be developed if and as required. DFO provides guidelines for the use of explosives on their website (http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/index-eng.html). • Design the effluent treatment plant (ETP) to treat effluent. • Detoxification of cyanide (used to process the ore and extract gold) in effluent prior to discharge to TMF (closed system during operation; cyanide destruction at closure). • Limit access to waterbodies and banks to protect riparian vegetation and limit bank erosion. • Maintain equipment to be used in water in a clean condition, free of fluid leaks and aquatic invasive species. • Whenever possible, operate machinery on land above the high water mark, on ice, or from a floating barge in a manner that limits disturbance to the banks and bed of the waterbody. • Limit machinery fording of the watercourse to a one-time event (i.e., over and back),				

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	and only if no alternative crossing method is available. If repeated crossings of the watercourse are required, construct a temporary crossing structure. • Use temporary crossing structures or other practices to cross streams or waterbodies with steep and highly erodible banks and beds (e.g., dominated by organic materials and silts). For fording equipment without a temporary crossing structure, use stream bank and bed protection methods (e.g., swamp mats, pads) if minor rutting is likely to occur during fording. • Design and install culverts in a way that prevents the creation of barriers to fish movement, and maintains bank full channel functions and habitat functions including: - embedment - re-instatement of low flow channel and native substrates - proper sizing - maintaining adequate channel slope. • Avoid building structures on meander bends, braided streams, alluvial fans, active floodplains or any other area that is inherently unstable and may result in erosion and scouring of the stream bed or the built structures. • Habitat offsetting for the loss of fish habitat that cannot be avoided or mitigated will employ a natural channel design and incorporate habitat attributes as provided in the Draft Fisheries Offset Plan (Appendix F10 of the Final EIS/EA). • Implement a Blasting Plan for the Project to reduce risk of lethal or sub-lethal effects on fish, changes in bank stability and composition and sedimentations within Kenogamisis Lake. Blasting Plan measures would be followed for the construction and operation phases of the Project.				

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Follow the "Hardrock Project Conceptual Water Management and Monitoring Plan" (Conceptual WMMP; Appendix M1 of the Final EIS/EA), which been developed to divert noncontact water around Project components and to collect and manage contact water. • Design the effluent treatment plant (ETP) to treat effluent to levels that will not be acutely toxic in the effluent, will not have chronic toxicity outside the mixing zone, and will meet applicable guidelines outside the mixing zone. • Detoxification of cyanide (used to process the ore and extract gold) in effluent prior to discharge to TMF (closed system during operation; cyanide destruction at closure).		✓		
	• Follow the "Hardrock Project Conceptual Water Management and Monitoring Plan" (Conceptual WMMP; Appendix M1 of the Final EIS/EA), which been developed to divert noncontact water around Project components and to collect and manage contact water. • Promptly stabilize shoreline or banks disturbed by activities associated with the Project to prevent erosion and/or sedimentation, preferably through revegetation with native species appropriate for the site. • Restore bed and banks of the waterbody to their original contour and gradient; if the original gradient cannot be restored due to instability, a stable gradient that does not obstruct fish passage would be restored. • Where replacement rock reinforcement or armouring is required to stabilize eroding or exposed areas, use appropriately-sized, clean rock, and install rock at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment. • Remove all construction materials from site upon Project completion.			✓	

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Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Undertake all instream activities in isolation of open or flowing water to maintain the natural flow of water downstream and avoid introducing sediment into the watercourse. • Limit access to waterbodies and banks to protect riparian vegetation and limit bank erosion.				
	Loss of fish habitat • Implement a Spill Prevention and Response Plan (SPRP) immediately in the event of a sediment release or spill of a deleterious substance and an emergency spill kit will be kept onsite.	✓	✓		
	• Design and install culverts in a way that prevents the creation of barriers to fish movement, and maintains bank full channel functions and habitat functions including: - embedment - re-instatement of low flow channel and native substrates - proper sizing - maintaining adequate channel slope. Habitat offsetting will employ a natural channel design and incorporate habitat attributes as provided in the Draft Fisheries Offset Plan (Appendix F10 of the Final EIS/EA).				
	• Follow the "Hardrock Project Conceptual Water Management and Monitoring Plan" (Conceptual WMMP; Appendix M1 of the Final EIS/EA), which been developed to divert noncontact water around Project components and to collect and manage contact water.		✓		

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
Vegetation Communities (Chapter 12)	**Change in abundance of vegetation communities (upland and wetland communities)** • Restrict vegetation clearing activities to the PDA. • Mechanical vegetation removal practices when possible. • Standard forestry practices to remove all merchantable timber inside the PDA.	✓			**Aboriginal health conditions**
	• Progressive rehabilitation as outlined Conceptual Closure Plan (Appendix I of the Final EIS/EA).		✓	✓	
	Change in function, connectivity, and quality of vegetation communities • Restricting vegetation clearing activities to the PDA. • Mechanical vegetation removal practices when possible.	✓			
	• Using clean, coarse fill material for grading to reduce the potential for introducing or spreading non-native, or invasive plant species.	✓		✓	
	• Reestablishment of drainage patterns, to the extent feasible.			✓	
	• Mitigation for potential effects from dust in Chapter 7.0 of the Final EIS/EA (atmospheric environment). • Mitigation for potential effects on groundwater in Chapter 9.0 of the Final EIS/EA (groundwater). • Mitigation for potential effects on surface water in Chapter 10.0 of the Final EIS/EA (surface water).	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	Change in abundance of plant species of interest • Where there is interest, provide opportunities to local communities for harvesting of plants for traditional purposes prior to construction. • Restricting vegetation clearing activities to the PDA. • Mechanical vegetation removal practices when possible.	✓			
	• Incorporating plant species of interest to local Aboriginal communities into the Closure Plan as feasible.			✓	
Wildlife and Wildlife Habitat (Chapter 13)	**Change in Habitat** • Mitigation for potential effects from lighting in Chapter 7.0 of the Final EIS/EA (atmospheric environment) • Mitigation for potential effects from noise and vibration described in Chapter 8.0 of the Final EIS/EA (acoustic environment). • Mitigation measures related to vegetation described in Chapter 12.0 of the Final EIS/EA (vegetation communities)	✓	✓	✓	**Aboriginal health conditions**
	• Obtain proper authorizations under the Ontario *Endangered Species Act, 2007* (ESA), including Ontario Regulation 242/08 (as applicable) for damage or destruction of habitat protected under the ESA and implement measures required by the authorization. • If an active bald eagle nest occurs within 800 m of Project construction or operation activities, develop protection measures. • Prior to construction flag environmentally sensitive areas adjacent to work areas (e.g.,	✓			

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	key habitat features such as dens, roosts, stick nests, beaver dams, hibernacula) prior to clearing and construction, and evaluate the features for additional mitigation measures (e.g., timing windows and/or setbacks). • Retain actual or potential wildlife trees (e.g., cavity trees or snags) in areas where it is safe to do so. • Incorporate MNRF Best Management Practices for Mineral Exploration and Development Activities and Woodland Caribou in Ontario (MNR 2013c) in the development of the Biodiversity Management and Monitoring Plan (BMMP) and apply specific mitigation measures developed in consultation with MNRF (a Conceptual BMMP is provided as Appendix M13 of the Final EIS/EA).				
	• If an active bald eagle nest occurs within 800 m of Project construction or operation activities, develop protection measures. • Managing vegetation cover along the boundaries of high activity areas (e.g., access roads) where adjacent to wildlife habitat to reduce sensory (noise and visual) disturbance. • Avoid use of herbicides where feasible or practical. • Progressive rehabilitation of disturbed areas used during construction. • Use of directional light fixtures to avoid the transmission of light outside of the PDA.		✓		
	• Implement measures detailed in the Conceptual Closure Plan (see Appendix I of the Final EIS/EA) including the revegetation plan.			✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	Change in Mortality Risk • Implementation of a BMMP (a Conceptual BMMP is provided in Appendix M13 of the Final EIS/EA). • Implement mitigation measures in the Conceptual Explosives and Blasting Management Plan, Conceptual Spill Prevention and Contingency Plan, and Conceptual Waste Management Plan. • Report the discovery of active nests during all Project phases to the Project Environmental Department who will refer to the BMMP for direction on follow-up actions. • Report the discovery of occupied habitat features (e.g., active dens, beaver dams) during all Project phases to the Project Environmental Department for direction on follow-up actions. • Maintain the Project site in a manner that reduces the risk that wildlife will encounter potential hazards, such as ropes, wires and holes. • Avoid situations that can lead to the creation of problem wildlife. Although food wastes are the typical wildlife attractant implicated in the creation of problem wildlife, there are other attractants that may be a concern, specifically roadside wildlife carcasses and vegetation. Project personnel and contractors will be required to report roadside wildlife sightings or interactions to the Project Environmental Department for initiation of follow-up actions to address these concerns. • Report wildlife-vehicle collisions, near misses or observations of a wildlife road mortality on Project roads to the Environmental Department. Implement adaptive management measures where high frequency locations of wildlife-vehicle interactions are identified. • Require Project personnel and contractors to report wildlife incidents and encounters related to garbage or other attractants to the Environmental Department so that	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	corrective action can be initiated. • Require Project personnel and contractors working in active zones (e.g., mine site) to relay wildlife sightings to other workers as soon as possible (e.g., by radio). • Implement road safety measures (e.g., speed limits and signage) and yield the right of way to wildlife on Project roads to reduce wildlife road mortality. • Obtain a permit under the Fish and Wildlife Conservation Act for the removal of any raptor nests or beaver dams required for the Project. Removal to be conducted following timing restrictions and any other mitigation specified in the permit and as determined during consultation with MNRF.				
	• Address incidental take of migratory birds. GGM recognizes that scheduling vegetation clearing and site preparation activities outside the breeding period for migratory birds is the best way to reduce the risk of incidental take. If activities that could result in incidental take cannot be avoided, GGM will prepare a Bird Nest Mitigation Plan that outlines how risk of incidental take will be managed in accordance with Environment and Climate Change Canada guidance. • To the extent feasible, recover and relocate turtles and amphibians encountered during fish salvage/rescues. • Carry out the removal of structures supporting barn swallow nesting outside of the active nesting season (approximately May- August; O.Reg. 242/08, s.23.5). • Carry out the removal of mature deciduous and mixed forest communities or buildings outside the core maternity roosting season for bats, to the extent practical. Additional mitigation may be required for occupied features. This measure will also reduce the risk to other species that use trees for denning or shelter (e.g., marten).	✓			

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Clear area of wildlife before blasting.	✓	✓		
	• Where project site roads occur through forest or treed wetland communities, a regular vegetation cutting regime will occur along the edges of project site roads both to increase driver visibility and to reduce the attractiveness of the area for moose to browse (Tanner and Leroux, 2015). • To reduce use of the ponds by waterfowl for foraging or breeding, no vegetation will be planted on the embankments of the TMF or the water management collection ponds. Vegetation that naturally regenerates around seepage and water collection ponds and the TMF will be removed as required. • Monitor wildlife use (primarily targeting waterfowl but also species such as moose and bear) and water quality of the TMF, open aquatic areas and other key Project locations and implement adaptive management measures (e.g., deterrents and/or exclusionary measures) as required.		✓		
	Change in Movement • Implementation of mitigation measures to reduce potential effects on wildlife habitat, specifically, those measures that reduce the size of movement barriers (by limiting the size of clearing areas) and that limit behavioral disruptions (by reducing the intensity of sensory disturbance). • Implementation of the progressive rehabilitation of the Project as per the Closure Plan and Fish Habitat Offset Plan. A Conceptual Closure Plan and Draft Fish Habitat Offset Plan are provided in Appendix I and F10 of the Final EIS/EA, respectively. • Provide low areas in the ploughed snow banks of access and haul roads if excessive snow buildup is encountered. These low areas will facilitate wildlife movements across	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Operation	Closure	Associated Section 5(1)(c) Factors
	and out of road corridors				
	• When designing water crossings include consideration of design features that promote wildlife (e.g. amphibian, turtle, furbearers) movement.	✓			
	• When designing water crossings include consideration of design features that promote wildlife (e.g. amphibian, turtle, furbearers) movement.		✓		
Labour and Economy (Chapter 14)	**Change in Labour** • Posting job qualifications and identifying available training programs and providers so that local and Aboriginal residents can acquire the necessary skills and qualify for potential employment. • Working with local and Aboriginal businesses to enhance the opportunity to participate in the supply of goods and services for construction and operation. • Working with local communities to develop training programs oriented to operational needs. • Implement the Project's labour and training framework, which includes partnerships with Aboriginal communities and education institutes, information sharing (e.g., skills databases) and employment preparation and training.	✓	✓	✓	**Aboriginal socio-economic conditions**

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Establish a skills inventory that should be retained for active closure. • Support re-training to establish transferable skills. • Provide opportunities for voluntary redundancies during ramp-down (e.g., early retirement). • Provide redundancy payments. • Provide job search assistance.			✓	
	Change in Economy • The potential effects of the Project on the LAA and RAA economies because of purchases of labour, goods and services will be positive during construction and operation, therefore no mitigation will be required. However, GGM has and will continue to work with local and Aboriginal-owned businesses on Project contract opportunities regarding the supply of goods and services, particularly for the operation phase. • With respect to potential adverse effects on forestry, GGM has consulted with the MNRF and the enhanced Forest Resource Licence holder to address, to the extent possible, access to the PDA and the Crown timber allocated within the FMP that will be removed as part of site preparation, and long-term changes in the forest land base. As per discussions held to date, GGM will continue discussions with Ne-Daa-Kii- Me-Naan Inc. to obtain an Overlapping Agreement and to harvest the trees under their pulp mill license.	-	-	-	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
Community Services and Infrastructure (Chapter 15)	**Change in Capacity of Housing and Accommodation** • A temporary camp will be in place for construction, and potentially early operation, when some construction activities may be ongoing. The temporary camp will have the capacity to house an anticipated average of 450 people to a maximum of 600 during peak construction, so non-local construction workers can be housed during their on-site rotation.	✓			**Aboriginal socio-economic conditions**
	• No additional mitigation is required for housing operation or closure workers due to the availability of vacant housing in the LAA/RAA.		✓	✓	
	• Change in capacity of municipal and provincial services and infrastructure (police, fire, medical, recreation, education, water/sewer, power and waste) • GGM will maintain communication with relevant agencies and organizations, including municipal authorities, health agencies and school boards, to provide Project information, to identify and address potential Project-related implications for services and infrastructure, and to support responsible organizations in planning for, adapting to, or benefitting from changing demand as a result of the Project. • GGM will offer its employees an Employee Assistance Program and require pre-employment physicals. Workforce education to encourage healthy lifestyle choices, sensitivity training and strict enforcement of GGM's health and safety policies will also help mitigate adverse social effects. For example, sensitivity training will raise the level of awareness about the potential effects that workers can have on the community and their families through drug and alcohol use or other social concerns. • Demands on emergency response services will be managed by having Project rescue vehicles and trained First Responders at the worksite.	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	• Safety orientations will be mandatory and provided for new employees, and select employees will be trained in fuel handling, equipment maintenance, and fire prevention and response measures. Fire prevention and suppression systems will be maintained onsite, including water supplies, sprinklers, fire extinguishers and other firefighting equipment. Flammable material (such as fuels and explosives) will be carefully controlled within the PDA. • GGM will consult with local emergency providers so that roles and responsibilities are understood, and the necessary resources are in place. • Project planning and management strategies, including in-design mitigation measures and environmental protection measures, will reduce the likelihood of accidents and potential fires to as low a level as is reasonably practical. Environmental Management and Monitoring Plans, such as a Spill Prevention and Response Plan, are provided in Appendix M of the Final EIS/EA. • Demands on police services due to Project activities will be managed by controlling access to the mine site through the use of a security gate and guard house, and by employing onsite security staff. The use of a temporary camp, along with the work rotation, will limit interactions among local residents and non-local Project construction workers as some of the workforce will return to their home communities during their time off. • Implementation of a Waste Management Plan, that sets out procedures for reducing Project-related waste and limiting demands on local landfills. A Conceptual Waste Management Plan is provided in Appendix M4 of the Final EIS/EA and includes conceptual strategies. A Conceptual Closure Plan is provided in Appendix I of the Final EIS/EA.				

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• GGM will provide Project information to the Municipality and local service providers to prepare for increased waste, water, or sewer infrastructure demand. • GGM will maintain access and use of the front nine holes of the golf course and club house. In the event the contingency waste rock storage area A/C is required during the Project life, GGM will discuss its requirements with the Municipality.				
	• GGM will develop cooperative protocols with responsible agencies to deal with temporary construction and closure worker access to emergency and other medical services. During construction most workers will continue to receive general health care in their home communities. Minor injuries or health problems will be addressed through the provision of first-aid at the worksite • GGM will provide notice to the local school board regarding Project scheduling and human resources planning in order for the school board to prepare for the enrollment of additional students. • The temporary camp provided by GGM will include dining services and a basic recreation area, which may include a pool table and/or ping pong table, television and exercise equipment.	✓			
	• GGM will provide notice to the local school board regarding Project scheduling and human resources planning in order for the school board to prepare for the enrollment of additional students. • Heat and power for Project operation will be supplied by an onsite natural gas-fuelled power plant and power generation heat recovery distribution system. • GGM will install a package modular STP for the mine site and there will be no direct interaction between the mine site and the municipal wastewater system.	✓			

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• A third-party sewage disposal contractor will provide portable washroom facilities during early construction until the STP and sewage discharge line is set up and during active closure when facilities are decommissioned.	✓		✓	
	Change in capacity of transportation services and infrastructure • Schedule arrivals/departures of employee traffic to occur earlier than the existing observed a.m. peak hour for local traffic and later than the existing observed p.m. peak hour. • Schedule alternating work shifts so that all workers do not arrive in and leave the area at the same time to limit Project-related demands on both highway and air services and infrastructure.	✓	✓	✓	
	• Implement standard construction procedures and a Traffic Management Plan to reduce traffic delays during construction of realigned Highway 11. The Traffic Management Plan will be developed during ongoing planning and engineering design to address traffic staging in order to reduce delays. • Provide bussing services between the temporary camp and mine site.	✓			
Land and Resource Use (Chapter 16)	**Change in recreational land and resource use** • Implementation of mitigation outlined for atmospheric environment (Chapter 7.0 of the Final EIS/EA), acoustic environment (Chapter 8.0 of the Final EIS/EA), fish and fish habitat (Chapter 11.0 of the Final EIS/EA) and wildlife and wildlife habitat (Chapter 13.0 of the Final EIS/EA). • Initiate revegetation as soon as practical after Project components are no longer needed.	✓	✓	✓	**Aboriginal socio-economic conditions** **Aboriginal physical and cultural heritage**

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Provide in-kind support to assist Greenstone Snowmobile Club in improving the existing trail to Longlac (Aboriginal communities have indicated they use trails maintained by the Greenstone Snowmobile Club). • Where possible in accessible areas (e.g., along cleared rights-of-way), leave trees and other vegetation in place to buffer the view of Project components, reducing the change in viewshed and muffling nuisance noise. • Site the majority of Project components so as to achieve a 120 m setback for the surface rights reservation area on claim to lease lands and a 30 m high water mark setback for patent lands; existing vegetation will remain in these areas. • Implement progressive rehabilitation works, including stabilization and rehabilitation of aggregate source areas, the north cell of the TMF, plateaus and benches of WRSAs A, B, and C and the overburden storage areas. • Remove construction-related buildings, access roads and laydown areas following construction.	✓			**Current use**
	• Where possible in accessible areas (e.g., along cleared rights-of-way), leave trees and other vegetation in place to buffer the view of Project components, reducing the change in viewshed and muffling nuisance noise. • Implement progressive rehabilitation works, including stabilization and rehabilitation of aggregate source areas, the north cell of the TMF, plateaus and benches of WRSAs A, B, and C and the overburden storage areas.		✓		
	• Rehabilitation will be designed to meet desired end land uses, end land uses will be identified in the Closure Plan, in consultation with agencies, stakeholders and Aboriginal communities, as the Project progresses.			✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	Change in commercially-based land and resource use • Implementation of mitigation outlined for atmospheric environment (Chapter 7.0 of the Final EIS/EA), acoustic environment (Chapter 8.0 of the Final EIS/EA), fish and fish habitat (Chapter 11.0 of the Final EIS/EA) and wildlife and wildlife habitat (Chapter 13.0 of the Final EIS/EA). • Maintain access to mining claims located on the peninsula east of the PDA.	✓	✓	✓	
	• Provide in-kind support to assist Greenstone Snowmobile Club in improving the northeast trail. • Where possible in accessible areas (e.g., along cleared right-of-ways), leave trees and other vegetation in place to buffer the view of Project components, reducing the change in viewshed and muffling nuisance noise. • Site the majority of Project components so as to achieve a 120 m setback for the surface rights reservation area on claim to lease lands and a 30 m high water mark setback for patent lands; existing vegetation will remain in these areas. • Implement progressive rehabilitation works, including stabilization and rehabilitation of aggregate source areas, the north cell of the TMF, plateaus and benches of WRSAs A, B, and C and the overburden storage areas. • Remove construction-related buildings, access roads and laydown areas following construction.	✓			

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	• Where possible in accessible areas (e.g., along cleared rights-of-way), leave trees and other vegetation in place to buffer the view of Project components, reducing the change in viewshed and muffling nuisance noise. • Implement progressive rehabilitation works, including stabilization and rehabilitation of aggregate source areas, the north cell of the TMF, plateaus and benches of WRSAs A, B, and C and the overburden storage areas.		✓		
	• Rehabilitation will be designed to meet desired end land uses, end land uses will be identified in the Closure Plan, in consultation with agencies, stakeholders and Aboriginal communities, as the Project progresses.			✓	
	Change in navigation • Implementation of mitigation outlined for surface water (Chapter 10.0 of the Final EIS/EA), specifically those related to surface water quantity.	✓	✓	✓	
	• Construction activities will be undertaken in a way to prevent debris from flowing into a navigable waterbody.	✓			

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
Heritage Resources (Chapter 17)	**Loss of archaeological resources (either Aboriginal or European) determined to have cultural heritage value or interest** • If an archaeological resource is discovered during the construction phase, all construction will cease within a 20 meter radius of where the archaeological resource has been found. • In the event of a chance find, a licensed archaeologist will be retained by GGM and a Stage 2 Archaeological Assessment will be conducted with the participation of any interested Aboriginal groups. • Follow-up Stage 3 or Stage 4 archaeological investigations will be conducted as required by the Ontario Heritage Act and the 2011 Standards and Guidelines for Consultant Archaeologists, as necessary. • Key construction and operation staff will be trained in the recognition of basic archaeological artifacts such as Aboriginal material culture, and Euro-Canadian material culture and also on the potential and documented historic use and occupation of the PDA and LAA/RAA. • If human remains are encountered, GGM will stop work immediately and contact the Registrar or Deputy Registrar of the Cemeteries Regulation Section of the Ontario Ministry of Government and Consumer Services, as well as the Archaeology Programs Unit.	✓	✓		**Aboriginal physical and cultural heritage**

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	Loss of, change in access to, or change in cultural heritage value or interest of architectural or historical resources determined to have cultural heritage value or interest. • A buffer zone of 60 m will be implemented to isolate CHR 1 from Project activities including construction, operation, and closure. The 60 m construction buffers at CHR 1 will be noted on all construction plans and communicated to the construction team leads. Site plan controls, such as flagging, will be used to prevent Project activity from occurring within the 60 m buffer zone. If Project activities need to encroach upon the 60 m buffer zone, GGM will consult a qualified building condition specialist, specializing in structures built to 20th century or later Euro-Canadian constructions standards, prior to the commencement of Project activities.	✓	✓	✓	
Traditional Land and Resource Use (Chapter 18)	**Change to availability of plant species and access to plant harvesting sites and activities** • Mitigation for potential effects on groundwater in Chapter 9.0 of the Final EIS/EA (groundwater). • Mitigation for potential effects on surface water in Chapter 10.0 of the Final EIS/EA (surface water). • Mitigation measures related to vegetation described in Chapter 12.0 of the Final EIS/EA (vegetation communities). • Mitigation measures related to land and resource use described in Chapter 16.0 of the Final EIS/EA (land and resource use).	✓	✓	✓	**Aboriginal health conditions;** **Aboriginal physical and cultural heritage;** **Current use**
	• Mitigation for the potential effects from dust in Chapter 7.0 of the Final EIS/EA (atmospheric environment). • Where there is interest, provide opportunities to local communities for harvesting of	✓			

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Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	plants for traditional purposes prior to construction.				
	• Avoid the use of chemical herbicides.	✓	✓		
	• Incorporate plant species of interest to Aboriginal communities into the Closure Plan as feasible.			✓	
	Change to availability of fish species and access to fishing areas and activities • Mitigation for potential effects on fish and fish habitat in Chapter 11.0 of the Final EIS/EA (fish and fish habitat) including the Offsetting Plan (Appendix F10). • Mitigation measures related to land and resource use described in Chapter 16.0 of the Final EIS/EA (land and resource use).	✓	✓	✓	
	Change to availability of hunted and trapped species and access to hunting and trapping areas and activities • Mitigation for potential effects on change in habitat, mortality risk, and movement of wildlife in Chapter 13.0 of the Final EIS/EA (wildlife and wildlife habitat). • Mitigation measures related to land and resource use described in Chapter 16.0 of the Final EIS/EA (land and resource use). • Implementation of environmental management and monitoring plans (EMMPs) (Appendix M of the Final EIS/EA) and Conceptual Closure Plan (Appendix I of the Final EIS/EA).	✓	✓	✓	

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity: Construction	Project Activity: Operation	Project Activity: Closure	Associated Section 5(1)(c) Factors
	Change to cultural or spiritual practices, sites or areas • Detailed recording and mapping of spiritual or cultural sites in partnership with Aboriginal community representatives, a decision is then made about the relative importance of the site and, if warranted, how to maintain and control access.	✓	✓	✓	
	• Where there is interest, provide opportunities to local communities for harvesting of plants for traditional purposes prior to construction. • Through Project design the length and location of roads have been considered in order to reduce potential access restrictions. • A pipe ceremony will be held prior to commencement of construction under the direction of local Aboriginal communities.	✓			
Human and Ecological Health **(Chapter 19)**	**Change in human health** • Mitigation measures already incorporated to eliminate or reduce environmental effects of the Project also serve to address human health effects. They include, but are not limited to: o the use of dust suppressants, dust collectors and protective covers o a Water Management and Monitoring Plan (Appendix M1 of the Final EIS/EA) o Soil Management Plan and progressive rehabilitation • The mitigation measures to reduce air emissions and dust deposition are described in detail under the atmospheric environment VC (Chapter 7.0 of the Final EIS/EA). • Mitigation measures to control discharges into both surface water and groundwater are described in detail under the surface water VC (Chapter 10.0 of the Final EIS/EA) and	✓	✓	✓	**Aboriginal health conditions**

Table 6-1: Summary of Mitigation Applicable to Effects on Section 5(1)(c) Factors

Valued Component	Mitigation Measures	Project Activity			Associated Section 5(1)(c) Factors
		Construction	Operation	Closure	
	groundwater VC (Chapter 9.0 of the Final EIS/EA), respectively.				

	Change in ecological health
	• Mitigation measures already incorporated to eliminate or reduce environmental effects of the Project also serve to address human health effects. They include, but are not limited to:
	  o the use of dust suppressants, dust collectors and protective covers
	  o a Water Management and Monitoring Plan (Appendix M1 of the Final EIS/EA)
	  o Soil Management Plan and progressive rehabilitation
	• The mitigation measures to reduce air emissions and dust deposition are described in detail under the atmospheric environment VC (Chapter 7.0 of the Final EIS/EA).
	• Mitigation measures to control discharges into both surface water and groundwater are described in detail under the surface water VC (Chapter 10.0 of the Final EIS/EA) and groundwater VC (Chapter 9.0 of the Final EIS/EA), respectively.
		✓	✓	✓	

6.3 OTHER COMMITMENTS IN RELATION TO LOCAL ABORIGINAL COMMUNITIES

In addition to the mitigation measures identified in Table 6-1, GGM has developed the following additional mitigation to support local Aboriginal communities' (including LLFN, GFN, AFN, AZA and the MNO) participation in the Project and also to address Project-related effects.

1. GGM is working to support the capacity of local Aboriginal business to participate in mine procurement.
2. GGM is taking steps to maximize hiring of local and Aboriginal people.
3. GGM will support training of Aboriginal people through agreements with communities, seeking joint funding of programming, preparedness training, and providing on-the-job training.
4. GGM will provide opportunities to local Aboriginal communities to review and comment on permits, the Closure Plan, Environmental Management Plans, and monitoring.
5. GGM will consult with local Aboriginal communities prior to engaging an archaeologist for any further archaeology work that may be required.
6. GGM will consult with local Aboriginal communities regarding disposition and treatment of heritage resources that may be found.
7. GGM will meet regularly (or at least annually) with local Aboriginal communities to share information about the Project.
8. GGM has supported, and will continue to support, the use of local Aboriginal environmental monitors and/or technicians.
9. GGM commits to supporting local Aboriginal cultural practices through community driven initiatives.

In addition, as was committed to in Section 16.4.3.2 of the Final EIS/EA, GGM will continue discussions with AZA trapline holder regarding accommodation for the lost trapping area GE021and trapping on GGM's patented lands prior to the start of construction and where there is currently little activity.

GGM will continue information sharing with Aboriginal communities, throughout all phases of the Project.

7.0 CHARACTERIZATION OF RESIDUAL EFFECTS ON SECTION 5(1)(C) FACTORS

Having presented the mechanisms or pathways by which the Project could result in an environmental effect on a valued component that could then cause an effect on Aboriginal peoples with respect to the Section 5(1)(c) Factors in Chapter 5.0 of this report, and having identified mitigation measures, design features, or other commitments that address those effects in Chapter 6.0 of this report, the next step is to provide a discussion of residual effects on the VCs that could affect the Section 5(1)(c) Factors.

The following sections provide a review of residual effects related to each of the Section 5(1)(c) Factors; Aboriginal health conditions, Aboriginal socio-economic conditions, Aboriginal physical and cultural heritage, and current use. A high-level summary of the residual effects characterizations and conclusions as identified by the VC Chapters in the Final EIS/EA is provided. Following the VC specific summary, assessment conclusions regarding residual effects of changes to the environment on Aboriginal peoples as defined in Section 5(1)(c) of CEAA 2012 is provided. Where possible, residual effects which are anticipated to be limited to certain Aboriginal communities are also discussed. A review of the determinations of significance made by each VC and how they relate to each of the Section 5(1)(c) Factors Key Topics.

7.1 ABORIGINAL HEALTH CONDITIONS

7.1.1 Introduction

As required by the EIS Guidelines, this section provides a description and analysis of how changes to the environment caused by the Project may affect Aboriginal health conditions. It includes discussion of the following:

- change in air quality
- change in quality and availability of country foods
- change in drinking water quality or quantity
- change in noise or vibration exposure

This section first summarizes, at a high level, the main findings and conclusions for relevant VCs, and then provides GGM's conclusions regarding the overall characterization of residual effects on Aboriginal health conditions based on those VC findings.

7.1.2 Summary of Findings for Relevant Valued Components

7.1.2.1 Assessment of Potential Environmental Effects on Human and Ecological Health

Chapter 19.0 of the Final EIS/EA provided an encompassing assessment of potential environmental effects of the Project on human and ecological health, as supported by the human health and ecological risk assessment (HHERA) conducted for the Project that is presented in Appendix F08 of the Final EIS/EA. The HHERA used the ambient concentrations of various chemicals of potential concern (COPCs) in various environmental media at discrete locations surrounding the Project to predict the potential risks to humans and the environment due to baseline conditions as well as in consideration the Project contributions over baseline conditions. The HHERA used the model predictions, outputs, and findings of the atmospheric environment, groundwater, and surface water VCs as inputs to the HHERA model to predict potential human or ecological health risks to the general population as well as key ecological receptor species arising from exposure to COPCs from the Project as well as those in the existing environment. In so doing, consideration of the HHERA findings and those of the human and ecological health VC encompasses any effects that may arise to humans (including Aboriginal persons) and the environment from exposure to Project emissions to the atmosphere and releases of effluent to surface water and groundwater, thereby not necessitating their separate consideration. The pathways which contribute to inhalation, ingestion or dermal contact are discussed in Chapter 19 of the Final EIS/EA.

Chapter 19.0 Final EIS/EA assesses potential HHERA effects in detail. It includes specific consideration of effects on the health of Aboriginal people who live both inside and outside of the Human and Ecological Health LAA boundaries (boundaries shown in Figure 19-1 of the Final EIS/EA). Conservative assumptions made in the HHERA include those from incorporated into air, groundwater and surface water models and that Aboriginal people are assumed to consume higher levels of country foods harvested from within the Human and Ecological Health LAA compared to the general population, and that Aboriginal people are assumed to consume surface water from locations within the Human and Ecological Health LAA.

The analysis in Chapter 19.0 of the Final EIS/EA is divided into the following sub-topics:

a) Inhalation of Criteria Air Contaminants and Chemicals of Potential Concern
b) Inhalation of Dust and Exposure to Surface Water Runoff
c) Ingestion-Related Human Health Risks

Further information on the findings in each of these categories is provided below.

a) Inhalation of Criteria Air Contaminants and Chemicals of Potential Concern

The potential changes in inhalation health risks were assessed for exposure to both non-carcinogenic and carcinogenic chemicals of potential concern (COPCs). The chapter concludes that the change in inhalation exposures to both non-carcinogenic Criteria Air Contaminants (CACs) and COPCs presents negligible human health risks[1].

The incremental lifetime cancer risk associated with inhalation of carcinogenic COPCs (1,3-butadiene, acetaldehyde, benzene, formaldehyde, PAH, arsenic, beryllium and nickel) from the Project is below the 10^{-6} (one in a million) cancer risk acceptability benchmark established by the Ontario Ministry of the Environment and Climate Change. In general, for non-carcinogenic risks (with the exceptions of particulate matter less than 10 micrometres in diameter (i.e., PM_{10}), for acrolein, and for benzene), the change in inhalation exposures to the non-carcinogenic CACs and COPCs, represent negligible human health risks.

For typical residential receptors, health risks associated with inhalation of PM_{10}, acrolein, and for benzene did exceed the applicable benchmark. For more information on these exceedances see Section 19.4.2.3 of the Final EIS/EA.

In addition to the HHERA predictions that were made throughout the LAA for human and ecological health for the general population, 17 additional TLRU receptors were included in the assessment to provide additional information about potential changes in air quality to which Aboriginal people that may be practicing traditional activities at these locations may be exposed. The TLRU receptors were added in response to comments made by Aboriginal communities, additional information about the TLRU receptors is available in Section 7.1.2 of the Final EIS/EA. During construction and closure, concentrations of particulates, criteria air contaminants (CACs) and other COPCs outside the modelled property boundary (an area owned or leased by GGM) are predicted to be below applicable air quality criteria with the exception of benzene and benzo(a)pyrene, whose background levels are above the applicable criteria.

During operation, in areas outside the modelled property boundary (see Figure 7-10 in the Final EIS/EA; Stantec 2017d), concentrations were predicted to be below applicable air quality criteria, with the exception of infrequent exceedances (no more than 2-days in 5-years, or 0.1% of the time) of PM_{10} concentrations at the Kenogamisis Golf Club and short in duration. GGM will implement a best management plan to control fugitive dust from the Project. A Greenhouse Gas (GHG) Management and Monitoring Plan will also be implemented to reduce, where possible, GHG emissions from the Project. A "Hardrock Project Conceptual Greenhouse Gas Management and Monitoring Plan" (Conceptual GHGMMP; GGM 2017e) is provided in Appendix M6 of the Final EIS/EA (Stantec 2017d).

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[1] A negligible health risk as defined in the "Technical Data Report: Hardrock Project – Human Health and Ecological Risk Assessment" (HHERA TDR; Stantec 2017f) is health risk is considered negligible when the difference in health risk between Baseline Case and Future Case is less than the applicable benchmark (i.e., 0.2 for hazard quotients, 1E-06 for incremental lifetime cancer risks, 1.0 for concentration ratios, 1.0 for risk quotients, 1.0 for screening ratios).

For Aboriginal people who use the Kenogamisis Gold Club the inhalation health risk for PM_{10} exceeded the applicable benchmark. However, further analyses demonstrates that the yearly frequencies of these exceedance were low enough that potential health risks were negligible.

b) Inhalation of Dust and Exposure to Surface Water Runoff

As described in Section 19.4.2.3 of the Final EIS/EA, with the use of industry standard dust mitigation and surface water runoff control practices, potential exposure to humans will be limited or eliminated. Dust mitigation will limit or eliminate dust inhalation exposures for Aboriginal people engaged in hunting, trapping, fishing, recreational and traditional activities in the areas where Project construction activities occur. Control and treatment of runoff during construction and site preparation activities will limit or eliminate potential human exposures to chemicals in site-related particulate matter in runoff water, and the collection (and treatment if necessary) of mine contact water within the PDA will limit the release of untreated effluent and chemicals to the ambient environment. For these reasons, the residual effects of dust and surface water runoff on human health (including the health of Aboriginal people) are not significant.

c) Ingestion-Related Human Health Risks

The human health risks associated with ingestion exposures to COPCs were evaluated as the sum of the exposure pathways that contribute to total ingestion exposures. The pathways that may contribute to the total ingestion exposure are discussed in Chapter 19 of the Final EIS/EA.

The HHERA evaluated changes in ingestion-related health risks, which were assessed for exposure to arsenic, chromium, cobalt, methylmercury, and thallium. Aboriginal people, considered as part of the Aboriginal/High Use Receptor, were assumed to obtain 100% of their intake of fish from the various basins of Kenogamisis Lake and to obtain 100% of their intake of wild meat and traditional plants from the LAA, as conservative assumptions refined through the Draft EIS/EA review process. There is an existing consumption advisory for fish in Kenogamisis Lake (see section 4.5. in the HHERA TDR; Stantec 2017f). The changes in total ingestion exposures to arsenic, chromium, cobalt, methylmercury, and thallium were found to represent a negligible human health risk. The removal of portions of the historical MacLeod and Hardrock tailings, as part of the Project activities, is predicted to result in a decrease in total ingestion risks for arsenic. Overall, unacceptable health risks are not expected for the ingestion of country foods. A complete description of the methods and results for the risk assessment of each chemical of concern and country food source is presented Chapter 19.0 of the Final EIS/EA (Stantec 2017d) and the HHERA TDR (Stantec 2017f).

Through consultation, GGM recognizes that Aboriginal communities are interested in participating in a moose health (i.e., tissue sampling) monitoring study in the region. Given the large ranges of these animals and mandate of the MNRF, GGM will participate in a potential MNRF-led study with local Aboriginal communities during Project operation.

7.1.2.1.1 Conclusions for Chapter 19.0 of the Final EIS/EA: Assessment of Environmental Effects on Human Health

Taking into account proposed air quality and water quality mitigation and management measures, the Project would cause a negligible increase in human health risk limited to the Human and Ecological Health LAA (as shown in Figure 19-1 of the Final EIS/EA). Residual environmental effects to human and ecological health were identified as not significant for both the general population as well as for the Aboriginal/High Use receptor. Human exposures to Project emissions will occur on a year-round basis and any changes in exposure or health risk will be continuous over the life of the Project and into the post-closure phase of the Project. The change in health risk associated with the changes in exposure to Project- related chemicals is unlikely to return to baseline conditions and is considered irreversible.

7.1.2.2 Assessment of Potential Environmental Effects on Traditional Land and Resource Use

Residual effects on vegetation communities, fish and fish habitat, and wildlife and wildlife habitat can affect the distribution and abundance of species that are harvested traditionally for food by Aboriginal people. Changes in access to sites and areas where country foods are harvested can also contribute to changes in the availability of country foods. These subjects are assessed in detail in Chapter 18.0 of the Final EIS/EA and those conclusions are summarized below.

As with the assessment of potential environmental effects on human health above, Chapter 18.0 of the Final EIS/EA provided an encompassing assessment of potential environmental effects of the Project on traditional land and resource use. The assessment of traditional land and resource use considered the potential for a change to availability of plant species and access to plant harvesting sites and activities, a change to availability of fish species and access to fishing areas and activities, a change to availability of hunted and trapped species and access to hunting and trapping areas and activities, and a change to cultural or spiritual practices, sites, or areas. Combined, these assessments provide a holistic and encompassing evaluation of potential changes that may occur to biophysical resources upon which Aboriginal persons depend for practicing their traditional activities, such that their separate consideration is not required.

a) Changes in Distribution and Abundance of Species Harvested for Food

The following analysis of potential changes in the availability of country foods addresses changes in the distribution and abundance of species harvested for food.

As described in detail in Chapter 18.0 of the Final EIS/EA, Project activities during the construction, operations and closure phases have the potential to change the distribution of fish, wildlife and harvested plants (i.e., country foods). Chapter 18.0 assesses these potential effects in detail. Relevant residual effects conclusions are summarized below.

(i) Vegetation Communities

It is conservatively predicted that Project will result in the long-term loss of approximately 1,133 ha of forest and 810 ha of wetland vegetation communities from the PDA. The majority of areas where vegetation will be removed during construction are not predicted to return to the same upland and wetland community types until after closure. The Project is not predicted to remove uncommon features or functions of wetlands, or reduce carrying capacity beyond current or expected future use. The functions and attributes of the system are predicted to remain comparable to what would be expected in a similar landscape and in the remainder of the LAA. Given that the community types that will be removed are generally common and widespread in the RAA, the loss of the community types in the PDA will not affect the long-term viability of the community types.

Areas within the PDA and vegetation communities LAA not currently affected by invasive species may be affected by the spread of these species by new roads. If the spread of invasive species is found to be occurring at an unacceptable level within the PDA, GGM will use the system established through the Adaptive Management Framework (Chapter 23.0 Final EIS/EA; Stantec 2017d) to mitigate negative effects. Effects from dust deposition due to construction, operation and active closure activities will be localized to 30 m from the PDA.

The removal of habitat that supports plant species of interest to Aboriginal communities from the PDA is not anticipated to affect the viability of populations of these species in the vegetation communities LAA and RAA, though individual preferences by Aboriginal persons to practice traditional activities in specific areas may be affected for some members. Where there is interest, GGM will provide opportunities to local Aboriginal communities for harvesting of plants for traditional purposes prior to construction. Given that the plant species of interest to Aboriginal communities are relatively common in the RAA for vegetation communities, the availability of these species for harvest as country foods or for other traditional activities (such as basket making and other crafts) is not anticipated to be affected by the Project. Progressive rehabilitation activities will commence during operation, as Project components reach design capacities, and during closure. Effects on vegetation communities will be managed and monitored as identified in the Conceptual BMMP (GGM 2017c).

(ii) Fish and Fish Habitat

The assessment of potential impacts to Fish and Fish Habitat categorized potential effects on Fish and Fish habitat into one of three potential categories:

1) Lethal and sub-lethal effects on fish
2) Permanent Alteration of Fish Habitat, and
3) Loss of Fish Habitat.

Each of these potential effects was considered throughout the Construction, Operation, and Closure Phases of the Project.

When considering potential lethal and sub-lethal effects on fish, a residual effect was identified. However, the residual effect was not considered significant, because it is not expected to result in a reduction in the productivity of CRA fisheries, nor a change in the usability of fish (i.e., for consumption). The residual effect identified was potential sub-lethal effects on fish due to PoPC inputs from treated effluent and nonpoint sources. This residual effect was not considered significant because, overall, there will be a net improvement in water quality and fish communities overall will be exposed to lower concentrations of PoPCs. Furthermore, the results of a site-specific Bioavailability Study (Final EIS/EA, Appendix F07) indicate that the predicted concentrations of PoPCs in water, sediment and biota will not adversely affect the aquatic community in Kenogamisis Lake. These predictions were made conservatively, with a high degree of confidence.

Permanent alteration of fish habitat due to nutrient inputs from treated effluent and non-point sources was identified as a residual effect of the Project. The predicted changes are not considered significant because they will be limited to a small area of the lake and not adversely affect aquatic life. The predicted nutrient concentration is lower than the Interim provincial water quality objectives (PWQO) and the predicted 3% increase in total phosphorus in the Southwest Arm is smaller than that required to cause a change in trophic status.

Some fish habitat will be lost due to overprinting by Project components. Of the 6.02 ha of fish habitat that will be overprinted, approximately 64% of that area is artificial, degraded habitat (e.g., golf course ponds, roadside ditches and drainage features that receive seepage from historical tailings). The section of Goldfield Creek that will be re-aligned accounts for approximately 35% of the overprinted habitat. Watercourse O and G are intermittent habitats that will also be partially overprinted and account for 1% of the overprinted area. Overprinted habitats will be replaced by habitat that provides year-round structure and cover for fish. Thus, lost habitats will be replaced by new habitat and the productivity of CRA fisheries will be maintained.

(iii) Wildlife and Wildlife Habitat

Vegetation clearing and sensory disturbance is predicted to result in a decrease in the availability of wildlife habitat in the LAA; however, the loss of habitat is unlikely to affect the long-term persistence or viability of wildlife in the Wildlife and Wildlife Habitat RAA. Increased mortality risks will be greatest for small species with limited avoidance capability and wildlife that require and occupy specialized habitat features. Risk for changes in mortality can be reduced through the application of timing windows and will be managed and monitored through the BMMP. The residual adverse effect on wildlife mortality is predicted to be within the normal variability of baseline conditions and is not expected to affect the long-term persistence or viability of wildlife within the Wildlife and Wildlife Habitat RAA.

The open pit, WRSAs, and TMF will result in a loss of habitat availability and connectivity, which may result in changes to daily and seasonal movements of wildlife.

The movement of large mammals in the Wildlife and Wildlife Habitat LAA could be disrupted due to vegetation removal and the presence of Project components. However, large mammals such as moose and bear have large home ranges which allow them to adapt. Given that large mammal habitat exists throughout the Wildlife and Wildlife Habitat RAA and that large mammals tend to move through and around anthropogenic areas readily within their home range, it is assumed that these species will mostly avoid the PDA. Progressive rehabilitation activities will commence during operation, as Project components reach design capacities, and during closure. The predicted change in local movement is not expected to affect the long-term persistence or viability of wildlife in the Wildlife and Wildlife Habitat RAA.

As these changes relate to the availability of country foods, the abundance of harvested wildlife is not anticipated to change although the distribution of harvested wildlife may change as large mammals avoid the PDA, which could result in a localized change in availability.

b) Changes in Harvesting Area Availability and Access

(i) Access to Plant Harvesting Areas

Residual environmental effects on access to plant harvesting sites and activities were characterized based on consideration of information provided by Aboriginal communities through Project-specific TLRU studies, cultural impact assessments, literature review and Aboriginal consultation activities, as well as relevant VC residual environmental effect assessments.

The plants of Aboriginal interest that will be lost to the development of the PDA, however, are abundant in the LAA and RAA such that loss of the community types in the PDA is not predicted to jeopardize the long-term viability or availability of the community types. Patterns of access to harvesting areas in the Traditional Land and Resource Use LAA may be altered by access restrictions to the PDA, including the closure of Lahtis Road. Access changes may affect harvesting sites located southwest of the PDA (however, this area may be accessed via Goldfield Road), and along the shoreline of the Southwest Arm of Kenogamisis Lake.

During construction, clearing of the PDA will result in a loss of existing vegetation, including potential plant harvesting sites identified by Aboriginal communities.

Changes to access and navigation routes as a result of the Project will affect harvesting, navigation, and trail use areas in the PDA in the Traditional Land and Resource Use LAA. Changes to patterns of access within the PDA and Traditional Land and Resource Use LAA will result in an effect of continuous frequency throughout all Project phases. Effects extending into the Traditional Land and Resource Use LAA are anticipated to be moderate in magnitude. The duration of effects on access are medium-term in duration because access through the PDA will be restored following active closure. During rehabilitation of Project components access will be limited while in progress.

(ii) Access to Fishing Areas

Due to safety concerns, access to the PDA will be restricted during construction, operation, and active closure. Residual effects are anticipated for access to: portions of the Southwest Arm Tributary and its online ponds (Ponds SWP1, SWP2, SWP3 and SWP4); Lake A-322; and parts of Kenogamisis Lake accessed via Lahtis Road, though with authorization and offsetting, these residual effects were determined to be not significant.

Although navigation in the PDA has not been observed or identified through consultation or TK and TLRU studies, travel by small craft (e.g., canoe) will continue to be possible with obstacles (e.g., beaver dams and vegetation obstructions) between Goldfield Lake and Kenogamisis Lake with the new Goldfield Creek diversion; however, access through this area will be restricted during construction, operation, and active closure. The closure of Lahtis Road will affect access to areas located to the southwest of the PDA (although this area may be accessed via Goldfield Road). Access restrictions will remain in place until the end of active closure. The change in access may require Aboriginal communities to seek alternative routes and methods of access (i.e., boat vs. vehicle). Access through the PDA will be restored following active closure.

Effects on fish species and fish areas and activities are considered low in magnitude, limited to the Traditional Land and Resource Use LAA, and continuous in frequency. The duration is characterized as medium-term and reversible overall because access will be re-opened after Project closure.

(iii) Access to Hunting Areas

The terms used to characterize residual environmental effects on hunted and trapped species and hunting and trapping areas and activities are presented in Section 18.1.7 of the Final EIS/EA. Residual environmental effects on hunted and trapped species and hunting and trapping areas and activities were characterized based on information provided by Aboriginal communities as well as relevant VC residual environmental effect assessments.

The Wildlife and Wildlife Habitat VC (Chapter 13.0 of the Final EIS/EA) and Land and Resource Use VC (Chapter 16.0 of the Final EIS/EA) were reviewed for this assessment. After the application of mitigation, the wildlife and wildlife habitat and land and resource use assessments identified residual environmental effects that, in turn, will affect hunting and trapping through changes in wildlife habitat in the PDA. Effects on habitat through vegetation removal and sensory disturbance may cause wildlife important to TLRU to avoid habitat.

Mortality risk may affect species important to TLRU through site preparation as the primary effect mechanism followed by traffic, and human-wildlife encounters. However, with the implementation of the identified mitigation measures in Chapter 13.0 of the Final EIS/EA (Wildlife and Wildlife Habitat VC), direct mortalities resulting from the Project (if they occur) are expected to be within the normal variability of baseline conditions and are not expected to affect the long-term persistence or viability of wildlife within the Traditional Land and Resource Use RAA.

Change in movement of wildlife important to TLRU will be primarily due to the open pit and its associated infrastructure, which act as a local barrier to wildlife movement. Other Project components such as ditches, access roads and transmission/distribution lines also have the potential to alter wildlife movement. Wildlife may be reluctant to cross these components because of high levels of human activity, sensory disturbance, or because the features are too high or wide to physically move across. Access will be altered by changes to access to Lahtis Road and the diversion of Goldfield Creek. Residual environmental effects described in these relevant VC assessments were considered to characterize residual environmental effects on hunted and trapped species and hunting and trapping areas and activities.

Residual effects are anticipated for TLRU locations in the PDA. Patterns of access to hunting and trapping in the Traditional Land and Resource Use LAA may be altered by access restrictions to the PDA, including the closure of Lahtis Road. Access changes may affect hunting and trapping areas located southwest of the PDA (however this area may be accessed via Goldfield Road), and along the shoreline of the Southwest Arm of Kenogamisis Lake.

Residual environmental effects on hunted and trapped species and hunting and trapping sites and activities or access to these are considered adverse. During construction, clearing of the PDA will result in a loss of wildlife habitat. In particular, wetland and forest areas will have some irreversible loss of associated wildlife habitat. During operation, hunted and trapped species will be affected because of indirect loss or alteration by sensory disturbance (habitat avoidance or under-utilization due to human activity) and is predicted to be adverse, moderate in magnitude but is not predicted to affect the continued viability of wildlife within the Traditional Land and Resource Use RAA.

The residual adverse effect on mortality risk during construction, operation and closure is predicted to be within the normal variability of existing conditions. The residual adverse effect on mortality risk will extend into the Traditional Land and Resource Use LAA and is considered reversible. Access to areas used for hunting and trapping and trails and navigable waterways will be changed in the PDA and hunting and trapping will be affected in the Traditional Land and Resource Use LAA due to the Project altering access conditions and navigability.

Changes to patterns of access within the PDA and LAA will result in an effect of continuous frequency throughout construction, operation and active closure. Effects extending into the

Traditional Land and Resource Use LAA because of change in access through the PDA along Lahtis Road are anticipated to be moderate.

It is expected that effects on hunted and trapped species and hunting and trapping sites will be reversed (except for some areas of the PDA) following the completion of rehabilitation during closure. Residual effects are characterized as moderate in magnitude, medium-term in duration and irreversible overall because access through the PDA will be restored following active closure, but some wildlife habitat will be irreversibly lost.

7.1.2.2.1 Conclusions for Chapter 18.0 of the Final EIS/EA: Assessment of Potential Environmental Effects on Traditional Land and Resource

Residual effects on traditional land and resource use may include reduced access to land and availability of resources for the pursuit of traditional activities such as plant harvesting, fishing, hunting, trapping.

Lahtis Road will be closed during construction and operations due to safety reasons. Harvesting areas will not likely be directly disturbed in the local assessment area, although there will be a change in access patterns for use of sites located southwest of the Project development area (however this area may be accessed via Goldfield Road. At closure, Lahtis Road is anticipated to be re-opened to the Goldfield Creek diversion.

While access to the Project development area will be limited for the lifetime of the Project, traditional land and resource use sites and areas, except for Lahtis Road, within the local assessment area and regional assessment area will continue to be accessible. Furthermore, GGM is committed to maintaining alternate access within the Project development area to the Southwest Arm of Kenogamisis Lake during construction and operation.

The residual environmental effects from the Project on TLRU are determined to be not significant because they do not result in the long-term loss of availability of traditional use resources or access to lands relied on for traditional use practices or the permanent loss of traditional use sites and areas in the Traditional Land and Resource Use LAA and RAA. The ability of Aboriginal communities to maintain traditional land and resource use outside of the Project development area will be maintained with some access changes, as GGM is committed to maintaining alternate access within the Project development area to the Southwest Arm of Kenogamisis Lake during construction and operation.

7.1.2.3 Assessment of Potential Environmental Effects on the Acoustic Environment

As described in detail in Chapter 8.0 of the Final EIS/EA, residual effects on acoustic environment may affect human health conditions, including Aboriginal health conditions.

Changes in noise and vibration levels are assessed in detail in Chapter 8.0 of the Final EIS/EA may and those conclusions are summarized below.

a) Change in Noise Levels

Results for all Project points of reception (PoRs) are provided in the Noise and Vibration TDR (Appendix F2). Additional information about the acoustic model is provided in Chapter 8 of the Final EIS/EA.

i. Construction and Closure

Acoustic model predictions in Table 8-7 and Figure 8-2 of the Final EIS/EA indicate that the sound levels at the identified PoRs as a result of Project construction are within the target thresholds set by using the MOECC NPC-300 operation sound level limits (SLLs). As a result, Project noise emissions in the LAA will not exceed the applicable criteria for each PoR during the construction and closure phases.

ii. Operation

Acoustic model predictions in Section 8.4.2.2 of the Final EIS/EA demonstrate that the sound levels at the identified PoRs as a result of Project operation during Mill Phases 1 and 2 will be equal or below the MOECC NPC-300 SLLs for operation noise. For Project effects related to noise during operation Mill Phases 1 and 2, noise emission levels at PoRs will not exceed applicable criteria.

In summary, the Project will result in an increase in noise emissions over baseline conditions in the LAA throughout construction, operation and active closure; however, the noise emission levels at PoRs will not exceed applicable criteria. Noise emissions estimates at PoRs are expected to be conservative and represent worst-case short-term emissions from the Project. The increase in sound levels is consistent with current baseline conditions which are typical of a Class 2 and Class 3 acoustical environment as defined by NPC-300.

iii. Blasting

The Project will result in an increase in noise emissions over baseline conditions due to blasting in the LAA throughout construction and operation; however, the blasting noise emission levels at PoRs will not exceed applicable criteria, see Table 8-10 and Figure 8-5 of the Final EIS/EA. Blasting will occur on a regular basis (approximately five times per week) depending on the detailed open pit plan and specific operational requirements throughout the LOM. As the WRSAs and open pit develop and blasting occurs increasingly below ground surface, blasting noise emissions at PoRs would become progressively less as a result.

b) Change in Vibration Levels

i. Construction and Active Closure

The zone of influence (ZOI) represents the area within which a vibration velocity greater than 5.0 mm/s is predicted. All identified PoRs and Points of Interest (PoIs) are located outside the ZOI and predicted to be exposed to vibration levels below 5.0 mm/s. Based on the prediction results, Project construction activities are below the benchmark presented in Toronto *By-law No. 514-2008*.

ii. Operation

The assessment of the vibration effects due to Project operation incorporates the prediction on a criteria boundary representing a distance from the Project where vibration meets the ISO 2631-2 limit. Prediction results demonstrate that all identified PoRs and PoIs are located outside of the criteria boundary.

iii. Blasting

Prediction results were compared to the criteria to determine the status of compliance with NPC-119 and are summarized in Table 8-11 of the Final EIS/EA. For Project effects related to vibration during blasting, vibration emission levels at PoRs will not exceed applicable criteria.

Acoustic model predictions demonstrate that the vibration levels at the identified PoRs as a result of blasting during Project operation will comply with the target vibration limits defined in NPC-119.

In summary, the Project is predicted to result in an increase in vibration levels over baseline in the LAA throughout construction, operation and active closure; however, the vibration emission levels at PoRs will not exceed applicable criteria. Although blasting will mainly occur within the open pit at or below grade level, the models were set up to simulate a blast at ground level where no shielding by the open pit cut/edge is provided. The predictions therefore represent a conservative emissions scenario and are therefore considered to provide conservative estimates of the vibration levels.

7.1.2.3.1 Conclusions for Chapter 8.0 of the Final EIS/EA: Assessment of Potential Environmental Effects on the Acoustic Environment

i. Change in Sound Levels

All phases of the Project will contribute to an increase in sound levels compared to baseline condition at PoRs. Predicted Project noise emission levels at PoRs and PoIs comply with applicable guideline criteria and thresholds selected for assessment. It is expected that the change in existing sound levels will be confined to the LAA. The change in the existing acoustic environment may fluctuate depending on the season and time of day. The change in the existing sound levels may occur continuously throughout construction and operation. The change in existing sound levels may occur throughout the construction, operation and active closure. Noise emissions will cease at the end of the Project operating life and following active closure. The baseline sound levels within the LAA are considered typical as defined by the applicable guidance documents.

Residual environmental effects on sound levels were identified as not significant.

ii. Change in Vibration Levels

All phases of the Project will contribute to an increase in vibration levels compared to baseline condition at PoRs. Predicted Project vibration levels at PoRs and PoIs comply with applicable guideline criteria and thresholds selected for assessment. It is expected that the change in existing vibration levels will be confined to the LAA. The change in existing vibration levels may fluctuate depending on the season. The change in existing vibration levels will occur routinely throughout construction and operation phases of the Project. The change in existing vibration levels will occur at scheduled periods throughout the construction, operation and active closure. Vibration emissions will cease at the end of the Project operating life. The baseline vibration levels are considered typical with no observed major vibration producing activities (e.g., rail) within the LAA.

Residual environmental effects on vibration levels were identified as not significant.

7.1.3 Summary of Residual Effects Related to Aboriginal Health Conditions

This section considers how residual effects may affect Aboriginal health conditions and focuses on the Key Topics identified in Section 3.1.1 of this report. If changes to Key Topics are anticipated to be unique between Aboriginal communities those distinctions are addressed.

7.1.3.1 Change in Air Quality

This summary of residual changes in air quality incorporates information from the assessment of potential environmental effects on human and ecological health as presented in Chapter 19.0 of the Final EIS/EA and Section 7.1.2.1 of this report. The information provided by Aboriginal communities was not conducive to a separation of residual effects discussions for each Aboriginal community. Based on available information, and in keeping with the conservative assumptions outlined in Section 3.4 of this report, the discussion below is applicable to all of the identified Aboriginal communities.

During construction and closure, concentrations of particulates, criteria air contaminants (CACs) and other COPCs outside the modelled property boundary (an area owned or leased by GGM) are predicted to be below applicable air quality criteria with the exception of benzene and benzo(a)pyrene whose background levels are above the applicable criteria.

Aboriginal people may be exposed to infrequent exceedances of COPCs, including at the Kenogamisis Golf Club. For Aboriginal people who live and/or use areas within the Human and Ecological Health LAA, the inhalation health risk for PM_{10} exceeded the applicable benchmark. The Project's contributions to the concentrations of PoPC at locations used by Aboriginal people for traditional land use are predicted to be below the criteria set by the federal and provincial governments. When combined with the existing background level of PoPC, concentrations of PoPC at those locations are predicted to be below the respective criteria (with the exception of benzene and benzo(a)pyrene, for which the background levels are already above the criteria). Yearly frequencies of exceedance in those areas were low enough that potential health risks were negligible.

These effects are expected to apply equally to all members of identified Aboriginal communities that use areas within the Human and Ecological Health LAA.

7.1.3.2 Change in Quality and Availability of Country Foods

a) Change in Quality of Country Foods

This summary of residual changes in the quality of country foods incorporates information from the assessment of potential environmental effects on human and ecological health as presented in Chapter 19.0 of the Final EIS/EA and Section 7.1.2.1 of this report. The information provided by Aboriginal communities on this topic was not conducive to a separation of residual effects discussions for each Aboriginal community. Based on available information, and in keeping with the conservative assumptions outlined in Section 3.4 of this report, the discussion below is applicable to all of the identified Aboriginal communities.

The HHERA evaluated changes in ingestion-related health risks, which were assessed for exposure to arsenic, chromium, cobalt, methylmercury, and thallium. Aboriginal people, (considered as part of the Aboriginal/High Use Receptor) were assumed to obtain 100% of their intake of fish from the various basins of Kenogamisis Lake and to obtain 100% of their intake of wild meat and traditional plants from the Human and Ecological Health LAA. There is an existing consumption advisory for fish in Kenogamisis Lake due to presence of mercury in fish tissue (see Section 4.5 in the HHERA TDR; Stantec 2017f).

The changes in total ingestion exposures to arsenic, chromium, cobalt, methylmercury, and thallium were found to represent a negligible human health risk. The removal of portions of the historical MacLeod and Hardrock tailings, as part of the Project activities, is predicted to result in a decrease in total ingestion risks for arsenic due to improved surface water quality during operation arising from removal of a portion of historical tailings. Overall, unacceptable health risks are not expected for the ingestion of country foods. These effects are expected to apply equally to all members of identified Aboriginal communities that harvest country foods within the Human and Ecological Health LAA.

In response to comments from Aboriginal communities, fish sampling programs in the Conceptual AMMP (Stantec 2017a) will be expanded to obtain data on species Aboriginal communities have identified as being traditionally important (e.g., White Sucker). This will include the analysis of whole bodied fish to reflect the ways Aboriginal peoples prepare and consume fish. Through consultation, GGM became aware that local Aboriginal communities are interested in participating in a moose health (i.e., tissue sampling) monitoring study in the region. Given the large ranges of these animals and mandate of the MNRF, GGM will participate in a potential MNRF-led study with local Aboriginal communities during Project operation.

b) Change in Availability of Country Foods

This summary of residual changes in the availability of country foods incorporates information from the traditional land and resource use assessment as presented in Chapter 18.0 of the Final EIS/EA and Section 7.1.2.2 of this report. The information provided by some Aboriginal communities regarding this topic was conducive to allow a separation of residual effects discussions for individual Aboriginal communities. In an effort to provide standalone sections for individual Aboriginal communities, these discussions are necessarily repetitive.

i. Animbiigoo Zaagi'igan Anishinaabek

Secondary source information and consultation input has confirmed that AZA members fish in Longlac and Kenogamisis Lake and harvest a variety of game in the Traditional Land and Resource Use RAA. As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary.

GGM is not aware of specific AZA fishing sites in the PDA, but acknowledges that AZA members may fish there. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation.

The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources for AZA members within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

ii. Aroland First Nation

AFN TLRU practices in the Traditional Land and Resource Use RAA include hunting, fishing, and gathering. AFN identified traditional plants (including wild rice and weekah/wike [sweet flag]), fish and wildlife as important to their diet. Through consultation with the CEA Agency, AFN members identified the following fish species of importance: whitefish, walleye, sucker, sturgeon, trout, dace, and minnows. Through consultation, moose hunting was also identified as important to AFN and AFN identified that members use snowmobile trails through the PDA (e.g., along Lahtis Road).

As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific AFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation.

The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

iii. Biigtigong Nishnaabeg

Consultation input from Biigtigong Nishnaabeg raised comments regarding health effects on wildlife, including moose and bears from the TMF (Record of Consultation; Appendix C3 of the Final EIS/EA). In addition to consultation results, no TLRU information relevant to Biigtigong Nishnaabeg has been identified through a review of publicly available information. As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses. The Project is expected to result in the reduction of habitat used by animals due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

iv. Biinijitiwaabik Zaaging Anishinaabek

During consultation, BZA requested information regarding fish species in Goldfield Creek as well as fish spawning activity. In addition to consultation results, no TLRU information relevant to BZA has been identified through a review of publicly available information. As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific BZA fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

v. Bingwi Neyaashi Anishinaabek

During consultation, BNA provided comments about hunting areas identified around the Project and requested information regarding effects on swamplands in Geraldton; BNA also requested information regarding groundwater seepage and hydrogeology modelling and stated the importance of water treatment and controlling the release of contaminated water. In addition to consultation results, no TLRU information relevant to BNA has been identified through a review of publicly available information. As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA. Swamplands in Geraldton are outside the PDA and the Traditional Land and Resource Use LAA. Effects are not predicted to extend beyond the LAA boundary, therefore swamplands located in Geraldton are not addressed in the Final EIS/EA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

vi. Constance Lake First Nation

During consultation for the Project, CLFN requested information regarding effects on fish migration and spawning activities, including the Goldfield Creek and Southwest Arm Tributary drainages as well as potential effects on fish, wildlife and harvesting as a result of contamination resulting from the Project. CLFN also requested information regarding mitigation measures to manage water quality during Project activities and to address potential effects on fish habitat. In addition to consultation results, no TLRU information relevant to CLFN has been identified through a review of publicly available information.

As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific CLFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use or Traditional Land and Resource Use RAA.

vii. Eabametoong First Nation

A Project-specific TK study has confirmed that EFN TLRU practices include fishing, hunting and plant harvesting (in particular gathering blueberries within the LAA). Fishing is also important to EFN members as several species including northern pike, minnow, pickerel, and whitefish are reported to be harvested within the PDA. EFN members also noted the importance of fish spawning within the PDA. Hunting and trapping is important to EFN members' way of life and reported a rabbit snaring site within the PDA. EFN define cultural and traditional practices as cultural continuity, which can include teachings, travelling, place-based stories and values, spirituality, burial sites, and subsistence activities such as plant and medicine gathering. Several sites of cultural continuity were identified within the Traditional Land and Resource Use LAA and RAA. As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. EFN has identified subsistence sites in the PDA that may include fishing sites (EFN Knowledge and Use Study; Appendix J5 of the Final EIS/EA). The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

viii. Ginoogaming First Nation

A Project-specific SIA study has confirmed that GFN TLRU practices include harvesting plants for food, medicine, fishing, and hunting. GFN members noted the importance of moose as a source of meat. Kenogamisis Lake was noted as important habitat for harvested sweetgrass and for fishing and hunting. GFN members highlighted the importance of these traditional and cultural uses and their connection to the land for healing practices. GFN indicated that the decrease in the availability and access to fish, wildlife, and traditional plants could diminish the strong connection that GFN members have to the land and their traditional practices. As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the LAA. GGM is not aware of specific GFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation.

The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

ix. Long Lake #58 First Nation

A Project-specific TK assessment has confirmed that LLFN TLRU practices in the Traditional Land and Resource Use RAA include gathering berries and plants for medicinal uses and firewood, hunting, trapping, camping, ceremonies, and teaching and that locally caught fish are an important part of LLFN members diet. The LLFN TK Assessment (Appendix J1 of the Final EIS/EA of the Final EIS/EA) identifies four campsite or cabin areas in the PDA. During GGM and LLFN follow-up meetings on April 18 and 19, 2017, LLFN confirmed there are a total of four "land use" sites within the PDA. During consultation LLFN also identified Kenogamisis Lake as an area where sweetgrass is harvested.

As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Where there is interest, GGM will provide opportunities to local communities for harvesting of plants for traditional purposes prior to construction. The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is not aware of specific LLFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

x. Marten Falls First Nation

Secondary source information and consultation results indicate that MFFN TLRU practices include traditional activities such as moose hunting. As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Issues of importance identified by MFFN related to water quality, harvesting of wildlife and effects of development on the ability to access TLRU sites include loss of hunted species in the Traditional Land and Resource Use LAA such as moose.

The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

xi. Métis Nation of Ontario

A Project-specific TKLU study has confirmed that MNO TLRU practices include hunting, fishing and gathering activities. MNO members have identified key plant species including ferns, berries (blueberries and raspberries), herbs, chanterelle and shaggy mane mushrooms, chaga mushrooms, and trees. Fish species of importance to MNO members include trout, northern pike, walleye, whitefish, and sturgeon. Fishing areas of importance are Kenogamisis Lake, Goldfield Lake, Magnet Creek, and Moser Lake. Important species that are harvested by MNO members include moose, deer, ruffed grouse, geese, and various duck species. MNO members harvest plants in the Traditional Land and Resource Use LAA including areas near the southwest arm of Kenogamisis Lake, fish in the PDA, hunt in the TLRU LAA and access land use areas and Kenogamisis Lake using Lahtis Road. MNO reported a tent or temporary structure south of Mosher Lake and a route connecting Highway 11 with Mosher Lake, both located within the PDA.

As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. MNO has identified the Southwest Arm Tributary as a fishing site within the PDA (MNO TKLU Study; Appendix J3 of the Final EIS/EA). The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation.

The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the TLRU LAA or Traditional Land and Resource Use RAA.

xii. Pays Plat First Nation

A Project-specific watershed study has confirmed that PPFN TLRU practices include harvesting plants, fishing, and hunting. Of particular importance to PPFN members are wildlife populations including moose. PPFN members harvest plants in the Traditional Land and Resource Use LAA, fish and hunt within the PDA, and access harvesting and use areas (including Kenogamisis Lake) using Lahtis Road. As noted in Section 18.4.1.1 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific PPFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation.

The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or Traditional Land and Resource Use RAA.

xiii. Pic Mobert First Nation

Through consultation, PMFN provided comments regarding Project effects on commercial traplines near Caramat Road, which is outside the RAA (Record of Consultation; Appendix C3 of the Final EIS/EA). In addition to consultation results, no traditional land and resource use information relevant to PMFN has been identified through a review of publicly available information.

As noted in Section 18.4.1.1 of the Final EIS/EA, traditional land and resource use locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if a particular Aboriginal community did not specifically identify these activities or site-specific uses.

Overall, the Project is not expected to limit the availability of traditional resources within the TLRU LAA or Traditional Land and Resource Use RAA.

xiv. Red Sky Métis Independent Nation

Through consultation, RSMIN members provided comments regarding Project effects on fish habitat in Goldfield Creek (Record of Consultation; Appendix C3 of the Final EIS/EA). In addition to consultation results, no traditional land and resource use information relevant to RSMIN has been identified through a review of publicly available information.

GGM is not aware of specific RSMIN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the TLRU LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the TLRU LAA or RAA.

7.1.3.3 Change in Drinking Water Quality or Quantity

Although a change in drinking water quality was assessed in the Final EIS/EA as a Groundwater VC (Chapter 9.0) and a Surface Water VC (Chapter 10.0), the Human and Ecological Health VC (Chapter 19.0) provided an encompassing assessment of potential risks to human and ecological health arising from exposure to chemicals from a variety of potential sources of exposure. Therefore, this summary of residual changes in the quality and quantity of drinking water is based primarily on information from the assessment of potential environmental effects on human and ecological health as presented in Chapter 19.0 of the Final EIS/EA and Section 7.1.2.1 of this report. Based on available information, and in keeping with the conservative assumptions outlined in Section 3.4 of this report, the discussion below is applicable to all of the identified Aboriginal communities.

Historical tailings are currently contributing to existing water quality effects in Kenogamisis Lake through runoff and groundwater discharge. The main residual environmental effect on groundwater quality identified is positive. Several Project activities are anticipated to result in improvements to water quality and provide environmental benefits. Relocating a portion of the historical MacLeod and Hardrock tailings to the new TMF, and implementing an enhanced cover, stability measures and seepage collection for the remaining historical MacLeod tailings to reduce seepage, provide safety and long-term stability of structures, thereby substantially reducing environmental effects to groundwater and surface water quality from these historical tailings during operation through post closure. Arsenic loading to surface water features due to groundwater discharge is predicted to decrease by 99% during operation and 52% during closure.

Over the Project life, water will come in contact with Project components that will be collected and treated by the effluent treatment plant prior to discharge to the environment. The effluent treatment plant will be a conventional and modular plant for metals removal and reduction of total suspended solids prior to discharge and is well suited to the Project.

Lands contained within the zone of influence (ZOI) are owned or under lease by GGM and there are no known Aboriginal or non-Aboriginal groundwater users within the ZOI. As the groundwater within the ZOI is not being used as a drinking water source, the Project is not anticipated change groundwater drinking quality or quantity for Aboriginal people.

Residual effects on surface water quantity and quality are anticipated for Goldfield Creek, the Southwest Arm Tributary and Mosher Lake.

For residual effects on surface water quantity, due to the diversion of Goldfield Creek to the Southwest Arm Tributary, flows to Goldfield Creek will decrease and flows to the Southwest Arm tributary will increase. However, as the Goldfield Creek tributary forms most of the remaining portions of Goldfield Creek, Project residual effects on its flows are moderate and not significant. The increase in flows to the Southwest Arm Tributary due to the Goldfield Creek diversion will increase baseflows and flushing flows. Potential increases in stream erosion and flooding will be mitigated through diversion design, resulting in non-significant residual effects. In Mosher Lake, the Project is expected to reduce groundwater inflow to the lake due to the influence of the open pit. However, this effect is only expected to have a small effect on lake water levels and the effect will end after the open pit is refilled in closure, resulting in not significant residual effects.

With respect to residual effects on surface water quality, several design features of the Project are expected to result in generally improved surface water quality in Kenogamisis Lake as compared to current conditions. As discussed for groundwater above, relocating a portion of the historical MacLeod and Hardrock tailings to the new TMF, and implementing an enhanced cover, stability measures and seepage collection for the remaining historical MacLeod tailings to reduce seepage, provide safety and long-term stability of structures, thereby substantially reducing environmental effects to groundwater and surface water quality from these historical tailings during operation through post closure. When compared with present day baseline conditions, arsenic concentrations in the water of the Southwest Arm of Kenogamisis Lake would increase slightly during operation, returning to near baseline thereafter. This slight increase would be more than offset by substantial decreases in total arsenic concentrations in the waters of Barton Bay East, the Central Basin, and the Outflow Basin during operation, and continuing through post closure. This also reduces potential effects on Aboriginal health conditions for Aboriginal persons that drink surface water from lakes and streams near the Project, and reduces potential effects on fish and wildlife upon which the practice of current use by Aboriginal persons depends heavily.

Particulate deposition (dustfall) on the Goldfield Creek diversion and Southwest Arm of Kenogamisis Lake is anticipated to increase by approximately 1% of the total load, which is a very small contribution (see section 10.4.3 of the Final EIS/EA [Stantec 2017] for additional detail). Residual effects will be monitored as identified in the WMMP (Stantec 2017e). To maintain public safety, access to the PDA will be restricted during construction and continue throughout operation and active closure. Effects on the MacLeod Provincial Park well, which is used for drinking water, are not anticipated as the well is located outside of the effluent mixing zone and outside of the groundwater ZOI.

AZA reported that Elders drink the water from Kenogamisis Lake and there is potential for Kenogamisis Lake to also be used as a drinking water source by other Aboriginal communities. Control and treatment of runoff during construction will limit or eliminate potential exposures of Aboriginal people to chemicals in Project-related particulate matter in runoff water. In the HHERA, Aboriginal/High Use Receptors were assumed to obtain their drinking water from Kenogamisis Lake three days a week and assessed the potential human health risks associated with exposures to metals in drinking water. The hazard quotients for arsenic associated with ingestion of water for the Aboriginal/High Use Receptors are predicted to decrease compared to background as a result of the removal of portions of the historical tailings area adjacent to Barton Bay East. Overall exposures to metals through the consumption of drinking water from Kenogamisis Lake represent a negligible human health risk for Aboriginal people. Project-related rehabilitation measures, such as relocating a portion of the historical MacLeod and Hardrock tailings to the new TMF, and implementing an enhanced cover, stability measures and seepage collection for the remaining historical MacLeod tailings to reduce seepage, are expected to improve overall water quality in Kenogamisis Lake compared to existing conditions, in particular for arsenic. Downstream effects on Long Lake and the drinking water supplies for GFN and LLFN are not anticipated.

7.1.3.4 Change in Noise or Vibration Exposure

This summary of residual changes in noise and vibration exposure incorporates information from the assessment of potential environmental effects on the acoustic environment as presented in Chapter 8.0 of the Final EIS/EA and Section 7.1.2.3 of this report. The information provided by Aboriginal communities was not conducive to a separation of residual effects discussions for each Aboriginal community. Based on available information, and in keeping with the conservative assumptions outlined in Section 3.4 of this report, the discussion below is applicable to all of the identified Aboriginal communities.

As described in detail in Chapter 8.0 of the Final EIS/EA, residual effects on acoustic environment may affect human health conditions, including the health conditions of Aboriginal people.

However, residual environmental effects for the acoustic environment are predicted to be low in magnitude and comply with applicable guideline criteria and thresholds selected for assessment. The blast design is predicted to meet the MOECC's criteria and source-specific mitigation measures were not required.

The noise and vibration levels at each PoI (i.e., special receptors representing areas where Aboriginal traditional land and resource use takes place) are anticipated to be within applicable guidelines.

With respect to the potential for Highway 11 drivers to become startled/distracted by Project-related noise and vibration effects (thereby causing hazardous driving conditions for Aboriginal and other highway users), the open pit is located approximately 500 m from the highway, with waste rock and overburden storage providing a buffer in-between; therefore, blasting is not expected to be noticeable by highway users. No residual effects on health conditions for Aboriginal people are anticipated due to exposure to noise or vibration releases from the Project.

7.1.3.5 Change in Well-Being

A discussion of how changes to the environment caused by the Project may affect well-being is not required by the EIS Guidelines; however, this discussion is provided to be responsive to concerns expressed by Aboriginal communities. Changes in well-being may take place through effects on tangible and intangible values. AFN anticipates that negative impacts on the land and limitations to land-based activities would change social cohesion, culture, as well as mental and emotional well-being. GFN identified potential negative aspects of mining development on well-being including reduced connection to culture and traditional land use as a result of hunting and gathering being more difficult and decreased quality and quantity of traditional foods and medicines. GFN noted that this loss of connection to culture can also result in substance abuse and worsen existing social and health effects of substance abuse. BN also identified potential for effects to community health and well-being through changes to social, cultural, mental and physical health. Based on comments from Aboriginal communities, the CEA Agency noted that effects of the Project may cause grief. These statements identify potential effects to both tangible and intangible values associated with well-being. Negative effects on the land and restrictions to land-based activities including hunting and gathering becoming more difficult and decreased quality and quantity of traditional foods and medicines are potential changes to tangible values. These changes are related to quantifiably measurable items such as changes in areas of cleared land, wildlife, vegetation and fish, and access conditions. Loss of connection to culture, decreased social cohesion and changes to mental or emotional health are potential changes to intangible values, as these items are conditional and experiential and cannot be observed or quantified in the same way.

Mitigation has been developed to address potential effects on both tangible and intangible values related to well-being. Negative effects on land and restrictions to land-based activities are effects to tangible values and are primarily addressed through Project design and siting, as the Project is a redevelopment of a previously disturbed brownfield site. Application of the mitigation measures presented in Section 6 of this report, such as limiting the construction footprint and the number of watersheds overprinted by the PDA, will also mitigate negative effects on the land. As discussed in Section 7.1.2.1.1 above, residual environmental effects on human health, including country foods, were identified as not significant for the Aboriginal/High Use receptor. Expansion of the Conceptual AMMP to obtain data on species Aboriginal communities have identified as being traditionally important and GGM's participation in a potential MNRF-led moose health study with local Aboriginal communities will also help address residual effects on country foods.

It is acknowledged that effects to intangible values are not quantifiable in the same way that effects to tangible values are; therefore, identifying proven and effective mitigation measures for intangible values has limitations. However, since tangible and intangible values are often connected, mitigation measures aimed at avoiding or reducing effects to tangible values could also help to avoid or reduce effects to intangible values. Loss of connection to culture, decreased social cohesion, and changes to mental or emotional health would be personal, subjective, and ultimately unmeasurable changes to well-being. The possibility of encountering residual Project effects that would change well-being will be reduced through careful Project design and application of mitigation measures presented in Section 6 of this report. However, in light of the subjective nature of intangible values, it is difficult to evaluate the how effective the mitigation might be. Residual effects will be managed through application of the environmental monitoring program and monitored through ongoing engagement with Aboriginal communities. Should residual effects of the Project on well-being be identified by Aboriginal communities as an ongoing concern, there are several mechanisms through which those effects may be mitigated. The environmental management and monitoring plans may be adapted based on feedback from Aboriginal communities. GGM has proposed to form Aboriginal Environment Committee(s) though which additional mitigation may be developed. GGM can also provide support for Aboriginal communities to continue cultural practices through TK studies or other efforts to maintain intangible component of well-being. Through these tangible and collaborative mechanisms, GGM will be able to work with Aboriginal communities to reasonably address concerns about effects to intangible values, should they arise during the Project.

7.1.4 Significance Determination for VCs Related to Aboriginal Health Conditions

Each of the environmental effects assessments for the VCs that are related to Aboriginal health conditions (Table 3-2 of this report) concluded that Project-related changes would not be significant. Below is a discussion of the determinations of significance made by each VC (and where appropriate, cross-referenced VCs) and how they relate to Aboriginal health conditions.

7.1.4.1 Change in Air Quality

The Human and Ecological Health VC defined a significant adverse residual environmental effect as one that results in the chemical exposures that are predicted to exceed objectives established by the relevant regulatory organization(s), and are likely to result in a long-term, substantive change in the health of the identified receptor(s). Health risks for most COPCs are not anticipated to exceed regulatory thresholds and where exceedances are predicted, this exceedance is due to baseline conditions. When considering the future case, some inhalation exposures are predicted to exceed the regulatory thresholds. These predicted exceedances are based on single events and do not represent continuous exposures that would represent potential concerns for human health. Residual effects on human and ecological health not anticipated to result in a long-term, substantive change in the health of the identified receptor(s) and have been determined to be not significant. The assessment of human and ecological health considered effects on Aboriginal people by including an Aboriginal/High Use Receptor at 17 additional special receptors which represented areas of TLRU where Aboriginal people may be exposed to Project-related air emissions. The residual effects on human health conditions, including the Aboriginal/High Use Receptor, were determined to be not significant.

7.1.4.2 Change in Quality and Availability of Country Foods

a) Quality of Country Foods

The Human and Ecological Health VC defined significant adverse residual environmental effect as one that results in the chemical exposures that are predicted to exceed objectives established by the relevant regulatory organization(s), and are likely to result in a long-term, substantive change in the health of the identified receptor(s). Project-related residual effects on human health via an ingestion pathway are not anticipated to result in a long-term, substantive change in the health of the identified Aboriginal receptors and have been determined to be not significant. The assessment of human and ecological health considered effects on Aboriginal people by including an Aboriginal/High Use Receptor. The residual effects on human health conditions, including the Aboriginal/High Use Receptor, were determined to be not significant.

b) Availability of Country Foods

The Traditional Land and Resource Use VC determined that the residual environmental effects of the Project on TLRU were not significant because they would not result in the long-term loss of availability of traditional use resources relied on for traditional use practices or the permanent loss of traditional use sites and areas in the Traditional Land and Resource Use LAA and RAA. The TLRU VC assessment referenced the conclusions for the Fish and Fish Habitat, Wildlife and Wildlife Habitat and Vegetation Communities VC assessments when determining the significance of residual effects on the availability of harvested species. The residual effects on Fish and Fish Habitat, Wildlife and Wildlife Habitat and Vegetation Communities were all determined to be not significant. With respect to Aboriginal health conditions, it follows that residual effects on the long-term persistence or viability of fish, wildlife and plant species, including species harvested as country foods, are also determined to be not significant.

7.1.4.3 Change in Drinking Water Quality or Quantity

The Human and Ecological Health VC defined a significant adverse residual environmental effect as one that results in the chemical exposures that are predicted to exceed objectives established by the relevant regulatory organization(s), and are likely to result in a long-term, substantive change in the health of the identified receptor(s). Health risks for most COPCs are not anticipated to exceed regulatory thresholds and where exceedances are predicted, this exceedance is due to baseline conditions. Residual effects on human and ecological health are not anticipated to result in a long-term, substantive change in the health of identified receptors, including Aboriginal receptors, and have been determined to be not significant.

7.1.4.3.1 Groundwater – Drinking Water Quality or Quantity

Two significance thresholds were established for the assessment of changes in groundwater: one for changes in groundwater quantity and one for groundwater quality. The following Project-related residual effects on groundwater would be characterized as significant:

- a reduction in the yield (productivity) of an existing water supply well such that it no longer meets the needs of the current users.
- a degradation of the quality of groundwater such that one or more of the health-based standards specified in the *Ontario Drinking Water Quality Standards under the Safe Drinking Water Act* to the extent that a water supply well no longer meets the needs of current users or land owners.

Project-related residual effects on groundwater were found to be not significant as the current users needs for groundwater will be met; therefore, with respect to Aboriginal health conditions, it follows that residual effects on groundwater use by Aboriginal people are also not significant. Even though groundwater wells can be used as a sources of drinking water, no groundwater wells are located within the Project predicted ZOI and resource effects on groundwater were determined to be not significant.

7.1.4.3.2 Surface Water – Drinking Water Quality or Quantity

The assessment of changes in surface water also established two significance thresholds: one for changes in surface water quantity and/or flow and one for surface water quality. Residual effects on surface water would be characterized as significant in the event that:

- Surface water quantity is consistently above existing flooding maximums and that affects other users including damage to infrastructure or long-term effects to riparian rights access and domestic uses, or below minimum environmental flow that affects aquatic ecosystems during fish spawning seasons, over winter and/or during other low flow periods, or affects the uses of local communities.

- Surface water quality which consistently exceeds regulatory criteria or guidelines[2], affects the continued viability of the ecosystem or the uses of local communities, degradation from baseline conditions which may result in effects related to human and ecological health at lower thresholds than the PWQO.

Project-related residual effects on surface water were below these thresholds and have been characterized as not significant; therefore, with respect to Aboriginal health conditions, it follows that residual effects on surface water use by Aboriginal persons are also not significant, as residual effects on surface water quality and quantity in local streams and lakes, including all basins of Kenogamisis Lake which were identified as potential sources of a drinking water by Aboriginal communities, have been characterized as not significant.

7.1.4.4 Change in Noise or Vibration Exposure

The environmental effects assessments for acoustic environment considered effects on Aboriginal people by including 17 additional special receptors which represented areas of TLRU where Aboriginal people may be exposed to Project-related air emissions, noise, or vibration. The assessments of the atmospheric environment and acoustic environment found residual effects for all receptors to be not significant; therefore, therefore, with respect to Aboriginal health conditions, it follows that residual effects on noise, or vibration in areas which are used by Aboriginal people are also not significant.

7.1.5 Overall Summary and Determination of Significance for Aboriginal Health Conditions

The individual VCs discussed above concluded that the Project-related environmental effects to those VCs were not significant. Those VCs informed the discussion in relation to Key Topics associated with effects of changes to the environment on Aboriginal health conditions. The possibility of residual Project effects on well-being may be reduced though careful Project design and the mitigation measures identified through these related VC assessments (also presented in Section 6 of this report). Residual effects on intangible values will be managed through the development and implementation of the environmental management and monitoring plans, creation of Aboriginal Environment Committee(s), and GGM's support of cultural practices, among other commitments listed in Section 6.3 of this report. Through these tangible and collaborative mechanisms, GGM will be able to work with Aboriginal communities to reasonably address concerns about effects to intangible values, should they arise during the Project.

Therefore, and in consideration of identified mitigation, the context of the Project being located in large part on brownfield conditions with an ability to carry out enhanced reclamation of historical tailings that affect the main local resource (Kenogamisis Lake) under baseline

[2] See Section 10.1.7 of the Final EIS/EA (Stantec 2017d) for additional information about the threshold set for determining Project-related significant residual effects on water quality.

conditions, information provided by Aboriginal communities, and specific consideration of how the effects of those changes to the environment might affect Aboriginal health conditions, the residual effects of changes to the environment on Aboriginal health conditions are characterized as not significant for all Project phases.

7.2 ABORIGINAL SOCIO-ECONOMIC CONDITIONS

7.2.1 Introduction

As required by the EIS Guidelines, this section provides a description and analysis of how changes to the environment caused by the Project may affect Aboriginal socio-economic conditions. The analysis includes discussion of the following:

- change in use of navigable waters
- change in forestry and logging operations
- change in commercial fishing, hunting, trapping, gathering and guide outfitting
- change in recreation
- change in labour and economy
- change in community services and infrastructure

This section first summarizes, at a high level, the main findings and conclusions for relevant VCs and then provides GGM’s conclusions regarding the overall characterization of residual effects on Aboriginal socio-economic conditions based on those VC findings.

7.2.2 Summary of Findings for Relevant Valued Components

7.2.2.1 Assessment of Residual Environmental Effects on Land and Resource Use

As described in Chapter 16.0 of the Final EIS/EA, Project activities construction, operation and closure phases are anticipated to have residual effects on activities and associated infrastructure related to the use of land and resources. The analysis in Chapter 16.0 of the Final EIS/EA is divided into the following categories:

a) Change in Recreation Land and Resource Use
b) Change in Commercially-based Land and Resource Use
c) Change in Navigation

Further information on the findings in each of these categories and the sub-topics within each category is provided below.

a) Change in Recreational Land and Resource Use

The analysis of change in recreational land and resource use within Section 16.4.2 of the Final EIS/EA is divided into the following sub-topics:

i. Decrease in the availability of hunting areas and wildlife;

ii. Decrease in the availability of fishing areas or fishing resources;

iii. Loss of recreation areas or change in access;

iv. Removal of 10.6 km of snowmobile trails and 1.4 km of hiking trails; and

v. Sensory disturbance to land and resource users.

Further information on the findings in each of these sub-topics is provided below.

(i) Decrease in the Availability of Hunting Areas and Wildlife

GGM is required to restrict access to the PDA so that mining activities can be carried out safely. Although access to the PDA will be restricted, the removal or restriction of areas considered appropriate for hunting is conservatively estimated at 1,950 ha, slightly less than the total PDA of 2,200 ha. In addition to the removal of wildlife habitat, the Project may result in avoidance or under-utilization of habitat by wildlife within 200 m of the PDA due to sensory disturbance and the disruption to wildlife movement patterns within and across the Land and Resource Use LAA.

Residual effects on availability of hunting areas and wildlife are anticipated to be adverse as the removal of wildlife habitat and the imposition of access restrictions to the PDA will result in the loss of areas for hunting and the Project may cause sensory disturbance, mortality risk and disruption of wildlife movement corridors thereby reducing the availability of wildlife resources. This decrease in the availability of hunting areas or wildlife resources is anticipated to take place construction, operation, and active closure and to reduce the ability to undertake hunting in the PDA and up to 200 m beyond the PDA. Seasonal aspects are unlikely to alter the residual environmental effect on recreational hunting, since effects will be restricted to the hunting season and therefore seasonality is implicitly considered in the assessment. Removal of hunting areas within the PDA will take place once during site preparation. Sensory disturbance and change in mortality risk and change in movement patterns will occur continuously throughout construction, operation and active closure. The residual effect is likely to be reversed following active closure when access restrictions to most the PDA are lifted; wildlife habitat is restored and new wildlife movement patterns are established. This residual effect is anticipated to will take place in a typical ecological and socio-economic context as hunting areas are considered common and widely available to the community. Additional information on this residual environmental effect characterization is provided in Table 16-17 of the Final EIS/EA.

(ii) Decrease in the Availability of Fishing Areas or Fishing Resources

Access to fishing areas located within the PDA will be restricted throughout construction, operation and active closure. Although Goldfield Creek, the Southwest Arm Tributary and Lake SWP-3 support game fish, these areas are not documented fishing areas. In addition, fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek diversion. Overall, there will be no net loss of areas for fishing as a result of the Project. Removal of the public access points along the Southwest Arm of Kenogamisis Lake is predicted to prevent anglers from launching their shelters for ice fishing into the Southwest Arm because there is currently no other appropriate location for launching a shelter available on this portion of Kenogamisis Lake. However, access to Kenogamisis Lake is available from two other boat launches, located on Barton Bay East and the Outlet Basin.

Residual effects on availability of fishing areas or fishing resources are anticipated to be adverse as the removal of the public access points and closure of Lahtis Road may result in the loss of access to ice fishing areas in the Southwest Arm. The decrease in access to areas for fishing is predicted to extend beyond the PDA and take place throughout the year. The loss of access to ice fishing from the Southwest Arm of Kenogamisis Lake will start in construction and continue beyond active closure; however, access to the Southwest Arm of Kenogamisis Lake will be maintained, and while this has conservatively not been considered in the assessment, maintaining this access will assist in mitigating the effect of loss of access. The residual adverse effect is considered moderate in magnitude as the reduced access is predicted to diminish but not eliminate the ability to undertake fishing activities. The residual environmental effect is anticipated to be reversed at the end of active closure, when access restrictions to fishing areas within the PDA will be removed with the exception of permanent Project components such as the open pit. These residual effects will take place in a typical ecological and socio-economic context as fishing areas are considered common and widely available to the community. Additional information on this residual environmental effect characterization is provided in Table 16-17 of the Final EIS/EA.

(iii) Loss of Recreation Areas or Change in Access

The closure of Lahtis Road will alter access to recreational areas located southwest of the PDA (however, this area may be accessed via Goldfield Road), and adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. This includes the Crown land campsite and public access points (boat launch areas are also used for launching ice fishing huts). At closure, Lahtis Road is anticipated to be re-opened to the Goldfield Creek diversion. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation.

Residual effects on recreation area and access are anticipated to be adverse as the Project will result in the loss of access to the Southwest Arm of Kenogamisis Lake through the closure of Lahtis Road and the removal of a crown land campsite and two access points to Kenogamisis

Lake. These effects are anticipated to reduce but not eliminate the ability to undertake recreational activities. Loss of recreation areas and change in access is anticipated to occur year-round and take place continuously. Existing recreation areas in the PDA will be permanently removed however at closure public access will resumed with the anticipated re-opening of Lahtis Road. Overall the residual environmental effect is anticipated to be reversed at the end of active closure and is taking place in a typical ecological and socio-economic context as recreational areas are considered common and widely available to the community. Additional information on this residual environmental effect characterization is provided in Table 16-17 of the Final EIS/EA.

(iv) Loss of Recreational Trails

The Project is predicted to result in the long-term removal of approximately 10.6 km of snowmobile trails and 1.4 km of the Barton Bay Wildlife Trail in the PDA. Considering the portion of snowmobile trail to be removed has not been maintained for the past several years and the Municipality of Greenstone may relocate the hiking trail, the removal of trails within the PDA is not predicted to reduce the ability for recreational users to undertake hiking and snowmobiling.

The loss of recreational trails within the PDA is considered adverse and PDA is predicted to reduce the ability to undertake hiking and snowmobiling in the PDA. Based on discussions with the Greenstone Snowmobile Club, removal 10.6 km of snowmobile trails is not anticipated to remove access to other trails outside of the PDA. Residual effects are anticipated to persist throughout construction, operation and active closure, but may be reversed at the end of active closure, when access restrictions would be removed from the PDA. The removal of the trails will be a single event during site preparation which will not vary seasonally. This residual effect is anticipated to take place within typical ecological and socio-economic context as recreational areas are considered common and widely available to the community. Additional information on this residual environmental effect characterization is provided in Table 16-17 of the Final EIS/EA.

(v) Sensory Disturbance to Land and Resource Users

Project-related emissions of particulate matter (dustfall) are predicted to meet regulated requirements except for a small area close to the PDA where the exceedance will be infrequent (i.e., no more than 0.1% of the time). The WRSAs and forested areas are predicted to act as a barrier to light from the process plant and mobile equipment. The Project's effect on ambient lighting is predicted to be below the relevant Commission Internationale de L'Éclairage (or International Commission on Illumination) Guideline levels.

Predicted increases in Project-related noise and vibration will comply with applicable regulations. In general, the predicted sound levels for the areas adjacent to PDA will be characteristic of a rural environment. Exceptions include the area along the shoreline of Southwest Arm of Kenogamisis Lake adjacent to the PDA where sounds levels are predicted to be between 45 to 50 decibels, which is considered consistent with the hum from an urban environment. A discussion of the predicted sounds and vibration levels is presented in chapter 8.0 of the Final EIS/EA. Sensory disturbance to users due to Project-related emissions outside of the PDA is not anticipated.

Changes to the visual setting will commence during construction with the start of vegetation clearing, timber harvesting and the construction of Project components. Changes to the viewscape will continue throughout the operation phase with the development of the tailings management facility (TMF) and waste rock storage areas (WRSAs). These two Project components are predicted to be the most visually prominent features. Users of the recreational trail and day-use area (including the beach) within MacLeod Provincial Park will see the WRSAs from vantage points within the Park. The viewscape will be permanently altered to varying degrees due to the WRSAs and TMF. From other vantage points in the LAA for land and resource use, Project components may not be visible or will be only partially visible relative to the existing landscape. The existing visual character of the PDA has been affected by mining, forestry and development over the past 90 years.

Sensory disturbance resulting from changes to the viewscape may affect recreational users and are considered adverse. The residual effect is predicted to change the land user experience outside of the PDA. Changes to the visual landscape will be continuous, extend beyond closure, and permanent. This residual effect is anticipated to take place within typical ecological and socio-economic context as the local environment that has been disturbed by mining, forestry and development over the past 90 years. Additional information on this residual environmental effect characterization is provided in Table 16-17 of the Final EIS/EA.

b) Change in Commercially-based Land and Resource Use

The analysis of Commercially-based Land and Resources use within Section 16.4.3 of the Final EIS/EA is divided into the following sub-topics:

i. Trapping, Guide Outfitting, and Bait Harvesting
ii. Sensory disturbance to commercial land and resource users
iii. Timber Harvesting and Resource Extraction Activities

Further information on the findings in each of these sub-topics within change in commercial land and resource use is provided below.

i. Trapping, Guide Outfitting, and Bait Harvesting

The Project will result in the restricted access to or loss (removal due to site clearing) of areas for harvesting for tenure holders in the PDA. However, this loss or restricted access to harvesting areas in the PDA includes areas where harvesting would be impractical or unlawful, such as in the urban settlement, private property, and golf course. The loss of area will vary for each of the affected trapline, guide outfitter and bait harvesting areas (Final EIS/EA Section 16.4.3.3 and

Figure 16-2). See Section 7.2.7 of this report for discussion of specific loss areas for Aboriginal trapline and tenure holders.

Access to harvesting areas located in the LAA for land and resource use may be altered by the closure of Lahtis Road at the start of construction. Access via Goldfield Road will be maintained see Final EIS/EA Section 16.4.3.3.

A change in the availability of wildlife resources due to sensory disturbance or a change in wildlife movement patterns could reduce the ability to undertake hunting in the LAA (see Final EIS/EA, Section 16.4.3.3). Changes in trapping, guide outfitting and bait harvesting is considered adverse as the removal of wildlife habitat and access restrictions for safety will result in a loss of areas for trapping, guide outfitting and bait harvesting and associated access. Project activities during construction, operation and active closure are also anticipated to reduce the availability of wildlife resources due to avoidance. Residual effects from a change in access to harvesting areas are anticipated to occur year-round and extend beyond the PDA. Removal of trapping, guide outfitting, and baitfish tenure areas will take place as a single event during construction, however access restrictions will be long-term and continuous extend beyond active closure. Following active closure, it is anticipated that access to most of the PDA will be available for commercial harvesting. This residual effect is anticipated to take place within typical ecological and socio-economic context as trapping, guide outfitting and baitfish tenure areas are considered common and widely available to the community. Additional information on this residual environmental effect characterization is provided in Table 16-17 of the Final EIS/EA.

ii. Sensory Disturbance to Commercially-Based Resource Users

Commercially-based harvesting activities may be affected by sensory disturbance in particular to clients of guide outfitting services. The remoteness and quality of the guide outfitting experience are valued; therefore, although the Project is not located in a remote location, construction activities may decrease interest in outfitting services in the vicinity of PDA especially if more intact landscapes and fish and wildlife habitats can be accessed elsewhere within the harvesting tenure areas and without increasing travel distance for users. As stated in Section 16.4.3.3 of the Final EIS/EA, sensory disturbance to users due to Project-related emissions (e.g., dust, light, noise and vibration) in the Land and Resource Use VC LAA is not anticipated. However, changes in the visual setting in the LAA are predicted due to the WRSAs and TMF.

Sensory disturbance resulting from changes to the viewscape may affect commercial land users and are considered adverse. The residual effect is predicted to change the land user experience outside of the PDA. Changes to the visual landscape will be continuous, extend beyond closure, and permanent. This residual effect is anticipated to take place within typical ecological and socio-economic context as the local environment that has been disturbed by mining, forestry and development over the past 90 years. Additional information on this residual environmental effect characterization is provided in Table 16-17 of the Final EIS/EA.

iii. Timber Harvesting

The Project will result in a very small (0.2%), long-term and irreversible reduction in the forested land base and loss of area associated with forest management activities in the Kenogami forestry management unit (FMU). Planned harvest areas identified within the Kenogami Forest Management Plan have received EA approval for removal of timber. Ne-Daa-Kii-Me-Naan Inc. has the first right of refusal to harvest the timber. Through discussions with Ne-Daa-Kii-Me-Naan Inc., GGM will enter into an Overlapping Agreement to harvest under Ne-Daa-Kii-Me-Naan Inc.'s pulp mill licence. For removal of timber on Crown land which is not included in the Kenogami Forest Management Plan (see Figure 16.6 in the Final EIS/EA), GGM will obtain a Forest Resource Licence from MNRF. Access to other planned harvest areas within the LAA for land and resource use will continue.

Residual effects on timber harvesting is anticipated to be adverse as the PDA overlaps approximately 342 ha of planned harvesting area within the Kenogami FMU for the period from 2011 to 2021. Removal of timber will reduce but not eliminate the practice of timber harvesting and effects will be limited to the PDA. The removal of harvest areas during construction as a single event will have permanent residual effects as the PDA is not anticipated to return to a productive forest. This residual effect is anticipated to take place within typical ecological and socio-economic context as the timber harvesting area proposed for removal comprises less than 1% of the total planned harvesting area within the FMU. Additional information on this residual environmental effect characterization is provided in Table 16-17 of the Final EIS/EA.

c) Change in Navigation

As discussed in Section 16.4.4 of the Final EIS/EA, none of the watercourses in the Land and Resource Use (LRU) LAA are listed on the *Navigation Protection Act* schedule of navigable waters and navigation within the PDA has not been observed or identified through consultation or TK and TLRU studies. However, it has been conservatively assumed that navigation is possible in the PDA on Goldfield Creek, the Southwest Arm Tributary (downstream of SWP3), and SWP3 see Section 16.4.4 and Figure 16-3 of the Final EIS/EA.

During construction, operation, and active closure, safety-related access restrictions will prevent use of watercourses in the PDA. Navigation, if it occurs, could also be affected by the installation of watercourse crossings within the Southwest Arm Tributary and the Goldfield Creek Tributary – North Branch (downstream of Lake A-322); see Figure 16-3 of the Final EIS/EA. Following active closure, watercourse crossings will be removed and access restrictions to the PDA will be lifted. Allowing for navigation of the Goldfield Creek diversion and Southwest Arm Tributary. Goldfield Creek and the Southwest Arm Tributary are currently only navigable by small vessels such as canoes or kayaks and include a number of barriers (e.g., beaver dams and vegetation obstructions); navigation will still be possible with obstacles for these types of watercraft (see Section 16.4.4.3 of the Final EIS/EA).

Although there has been no confirmed use of Goldfield Creek for navigation, the diversion will permit navigation by small vessels such as canoes or kayaks, with obstacles (e.g., beaver dams and vegetation obstructions), between Goldfield Lake and the Southwest Arm of Kenogamisis Lake following closure. It is conservatively assumed that the change in the Goldfield Creek channel alignment could pose an inconvenience to potential users; see Section 16.4.4.3 of the Final EIS/EA.

Residual effects on navigation are anticipated to be adverse as the Project will create obstacles to navigation and change a route that may pose an inconvenience to potential users. Navigation will still be possible with obstacles on waterways within the PDA and the Southwest Arm of Kenogamisis Lake and these changes to navigation will extend beyond closure. Effect will take place continuously but will be more noticeable in spring/summer/fall when watercourses are not frozen. The change in channel alignment between the Southwest Arm of Kenogamisis Lake and Goldfield Lake via Goldfield Creek will be permanent. This residual effect is anticipated to take place in an atypical ecological and socio-economic context as the route between the Southwest Arm of Kenogamisis Lake and Goldfield Lake via Goldfield Creek is specific to the area. Additional information on this residual environmental effect characterization is provided in Table 16-17 of the Final EIS/EA.

7.2.2.1.1 Conclusions for Chapter 16 of the Final EIS/EA: Assessment of Potential Environmental Effects on the Land and Resource Use

Residual effects on recreational and commercially-based land and resource use include direct loss of areas within the Project development area, and changes in access to sites within the local assessment area. Sensory disturbance may also affect wildlife resources and recreational/commercial users. Residual effects on the availability of recreational and commercially-based land and resource use areas are likely to be partially reversed following active closure when access restrictions to portions of the Project development area are lifted.

The Project will create obstacles to navigation and access to waterways in the Project development area will be restricted during construction and operation due to safety concerns. Although there has been no confirmed use of Goldfield Creek for navigation, the diversion will change the channel alignment but permit navigation by small vessels such as canoes or kayaks, with obstacles (e.g., beaver dams and vegetation obstructions), between Goldfield Lake and the Southwest Arm of Kenogamisis Lake following closure. Residual environmental effect on Land and Resources use were characterized as not significant for both Aboriginal and non-Aboriginal land users.

7.2.2.2 Assessment of Residual Environmental Effects on Labour and Economy

As described in Chapter 14.0 of the Final EIS/EA, expenditures and employment associated with Project activities are predicted to affect local, regional, and provincial economic conditions through all phases of the Project. The analysis in Chapter 14.0 of the Final EIS/EA is divided into two categories: Change in Labour, and Change in Economy. Further information on the findings in both of these categories and the sub-topics within each category is provided below.

a) Change in Labour

The analysis of change in labour within Section 14.4.2 of the Final EIS/EA is divided into the following sub-topics which align with Project phases.

i. Construction
ii. Operation
iii. Closure

Further information on the findings in each of these sub-topics within change in labour is provided below.

i. Construction

As discussed in Section 14.4.2 of the Final EIS.EA, direct employment during construction is anticipated to have positive residual effects by creating on average, 650 person years of employment each year. The effect is expected to be low in magnitude given the small construction labour force and the high rate of unemployment. Construction is expected to provide direct employment for residents of the Labour and Economy RAA, see Figures 14-1 and 14-2 in the Final EIS/EA. The direct employment will be continuous and extend throughout the operation phase. Seasonal aspects are unlikely to affect direct employment during construction. The residual environmental effect is likely to be reversed after the operation phase is completed and workers leave the area to seek employment elsewhere. This residual effect is anticipated to take place in a stable economy where the labour force has moderate diversity and can accommodate many of the demands of the Project.

ii. Operation

As discussed in Section 14.4.2 of the Final EIS/EA, direct employment during operation construction is anticipated to have positive residual effects by creating, on average, 450 person years of employment each year. The positive effect is anticipated to be high in magnitude in the LAA, where the Project would increase the size of the labour force by 10%. Effects are anticipated to extent to the Labour and Economy LAA/RAA (see Figures 14-1 and 14-2 in the Final EIS/EA) as residents in the LAA/RAA will account for over half of the Ontario portion of the labour force. The direct employment will be continuous and extent throughout the operation phase. The residual environmental effect is likely to be reversed after the operation phase is completed and workers leave the area to seek employment elsewhere. This residual effect is anticipated to take place in a stable economy where the labour force has moderate diversity and can accommodate many of the demands of the Project.

iii. Closure

As discussed in Section 14.4.2 of the Final EIS/EA, the closure of the Project after its final year of operation is anticipated to have an adverse effect as it will result in the loss of 450 positions. The effect is anticipated to be moderate in magnitude as this change is unlikely to pose a serious risk or represent a management challenge for labour within the Labour and Economy LAA (see Figure 14-1 in the Final EIS/EA). Employment will be gradually ramped down over a period of several years and will take place from the end of operation extending throughout the closure phase. The loss of direct employment will be permanent and is anticipated to occurs in a stable economy where the labour force has moderate diversity and can accommodate many of the demands of the Project.

Direct employment from closure activities is anticipated to have positive residual effects by creating approximately 40 person-years of employment during the active closure phase. Given the small labour force required for active closure activities in relation to the workforce, the magnitude is expected to be low. Direct employment during active closure is estimated to provide direct employment for residents of the Labour and Economy RAA (see Figure 14-2 in the Final EIS/EA). The direct employment will be continuous but limited to the closure phase and reversed after the active closure phase is completed. The residual environmental effect occurs in the future so that the resiliency of the economy to accommodate such changes is unknown because it is impossible to predict economic conditions at that time.

b) Change in Economy

As discussed in Section 14.4.3 of the Final EIS/EA, Project closure will have a net adverse effect on local and regional businesses, with the long-term loss of business associated with operation being partially offset in the short term by Project purchases of goods and services needed for active closure activities. GGM will work with local Aboriginal communities, local communities and government agencies to develop a strategy for addressing adverse economic implications of Project closure.

The analysis of change in economy within Section 14.4.3 of the Final EIS/EA is divided into the following sub-topics which align with Project phases.

i. Construction
ii. Operation
iii. Closure – Project expenditures
iv. Closure - Loss of Project expenditures

Further information on the findings in each of these sub-topics within change in economy is provided below.

i. Construction

During construction, Project spending is expected to have a positive effect on local and regional businesses through the acquisition of goods and services and by creating employment for businesses. Project expenditures at local and regional businesses during operation will extend into the Labour and Economy LAA and RAA (see Figures 14-1and 14-2 in the Final EIS/EA). When measured against the current labour force in non-basic industries, this effect will be low in magnitude as it will be at or near baseline conditions. Project expenditures at local and regional businesses will be continuous but limited to the construction phase and the effect is likely to be reversed after the closure phase is completed. The residual environmental effect occurs in a stable economy where the labour force has moderate diversity and can accommodate many of the demands of the Project.

ii. **Operation**

During operation, Project spending is expected to have a positive effect on local and regional businesses through the acquisition of goods and services and by creating employment for businesses. Project expenditures at local and regional businesses during operation will extend into the Labour and Economy LAA and RAA (see Figures 14-1and 14-2 in the Final EIS/EA). When measured against the current labour force in non-basic industries, this effect is anticipated moderate in magnitude as it is a measurable change but it unlikely to provide a serious benefit for the economy. Project expenditures at local and regional businesses will be continuous but limited to the operation phase and the effect is likely to be reversed after the closure phase is completed. The residual environmental effect occurs in a stable economy where the labour force has moderate diversity and can accommodate many of the demands of the Project.

iii. Closure -Project Expenditures

During closure, Project purchases and expenditures are expected to have a positive effect on local and regional businesses through the acquisition of goods and services. Project expenditures at local and regional businesses during operation will extend into the Labour and Economy LAA and RAA (see Figures 14-1and 14-2 in the Final EIS/EA). When measured against the current labour force in non-basic industries, this effect will be low in magnitude as it will be at or near baseline conditions. Project expenditures at local and regional businesses will be continuous but limited to the closure phase and the effect is likely to be reversed after the closure phase is completed. The residual environmental effect occurs in a stable economy where the labour force has moderate diversity and can accommodate many of the demands of the Project.

iv. Post Closure -Loss of Project Expenditures

The loss of Project expenditures at local and regional businesses following Project closure will result in an adverse effect. Project expenditures at local and regional businesses during operation will extend into the Labour and Economy LAA and RAA (see Figures 14-1and 14-2 in the Final EIS/EA). When measured against the current labour force in non-basic industries, this effect will be low in magnitude as it will be at or near baseline conditions. Project expenditures at local and regional businesses will be continuous, is expected to extend beyond the closure phase and will be permanent. The residual environmental effect occurs in the future so that the resiliency of the economy to accommodate such changes is unknown because it is impossible to predict economic conditions at that time.

7.2.2.2.1 Conclusions for Chapter 14 of the Final EIS/EA: Assessment of Potential Environmental Effects on Labour and Economy

The overall Project effect is positive given the direct, indirect, and induced effects of Project expenditures, and such things as the consequent increases in the size of the labour force, household incomes and reductions in the unemployment rate. While Project closure will result in adverse effects on labour, on local and regional businesses, they are a normal part of the mining life cycle and skills acquired through training and employment during Project operation are highly transferable. It is expected that the Project will result in positive effects on labour and GGM has committed to implementing various mechanisms for enhancing Project benefits to increase Aboriginal participation in the economic benefits of the Project

Key benefits in the local assessment area during Project operation are as follows:

- the unemployment rate (16.5% in 2011) is estimated to be reduced by more than six percentage points (to the equivalent of 9.7% in 2011)
- Project spending on wages and salaries (including benefits) during operation is estimated to be $48 million per year
- expenditures on goods and services is estimated to be approximately $480 million during Project construction, operation, and active closure.

Residual environmental effects on labour and economy were identified as not significant.

7.2.2.3 Assessment of Residual Environmental Effects on Community Services and Infrastructure

As described in Chapter 15.0 of the Final EIS/EA, in-migration of Project workers and their families, Project-related business growth and Project activities are anticipated to have residual effects on community services and infrastructure. The analysis in Chapter 15.0 of the Final EIS/EA is divided into the following categories

a) Housing and Accommodations,

b) Municipal and Provincial Services and Infrastructure,

c) Transportation services, all users (Aboriginal and non-Aboriginal).

As identified in Chapter 15, anticipated residual effects apply to all users, both Aboriginal and non-Aboriginal. Further information on the findings in each of these categories and the sub-topics within each category is provided below.

a) Housing and Accommodations

As discussed in Section 15.4.2 of the Final EIS/EA, the removal of existing MacLeod Townsite and Hardrock Townsite housing, located in the PDA, is not expected to have an effect on capacity of housing in the LAA/RAA for Community Services and Infrastructure, given the small number of units involved (49) and available housing stock elsewhere in the Community Services and Infrastructure, LAA/RAA. It is expected that the majority of construction workers will live in the temporary camp during construction. For operation, an estimated 350 workers are expected to move to the Community Services and Infrastructure LAA/RAA from other locations. Population decline in the area has led to an abundant supply of vacant residential properties in Greenstone, such that there is adequate vacant housing to accommodate Project workers who require a place to live.

The Project is anticipated to have adverse effects by decreasing the available housing and accommodations. The change in capacity of housing and accommodations will be at or near to baseline conditions and is categorized as low magnitude. During construction, the additional demands on housing and accommodations will occur continuously, will be limited to the construction phase and the anticipated to be reversed after the construction phase is completed and workers leave the area to seek work elsewhere. Although all construction workers can be accommodated at the temporary camp, some may choose instead to live in neighbouring communities and the effect is anticipated to extent to the Community Services and Infrastructure LAA/RAA (See Figure 15-1 of the Final EIS/EA). During operation and closure, the residual effect is also anticipated to extent to the Community Services and Infrastructure LAA/RAA as a portion of operation workers will relocate to live within communities located in the Community Services and Infrastructure LAA/RAA. During all Project phases, the residual environmental effects are anticipated to occur in an ecological and socio-economic context with moderate capacity to accommodate increased levels of demand.

b) Municipal and Provincial Services and Infrastructure

The analysis of change in municipal and provincial services and infrastructure within Section 15.4.3 of the Final EIS/EA is divided into the following sub-topics:

- Health Services and Infrastructure
- Police Services
- Fire Services
- Power and Municipal Servicing
- Recreation Services and Infrastructure

- Educational Services and Infrastructure

Separate residual effects characterizations are provided for each of the sub-topics, see Table 15.4.5 of the Final EIS/EA. For the purposes of this summary, sub-topics which have the same residual effects characterizations have are discussed together to minimize repetition.

1. Health Services Infrastructure and Power and Municipal Servicing

Effects on health care demands of Project employees will be managed through a range of initiatives, including health and safety plans and protocols, the Conceptual Emergency Response Plan, an Employee Assistance Plan, and a healthy lifestyle education program. GGM will consult with health agencies to provide Project updates, to support planning for changes in demand for health services. For additional information, see Section 15.4.3.3 of the Final EIS/EA.

As discussed in Section 15.4.3.3 of the Final EIS/EA, there is adequate existing capacity in the Municipality of Greenstone for waste, water and sewer services to handle new demand as a result of Project-related population growth.

Hydro One has confirmed there is sufficient capacity to provide power for the Project during construction. Power for construction activities will be from a temporary grid connection via the local distribution system that currently services the Geraldton area. Heat and power for Project operation will be supplied by an onsite natural gas-fueled power plant and power generation heat recovery distribution systems.

Residual effects are anticipated to be adverse as the Project is likely to cause additional demands on both power and municipal services and health services and infrastructure. The change in capacity of both power and municipal services and health services and infrastructure will be at or near to baseline conditions and has been characterized as low magnitude. The additional demands on both power and municipal services and health services and infrastructure will occur continuously though all phases of the Project and will be reversed following active closure when workers leave the area. The additional demands on both power and municipal services and health services and infrastructure will occur within the Community Services and Infrastructure LAA/RAA (See Figure 15-1 of the Final EIS/EA). These effects are anticipated to take place in a low-capacity socio-economic context as both the existing power and municipal services and health services and infrastructure have limited capacity to accommodate additional demands.

2. Police Services, Fire Services, and Educational Services and Infrastructure

As discussed in Section 15.4.3.3 of the Final EIS/EA, it is assumed that there is capacity to handle increases in demand for policing and fire services; however, GGM will provide Project information upon request to help in preparation efforts for potential Project-related increases in demand.

Effects on fire services in the LAA/RAA for the Community Services and Infrastructure VC will be managed through in-design and environmental protection measures, such as an Emergency Response Plan, additional information is provided in Section 15.4.3.3 of the Final EIS/EA. A Conceptual Emergency Response Plan is provided in Appendix M3 of the Final EIS/EA.

Schools in the LAA/RAA for the Community Services and Infrastructure VC have capacity to accommodate new students, and GGM will provide Project information to school boards upon request to help them prepare for potential Project-related increases in demand for educational services. Additional information is provided in Section 15.4.3.3 of the Final EIS/EA.

The Project is likely to have adverse effects by placing additional demands on police, fire and educational services. The change in demand for police, fire and educational services will be at or near to baseline conditions and has been characterized as low magnitude. The additional demands on police, fire and educational will occur continuously though all phases of the project and will be reversed following active closure when workers leave the area. These additional demands are anticipated to extend to the Community Services and Infrastructure LAA/RAA (See Figure 15-1 of the Final EIS/EA). These effects are anticipated to take place in a moderate-capacity socio-economic context as the police fire and educational have moderate capacity to accommodate additional demands.

3. Recreation Services and Infrastructure

As discussed in Section 15.4.3.3 of the Final EIS/EA, while the influx of construction workers, and operation workers and their family members, will increase, the demand for recreational services and infrastructure, this generally will return demand levels towards those experienced prior to recent population declines. Site preparation activities during construction will lead to the removal of nine holes of the Kenogamisis Golf Club, MacLeod-Cockshutt Mining Headframe, and the Discover Geraldton Interpretive Centre. GGM has committed to avoid using the contingency waste rock storage areas A/C to preserve the golf clubhouse and the front nine holes unless needed.

The Project's removal of nine holes from the Kenogamisis Golf Course, the MacLeod-Cockshutt Mining Headframe and the Discover Geraldton Interpretive Centre will have adverse effects. The change in capacity of recreation services and infrastructure will be at or near to baseline conditions after proposed mitigation and management and have been characterized as low magnitude. The removal of recreation services and infrastructure will occur once during construction and will be limited to the PDA. The residual effect will continue throughout all phases of the Project and will be a permanent removal of this infrastructure. Due to the removal of these three components of recreational infrastructure, the remaining recreation services and infrastructure is anticipated to have a capacity to accommodate additional demands.

c) Transportation Services and Infrastructure

Because the realigned highway will be constructed prior to closure of the existing one, access to the area will be uninterrupted and existing infrastructure will be able to accommodate Project-related traffic increases; see Section 15.4.4.3 of the Final EIS/EA. As identified in the "Traffic Impact Study, Premier Gold Mines Limited, Hardrock Property" (Stantec 2014), Highway 11 is operating well within its capacity. It is anticipated that access to the area will be uninterrupted and existing infrastructure will be able to accommodate Project-related traffic increases. Most non-local construction workers will be housed at the temporary camp and bussed to and from the Project. Bussing and carpooling among locally-resident construction and operation workers will limit daily traffic volumes. The traffic associated with the Project can easily be accommodated at both the Highway 11/Michael Power Boulevard and Highway 11/site access intersections.

The Project is likely to have adverse effects by placing additional transportation services and infrastructure. The change in capacity of transportation services and infrastructure will be at or near to baseline conditions and has been characterized as low magnitude. The additional demands on transportation services and infrastructure will occur continuously though all phases of the project and will be reversed following active closure when workers and their families leave the area. These additional demands are anticipated to extend to the Community Services and Infrastructure LAA/RAA (See Figure 15-1 of the Final EIS/EA). These effects are anticipated to take place in a moderate-capacity socio-economic context as the current transportation services and infrastructure has a moderate capacity to accommodate additional demands.

7.2.2.3.1 Conclusions for Chapter 15 of the Final EIS/EA: Assessment of Potential Environmental Effects Community Services and Infrastructure

Construction workers can be accommodated at the temporary camp. The non-local workforce during operation and closure is expected to reside in the local assessment area at existing accommodations.

Site preparation activities during construction will lead to the removal of some existing recreation facilities in the local assessment area. The future of the municipal facilities that will be removed rests with the Municipality and an agreement has been signed between the Municipality and GGM to support the Municipality's future plans with respect to affected facilities.

It is predicted that increased demand on municipal and provincial services and infrastructure should not result in demands on services or infrastructure above and beyond current capacity such that standards of service are routinely and persistently reduced below current levels for an extended period. The change in capacity of transportation services and infrastructure will be at or near to baseline conditions. Residual environmental effects to Community Services and Infrastructure were identified as not significant.

7.2.3 Summary of Residual Effects Related to Aboriginal Socio-economic Conditions

This section concerns how residual effects may affect Aboriginal socio-economic conditions and focuses on the Key Topics identified in Section 3.1.1 of this report. If changes to Key Topics are anticipated to be unique between Aboriginal communities, those distinctions are addressed.

7.2.3.1 Change in Use of Navigable Waters

This summary of residual effects on change in use of navigable waters incorporates information from the assessment of change in navigation on watercourses affected by the Project as presented in Section 16.4.4.3 of the Final EIS/EA and Section 7.2.2.1 of this report. The information provided by Aboriginal communities regarding their use of navigable waters was not conducive to a separation of residual effects discussions for each Aboriginal community. Based on available information, and in keeping with the conservative assumptions outlined in Section 3.4 of this report, the discussion below is applicable to all of the identified Aboriginal communities.

It is not known if the watercourses within the PDA are used by Aboriginal peoples for navigation. If the watercourse within the PDA are used by Aboriginal peoples the safety related restrictions implemented by the Project may affect patterns of access for Aboriginal people. Aboriginal peoples may also be among the potential users inconvenienced by the change in the navigation route between Goldfield Lake and the Southwest Arm of Kenogamisis Lake, which will be in place following active closure.

LLFN and MNO identified travel along the Southwest Arm of Kenogamisis Lake, although a specific route was not identified. It is not known if other Aboriginal communities use this travel route. If navigation takes place along the western shoreline of the Southwest Arm of Kenogamisis Lake the installation and removal of the treated effluent discharge locations and freshwater intake may temporarily affect navigation. The area will be properly marked and given the width of the Southwest Arm and the small footprint or the work area. LLFN and MNO members or other Aboriginal peoples who may use the area are anticipated to be able to navigate around these activities.

These effects are expected to apply equally to members of identified Aboriginal communities that use areas within the Land and Resource Use LAA.

7.2.3.2 Change in Forestry and Logging Operations

This summary of residual effects on change in forestry and logging operations incorporates information from the loss of timber harvesting land base assessment presented in Section 16.4.3.3 of the Final EIS/EA and Section 7.2.2.1 of this report. Following mitigation Project activities are anticipated to result in loss of timber harvesting land base. Ne-Daa-Kii-Me-Naan Inc. a First Nation-owned forest management company that is operated by a Board of Directors which includes GFN, LLFN, AFN, CLFN, PPFN and AZA holds the enhanced Forest Resource Licence for the Kenogami FMU. As discussed in Section 6.0 of this report, GGM will enter into an Overlapping Agreement to harvest under Ne-Daa-Kii-Me-Naan Inc.'s pulp mill licence. Project related loss of timber harvesting land base is not anticipated to affect the other eight Aboriginal communities engaged on the Project.

7.2.3.3 Change in Commercial Fishing, Hunting, Trapping, Gathering and Guide Outfitting Activities

This summary of residual effects on change in commercial fishing, hunting, trapping, gathering and guide outfitting activities incorporates information from the assessment of: decrease in availability of trapping, guide outfitting and bait harvesting tenure areas, and sensory disturbance to commercial land and resource users, as presented in Section 16.4.3.3 of the Final EIS/EA and Section 7.2.2.1 of this report. The information provided by some Aboriginal communities regarding this topic was conducive to allow for a separation of residual effects discussions for individual Aboriginal communities. In an effort to provide standalone sections for individual Aboriginal communities, these discussions are necessarily repetitive.

a) Animbiigoo Zaagi'igan Anishinaabek

Trapline area GE021 is held by a member of AZA and the Project will result in the loss of 20 ha (less than 1%) of trapline area GE021. The AZA trapline holder may not be able to access harvesting areas previously accessed via Lahtis Road, which may reduce the ability for trapping outside of the PDA. The effect may be greatest during the winter when alternate access via Goldfield Road may not be feasible. Twenty percent (3,182 ha) of trapline GE021 is located within the Land and Resource Use LAA and is anticipated to be affected by localized changes in availability of wildlife resources and disturbance effects. The effect on the availability of wildlife resources will be reversed following completion of active closure when sensory disturbance abates and wildlife movement patterns across the PDA are re-established.

GGM will continue discussions regarding accommodation for the lost trapping area associated with GE021and trapping on GGM's patented lands prior to the start of construction and where there is currently little activity. GGM will also continue to meet with affected tenure holders on a regular basis to discuss issues and concerns and to provide Project updates.

b) Long Lake #58 First Nation

Traplines GE009, GE023 and GE034 are held by members of LLFN. As these three traplines are located outside of the PDA and will not experience a direct loss of trapline areas. The closure of Lahtis Road is not anticipated to affect access to these traplines as alternate access roads are available. Portions of the traplines GE023 and GE034 are located within the Land and Resource Use LAA; less than 1% (197 ha) of GE023 and 11% (2,747 ha) of GE034 are affected. Changes to the availability of wildlife resources and disturbance effects are anticipated to extend to the portions of GE023 and GE034 located within the Land and Resource Use LAA. The effect on the availability of wildlife resources will be reversed following completion of active closure when sensory disturbance abates and wildlife movement patterns across the PDA are re-established. Residual effects are not anticipated to extend to trapline GE009 which is located outside of the Land and Resource Use LAA.

c) Other Aboriginal Communities

MNRF and the CEA Agency identified four additional traplines held by Aboriginal peoples: GE035, GE008, GE120, and NG089 (note the Aboriginal communities with which the trapline holders are affiliated were not disclosed). These four traplines are located within and outside of the RAA but are not anticipated to experience Project related effects. The traplines will not experience a direct loss of trapline areas. The closure of Lahtis Road is not anticipated to affect access to these traplines as alternate access roads are available. Changes to the availability of wildlife resources will be limited to the Land and Resource Use LAA and will not extend to these traplines.

The CEA Agency has identified seven bait harvesting areas held by Aboriginal peoples: NI5007, NI5013, NI5019, NI5020, NI5034, NI5035, and NI5055 (note the Aboriginal communities with which the tenure holder is affiliated was not disclosed). Based on the results of the assessment on fish and fish habitat (see Chapter 11 of the Final EIS/EA), effects on the sustainability and productivity of CRA fisheries within the LAA are not anticipated as a result of the Project. Due to habitat offsetting, no net loss of commercial baitfish harvesting is anticipated.

Six of the identified bait harvesting areas are located within and outside of the RAA and are not anticipated to experience Project related effects (NI5007, NI5013, NI5019, NI5020, NI5034 and NI5055). These bait harvesting areas will not experience a direct loss of bait harvesting areas and the closure of Lahtis Road is not anticipated to affect access to the six bait harvesting areas as alternate access roads are available.

Residual effects are anticipated for bait harvesting area NI5035. The Project will result in the restricted access to or loss (removal due to site clearing) of 141 ha of bait harvesting area NI5035. The 141 ha which is overlapped by the PDA includes both terrestrial and aquatic environments. As a result, the area of affected waterways where bait harvesting may take place within NI5035 and which will be affected by the Project is smaller than 141 ha and includes a portion of Goldfield Creek. The PDA will remain inaccessible to the NI5035 licence holder for the duration of the mine life until the PDA becomes accessible during post-closure. Areas within the PDA that support baitfish are mostly ephemeral drainage features and will be replaced with new, more permanent habitat with the Goldfield Creek diversion. Given the level of fishing activity carried out in the PDA and the other potential fishing areas within NI5035, this loss of access is not expected to substantially reduce the area available for commercial bait harvesting.

The NI5035 tenure holder may not be able to access harvesting areas previously accessed via Lahtis Road, which may reduce the ability for trapping and bait harvesting outside of the PDA. The effect may be greatest during the winter when alternate access via Goldfield Road may not be feasible. GGM will continue to meet the holder of bait harvesting area NI5035 which is overlapped by the PDA to discuss issues and concerns and to provide Project updates.

7.2.3.4 Change in Recreation

This summary of residual effects on change in recreation incorporates information from the assessment of change in recreational land and resource use presented in Section 16.4.2 of the Final EIS/EA and Section 7.2.2.1 of this report. The information provided by Aboriginal communities regarding their recreation was not conducive to a separation of residual effects discussions for each Aboriginal community. Based on available information, and in keeping with the conservative assumptions outlined in Section 3.4 of this report, the discussion below is applicable to all of the identified Aboriginal communities.

GGM is required to restrict access to the PDA so that mining activities can be carried out safely. These access restrictions will remove areas potentially used by Aboriginal communities for recreational fishing, hunting, snowmobiling and hiking. The predicted residual effects apply to both Aboriginal and non-Aboriginal recreational land users; see Section 16.4.2.3 of the Final EIS/EA.

The Project will result in the removal of approximately 10.6 km of snowmobile trails in the PDA that are reportedly used by AFN. The snowmobile trails are operated by the Ontario Federation of Snowmobile Clubs and maintained by the Greenstone Snowmobile Club. In discussions with GGM, the Greenstone Snowmobile Club indicated that the portion of snowmobile trail to be removed has not been maintained for the past several years. It is not known the extent to which AFN member or members of other Aboriginal communities use or have used these snowmobile trails; see Section 16.4.2.3 of the Final EIS/EA.

The Project is predicted to result in removal of 1.4 km of the Barton Bay Wildlife Trail in the PDA. Aboriginal communities have not identified use of the Barton Bay Wildlife Trail; however, if this trail is used, residual effects are anticipated to be similar to those predicated for non-Aboriginal recreational land users. In conversation with GGM, the Municipality of Greenstone has indicated the potential to relocate the Barton Bay Wildlife Trail may exist in the future; see Section 16.4.2.3 of the Final EIS/EA.

AFN, LLFN and MNO have confirmed use of use Lahtis Road to access Southwest Arm of Kenogamisis Lake for recreation. It is not known if other Aboriginal communities use Lahtis Road for recreational purposes. As discussed in Section 16.4.2.3 of the Final EIS/EA, Lahtis Road will be closed during construction and operation due to safety reasons and this will prevent public access to areas southwest of the PDA that may be accessed via this route. To mitigate effects on use of the area for recreational and traditional purposes, GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation; see Section 18.4.2 of the Final EIS/EA.

Similar to non-Aboriginal recreational land users, Aboriginal recreational users may be affected by altered viewscape. For all users of MacLeod Provincial Park, the viewscape will be permanently altered by the WRSAs and TMF. From other vantage points in the LAA for Land and Resource Use, Project components may not be visible or will be only partially visible relative to the existing landscape. The existing visual character of the PDA has been affected by mining, forestry, and development over the past 90 years; however, there is potential for non-Aboriginal and Aboriginal recreational users to shift their activities to areas that are further away from the PDA to areas without an altered viewscape.

These effects are expected to apply equally to members of identified Aboriginal communities that use areas within the Land and Resource Use LAA.

7.2.3.5 Change in Labour and Economy

This summary of residual effects on change in labour and economy incorporates information from the assessment of the same name presented in Section 14.4 of the Final EIS/EA and Section 7.2.2.2 of this report. The information provided by Aboriginal communities on this topic was not conducive to a separation of residual effects discussions for each Aboriginal community. Based on available information, and in keeping with the conservative assumptions outlined in Section 3.4 of this report, the discussion below is applicable to all of the identified Aboriginal communities.

The Project is anticipated to benefit both Aboriginal and non-Aboriginal communities through direct employment and Project expenditure on goods and services. As discussed in Section 14.4.2 of the Final EIS/EA, during construction, it is expected that RAA residents, including LAA residents, will account for over half of the Ontario portion of the labour force; see Section 14.4.2.3 of the Final EIS/EA. During operation, it is expected that workers will reside in the LAA and RAA. Nine Aboriginal communities (LLFN, GFN, AFN, AZA, BZA, BZA, PPFN, MNO, and RSMIN) have reserve lands or communities located within the Labour and Economy RAA and whose members may benefit from direct or indirect employment. Employment opportunities will be open to members of all Aboriginal and non-Aboriginal communities and workers may choose to relocate from areas outside of the Labour and Economy RAA for employment purposes; see Section 14.4.2.3 of the Final EIS/EA.

GGM has prepared a labour and training strategic action plan, which includes partnerships with Aboriginal communities and education institutes, information sharing (e.g., skills databases), and employment preparation and training. GGM will post job qualifications and identify available training programs and providers so that local and Aboriginal residents can acquire the necessary skills and qualify for potential employment and work with communities to develop training programs oriented to operational needs. It is expected that the Project will result in positive effects on labour and GGM has committed to implementing various mechanisms for enhancing Project benefits to increase Aboriginal participation in the economic benefits of the Project; see Section 14.4.2.3 of the Final EIS/EA.

As discussed in Section 14.4.3 of the Final EIS/EA, local and regional businesses, including Aboriginal businesses, stand to benefit from successful bids to supply the Project with goods and services. During construction and operation, it is expected that the Project will result in positive effects on the economy (within the Labour and Economy LAA and RAA); to enhance these benefits, GGM has and will continue to work with Aboriginal-owned businesses on Project contract opportunities regarding the supply of goods and services.

Project closure will result in the loss of jobs and will also have an adverse effect on local and regional businesses, likely including Aboriginal businesses. As discussed in Section 14.4.2 of the Final EIS/EA, the end of operation will result in the loss of jobs for the workers directly employed by the Project as well as employment associated with the Project. GGM recognizes the importance of communication and consultation with local Aboriginal communities to make sure the interests of potentially-affected parties are considered in planning for Project closure. GGM is committed to working with local Aboriginal communities to develop a strategy for buffering the effects of the eventual loss of mining jobs. As discussed in Section 14.4.3 of the Final EIS/EA, at Project closure, the loss of business associated with operation will have an adverse effect on the economy (within the Labour and Economy LAA and RAA). GGM will work with the affected Aboriginal communities to develop a strategy for addressing economic implications of Project closure. This will inform local and regional businesses about the Project's final closure in a timely manner that enable them to respond appropriately to reduce potential adverse effects.

GFN expressed concern about the economic costs of purchased foods and travel arising from decreased in the quality and quantity of traditional foods. As discussed in Section 7.1.4.2 of this report, residual effects on quality and availability of country foods were determined to be not significant; thus it follows that effects related to costs of purchased foods and travel arising from the quality and quantity of country foods are not significant. Project effects on quality and availability of country foods will be mitigated through the measures identified in Section 6 of this report and Chapters 11.0, 12.0, 13.0, and 19.0 of the Final EIS/EA. Follow up and management of residual effects will also take place though the fish sampling included in the Conceptual AMMP and GGM's participation in a potential MNRF-led moose health study. Increased economic costs of purchased foods and travel are not anticipated as a result of Project related changes in quality and availability of country foods.

These effects are expected to apply equally to all Aboriginal communities whose members live and work within the Labour and Economy RAA.

7.2.3.6 Change in Community Services and Infrastructure

This summary of residual effects on change in community services and infrastructure incorporates information from the assessment of the same name presented in Section 15.4 of the Final EIS/EA and in Section 7.2.2.3 of this report. As identified in Section 15.4 of the Final EIS/EA, residual effects for a change in community services and infrastructure are anticipated and apply to all users, Aboriginal and non-Aboriginal. The information provided by Aboriginal communities on this topic was not conducive to a separation of residual effects discussions for each Aboriginal community. Based on available information, and in keeping with the conservative assumptions outlined in Section 3.4 of this report, the discussion below is applicable to all of the identified Aboriginal communities.

Residual effects of changes in community services and infrastructure for Aboriginal people living off-reserve are anticipated to be the same as residual effects for non-Aboriginal people (see Section 15.4 of the Final EIS/EA and in Section 7.2.2.3 of this report for additional information).

Community services and infrastructure in the LAA/RAA are also used by Aboriginal peoples living on-reserve but there may be slight differences in the residual effects experienced by Aboriginal peoples living on-reserve. The LAA/RAA established for the Community Services and Infrastructure VC incorporates reserve lands for the following Aboriginal communities: LLFN, GFN, AFN, AZA, BNA and BZA. Project-related effects are not expected to interact with on-reserve lands such as housing and accommodations, police services, schools. As discussed in Section 15.4 of the Final EIS/EA, the construction and operation workers and their family members will place additional demands on the recreation services such as the Kenogamisis Golf Course and Geraldton Community Center and health services such as the Geraldton District Hospital which also service surrounding Aboriginal communities. The residual change in capacity of recreation services and health services is anticipated to be at or near to baseline conditions after proposed mitigation and management.

These effects are expected to apply equally to all Aboriginal communities whose members live and work within the Community Services and Infrastructure LAA/RAA.

7.2.4 Significance Determination for VCs Related to Aboriginal Socio-economic Conditions

The environmental effects assessments for the VCs which are related to Aboriginal socio-economic conditions (Table 3-2 of this report) concluded that Project-related changes are not significant. Below is a discussion of the determinations of significance made by each VC and how they relate to Aboriginal socio-economic conditions.

7.2.4.1 Change in Use of Navigable Waters; Forestry and Logging Operations; Commercial Fishing, Hunting, Trapping, Gathering and Guide Outfitting Activities and Recreation

As discussed in Section 16.4.4 of the Final EIS/EA, the changes in navigation, commercially-based and recreational land use apply to both Aboriginal and non-Aboriginal users. The Land and Resource Use VC defined a significant adverse effect as one that threatens the long-term viability of the recreational, commercial land use activity or navigation, see Section 16.5 of the Final EIS/EA. The residual effects on Land and Resource Use were determined to be not significant as the long-term viability of recreational, commercial land use activity or navigation are not threatened by Project activities. This finding of not significant residual effects is also applicable the following four Key Topics within Aboriginal socio-economic conditions:

- change in navigable waters,
- change in forestry and logging operations,
- change in commercial fishing, hunting, trapping, gathering and guide outfitting activities, and
- change in recreation.

7.2.4.2 Change in Labour and Economy

The labour and economy VC defined significant adverse effects as those that are distinguishable from current conditions and trends and cannot be managed or mitigated through adjustments to programs, policies, plans, or through other mitigation, see Section 14.5 of the Final EIS/EA. Project effects are distinguishable from current conditions and trends; however, these residual effects are positive, can be managed and were determined to be not significant. Nine Aboriginal communities (LLFN, GFN, AFN, AZA, BZA, BZA, PPFN, MNO, and RSMIN) have reserve lands or communities located within the Labour and Economy RAA and whose members may benefit from direct or indirect employment. As such, for Aboriginal socio-economic conditions, it follows that residual effects on labour and economy for Aboriginal people are also not significant. GGM has committed to implementing various mechanisms for enhancing Project benefits to increase Aboriginal participation in the economic benefits of the Project.

7.2.4.3 Change in Community Services and Infrastructure

The Community Services and Infrastructure VC defined a significant adverse effect as one that results in demands on services or infrastructure above current capacity, such that standards of service are routinely and persistently reduced below current levels for an extended period and are unlikely to recover to existing conditions, see Section 15.5 of the Final EIS/EA. Project-related residual effects do not meet this threshold and were determined to be not significant. As such, for Aboriginal socio-economic conditions, it follows that residual effects on community services and infrastructure used by Aboriginal people are also not significant, as the services and infrastructure which is also relied upon by Aboriginal peoples are not anticipated to be routinely and persistently below current levels for an extended period.

7.2.5 Overall Summary and Determination of Significance for Aboriginal Socio-economic Conditions

The individual VCs discussed concluded that the Project-related environmental effects to those VCs were not significant. Those VCs informed the discussion in relation to Key Topics associated with effects of changes to the environment on Aboriginal socio-economic conditions. In consideration of identified mitigation, the context of the Project being located in large part on brownfield conditions with an ability to carry out enhanced reclamation of historical tailings that affect the main local resource (Kenogamisis Lake) under baseline conditions, information provided by Aboriginal communities, and specific consideration of how the effects of those changes to the environment might affect Aboriginal socio-economic conditions, the residual effects of changes to the environment on Aboriginal socio-economic conditions are characterized as not significant for all Project phases.

7.3 ABORIGINAL PHYSICAL AND CULTURAL HERITAGE

7.3.1 Introduction

As required by the EIS Guidelines, this section provides a description and analysis of how changes to the environment caused by the Project may affect Aboriginal physical and cultural heritage (including any structures, sites or things of historical, archaeological, paleontological or architectural significance to Aboriginal people). This section includes discussion of physical changes to sites, structures or areas associated with Aboriginal physical and cultural heritage, as well as changes in how Aboriginal people access and use those sites, structures or areas.

This section first summarizes, at a high level, the main findings and conclusions for relevant VCs and then provides GGM's conclusions regarding the overall characterization of residual effects Aboriginal physical and cultural heritage based on those VC findings.

7.3.2 Summary of Findings for Relevant Valued Components

7.3.2.1 Assessment of Potential Environmental Effects on Heritage Resources

The Heritage Resources VC assessment in Chapter 17.0 of the Final EIS/EA concluded that Project effects on archaeological resources will be avoided because archaeological assessment programs will be carried out in areas of archaeological potential prior to ground disturbance activities in construction phase. Additional areas of Stage 2 archaeological assessment will be undertaken where refinements to the PDA have been made.

Although the presence or absence of archaeological, architectural, and historical resources has been documented during baseline data collection, it is possible that chance finds could be uncovered during the construction phase within the PDA. The Conceptual AHRMP (GGM 2017b) outlines the response and mitigation measures to be implemented. In addition, GGM has committed to developing a communication procedure with local Aboriginal communities. These specifically address archaeological and heritage resources and are described within the "Hardrock Project Conceptual Archaeology and Heritage Resources Management Plan" (Conceptual AHRMP; GGM 2017b).

No residual adverse effect on archaeological resources, including Aboriginal archaeological sites or sites of historical, architectural, or palaeontological importance, are anticipated.

7.3.2.2 Assessment of Potential Environmental Effects on Traditional Land and Resource Use

As discussed in Section 18.4.5.3 of the Final EIS/EA, effects on cultural and spiritual sites are site-specific and limited to the PDA. Patterns of access to cultural or spiritual sites or areas in the broader Traditional Land and Resource Use LAA may be altered by access restrictions within the PDA, including the closure of Lahtis Road. These changes are predicted to result in changes in access to TLRU areas located southwest of the PDA (however this area may be accessed via Goldfield Road), and along the shoreline of the Southwest Arm of Kenogamisis Lake.

The heritage resources VC assessment (Chapter 17.0 of the Final EIS/EA) concluded that no residual environmental effects on heritage resources are anticipated (Section 17.5 of the Final EIS/EA). As discussed in Section 17.4.4.3 of the Final EIS/EA, there is a potential for archaeological resources to go undiscovered while applying standard sampling methods. Protocols for chance encounters of archaeological resources during construction procedures described in the Conceptual AHRMP (Appendix M14 of the Final EIS/EA) will address potential effects on these resources.

The land and resource use assessment identified residual environmental effects related to changes in access conditions that could, in turn, affect cultural sites and practices in affected areas. The assessment indicates that areas and trails will be lost in the PDA, and there will be access restrictions to watercourses where it has been conservatively assumed navigation is possible, and change a route, which may pose an inconvenience to potential users. Access to cultural or spiritual practices, sites, or areas in the Traditional Land and Resource Use LAA will be affected due to changes in patterns of access because of the realignment of approximately 4.2 km of Highway 11 and the diversion of Goldfield Creek.

Within the Traditional Land and Resource Use LAA, disturbance of cultural or spiritual sites and changes in access are expected to occur during the construction, operation, and closure phases of the Project. It is unlikely that cultural or spiritual sites or areas will be directly disturbed by construction activities in the Traditional Land and Resource Use LAA, although cultural or spiritual practices may be affected due to the Project-related changes in access. Effects extending beyond the PDA are characterized as moderate in magnitude, medium-term in duration, and partially reversible because access through the PDA will be restored (exceptions include the vehicular access to the open pit, WRSA and TMF, Lahtis Road will only be re-opened to the Goldfield Creek diversion) following active closure.

Within the PDA, residual environmental effects on cultural or spiritual sites and areas (where they may exist) are expected during Project construction of the Project. Construction activities (i.e., clearing) in the PDA will permanently remove or otherwise disturb four cabin/camp locations, the temporary structure south of Mosher Lake, the route connecting Highway 11 with Mosher Lake, and the snowmobile trail identified by Aboriginal communities. The residual environmental effects from the Project on TLRU are determined to be not significant because they do not result in the long-term loss of availability of traditional use resources or access to lands relied on for traditional use practices or the permanent loss of traditional use sites and areas in the Traditional Land and Resource Use LAA and RAA.

7.3.2.3 Assessment of Potential Environmental Effects on the Atmospheric Environment

a) Assessment of Change in Ambient Air Quality

The Atmospheric Environment VC assessment presented in Chapter 7.0 of the Final EIS/EA concluded that, during Project construction, emissions of air parameters of potential concern may result from site preparation activities and the construction of Project components. These emissions would include particulate and combustion gases from construction equipment, and particulate (dust) emissions caused by such things as the operation of heavy earth-moving equipment and wind erosion. Many of the construction activities would not occur continuously (i.e., would be intermittent), nor would all activities occur concurrently at any given time. Construction activities would occur during daytime hours over the duration of the construction phase.

During Project operation, emissions of air parameters of potential concern may result from the combustion of diesel fuel in mining equipment, natural gas combustion in the power plant, and other stationary equipment used during operation.

Active closure emissions are expected to be less than construction emissions (as no ore extraction or tailings management facility construction would be occurring). The post-closure phase is expected to generate negligible air emissions.

Emissions of parameters of potential concern will occur during Project construction and closure primarily due to the combustion of diesel fuel from construction equipment. These activities are minor and are not predicted to result in emissions that exceed provincial air quality regulations or national objectives.

Results of the air dispersion modelling for operation indicate that there would be an increase in parameters of potential concern above baseline conditions that will extend beyond the Project development area, but be within regulatory limits and objectives at all outside modelled property boundary receptor locations (non-GGM owned/leased land) with the exception of infrequent 24-hour average of particulate matter close to the modelled property boundary (e.g., no more than 6 days in 5-years, or 0.3% of the time). At inside modelled property boundary receptors (primarily GGM owned/leased land), infrequent exceedances of particulate matter and manganese were predicted during the first two years of operation, and at the Kenogamisis Golf Club during operation. Residual concentrations of benzene and benzo(a)pyrene from vehicle tailpipe emissions also exceeded applicable criteria at inside and outside modelled property boundary receptors as the baseline levels of both benzene and benzo(a)pyrene are above applicable air quality criteria. These infrequent and minor increases above applicable regulatory criteria were further evaluated in the human and ecological risk assessment. Overall, they represent a negligible human health risk (see Section 7.1.1 above).

b) Assessment of Change in Lighting

The assessment of changes in lighting presented in Chapter 7.0 of the Final EIS/EA concluded that, during construction, operation, and active closure it is predicted that changes to ambient lighting will extend beyond the Project development area and into the Atmospheric Environment VC LAA. However, the Project's effect on ambient lighting is predicted to be below the relevant International Commission on Illumination guideline levels at all assessed receptors (refer to Chapter 7.0 for further information). The waste rock storage areas (WRSAs) will act as a barrier to light from the process plant and mobile equipment. Forested areas are also predicted to reduce the effect of process plant lighting and mobile equipment.

7.3.2.4 Assessment of Potential Environmental Effects on the Acoustic Environment

The Acoustic Environment VC assessment presented in Chapter 8.0 of the Final EIS/EA concluded that noise levels within the Acoustic Environment VC LAA will increase primarily due to the operation of equipment and blasting within the open pit; however, the predicted noise emission levels at points of reception and points of interest will comply with applicable guideline criteria and thresholds. In general, the predicted sound levels for the areas adjacent to PDA (including the Southwest Arm of Kenogamisis Lake and Mosher Lake) could be between 40 to 45 dBA. These sound levels would be characteristic of a rural environment where sounds of the natural environment dominate, such as the sounds of water (i.e., waves), rustling leaves or other sounds heard in a forested area. Exceptions would include the area along the shoreline of the southwest arm of Kenogamisis Lake (adjacent to the PDA) where sounds levels are predicted to be between 45 to 50 dBA, a sound level that is consistent with the hum experienced in an urban environment.

In addition, the assessment concluded that the predicted vibration levels at points of reception and points of interest will comply with applicable guideline criteria and thresholds. Vibration generated by the Project is not anticipated to extend beyond the PDA. A forested buffer around the PDA (including the shoreline of Southwest Arm of Kenogamisis Lake) would attenuate Project sound levels.

The predicted sounds and vibration levels were conservatively modelled as described in the "Technical Data Report – Hardrock Project: Acoustic Environment" (Appendix F2) of the Final EIS/EA (e.g., construction activities occur along the perimeter of the PDA and road construction along the realigned Highway 11 within the right-of-way; no attenuation is provided by enclosures/structures; stationary sources emitting sound were modelled as concentrated point sources).

7.3.2.5 Assessment of Potential Environmental Effects on Land and Resource Use (Visual Quality)

As discussed in Chapter 16.0 of the Final EIS/EA, Project-related vegetation clearing, timber harvesting and the construction of Project components will cause changes in the local visual setting. These changes will continue during the operations phase with the development of the tailings management facility (TMF) and WRSAs. During operation, the area covered by the WRSAs and TMF and their height above ground level and existing tree line will continue to increase. These two Project components are predicted to be the most visually prominent features in the LAA. The WRSAs are predicted to be visible from the four vantage points as shown on Figure 16-7 of the EIS/EA. The distance from the peak of WRSA A to the closest point of shoreline along the Southwest Arm of Kenogamisis Lake is approximately 340 m. The visual setting in the LAA will be permanently altered to varying degrees due to the WRSAs and TMF. Land user experience in proximity to the PDA will be permanently altered. The visual setting from several vantage points will be changed from existing conditions; the viewscape from Kenogamisis Lake will include the WRSAs and TMF. From other vantage points in the LAA, Project components may not be visible or will be only partially visible relative to the existing landscape.

7.3.3 Summary of Residual Effects Related to Aboriginal Physical and Cultural Heritage

This section considers how residual effects may affect Aboriginal physical and cultural heritage. The information provided by Aboriginal communities regarding Aboriginal physical and cultural heritage was not conducive to a separation of residual effects discussions for each Aboriginal community. Based on available information, and in keeping with the conservative assumptions outlined in Section 3.4 of this report, the discussion below is applicable to all of the identified Aboriginal communities.

7.3.3.1 Archaeological Resources

Project effects on Aboriginal archaeological resources will be avoided, with archaeological assessment programs carried out in areas of archaeological potential prior to ground disturbance activities in construction phase. Protocols to protect archaeological resources will be implemented in the event of a chance find. No residual adverse effect on Aboriginal archaeological sites or sites of historical, architectural, or paleontological importance are anticipated.

7.3.3.2 Access to Cultural and Spiritual Use Locations

Residual effects are anticipated for the cultural and spiritual use locations within the PDA identified by LLFN and MNO. LLFN reported four campsite or cabin areas within the PDA in the LLFN TK Assessment (Appendix J1 of the Final EIS/EA), referred to as land use sites in the Heritage Resources VC (Section 17.2.2.2 of the Final EIS/EA). During GGM and LLFN follow-up meetings on April 18 and 19, 2017, LLFN confirmed there are a total of four "land use" sites within the PDA. LLFN also confirmed that these are not sacred sites and further detail is confidential. The land use sites are in the same general locations as the campsite or cabin areas identified in the TK Assessment. GGM and LLFN have agreed upon a path forward for these sites. MNO reported a tent or temporary structure south of Mosher Lake and a route connecting Highway 11 with Mosher Lake, both conservatively assumed to be located within the PDA. Based on the layout of the PDA, Mosher Lake will remain accessible during all phases of the Project. MNO reported that camping sites may have important spiritual or ceremonial connection (MNO TKLU Study; Appendix J3 of the Final EIS/EA). GGM is unaware of any sites important for spiritual or ceremonial purposes within the PDA or Traditional Land and Resource Use LAA.

In comments made by AFN to the CEA Agency, AFN confirmed they use snowmobile trails, which are operated by the Ontario Federation of Snowmobile Clubs and maintained by the Greenstone Snowmobile Club, along Highway 11 in the PDA for hunting. Geraldton Snowmobile Club has confirmed that the trail along Lahtis Road is no longer maintained. Potential interactions with snowmobile trails as a result of the Project are considered in Chapter 16.0 (Sections 16.4.2 and 16.4.3 of the Final EIS/EA).

Construction activities will affect the ability to access areas used for cabin or camp locations within portions of the Traditional Land and Resource Use LAA. The Project will alter access routes to the Southwest Arm of Kenogamisis Lake, affecting access to LLFN and MNO cultural sites. Cultural or spiritual sites or areas will not likely be directly disturbed in the Traditional Land and Resource Use LAA, although cultural or spiritual practices will be affected due to the Project changing access conditions and affecting the ability to undertake TLRU activities throughout construction, operation, and closure phases. Access through the PDA will be restored (exceptions include the vehicular access to the open pit, WRSA and TMF, Lahtis Road will only be re-opened to the Goldfield Creek diversion) following active closure.

7.3.3.3 Sensory Disturbance

While sensory disturbance due to changes in air quality, ambient lighting, acoustics and vibration and changes in visual setting is predicted for Aboriginal users of cultural and spiritually important sites and areas, that disturbance will be experienced primarily in areas located very near to the PDA and will decrease substantially or be eliminated entirely as distance from the PDA boundary increases.

Project-related emissions of particulate matter (dust) are predicted to meet regulated requirements for all Project phases, except for a small area close to the PDA where the increase in particulate matter above MOECC guidelines will be infrequent (i.e., no more than 0.1% of the time) and limited to the first phase of operation of the processing plant (refer to Figure 7-7 in the Atmospheric Environment VC assessment in Chapter 7.0 of the Final EIS/EA).

The Project's effect on ambient lighting is predicted to be below the relevant CIE Guideline levels at all of the assessed receptors (refer to Chapter 7.0 of the Final EIS/EA for further information). The WRSAs will act as a barrier to light from the process plant and mobile equipment. Forested areas are also predicted to reduce the effect of process plant lighting and mobile equipment.

Predicted increases in Project-related noise and vibration will comply with applicable regulations at all assessed points of reception. In general, the predicted sound levels for the areas adjacent to PDA, including the Southwest Arm of Kenogamisis Lake and Mosher Lake are predicted to be between 40 to 45 dBA. These sounds levels are characteristic of a rural environment where sounds of the natural environment dominate such as the sounds of water (i.e., waves), rustling leaves or other sounds heard in a forested area. Exceptions include the area along the shoreline of Southwest Arm of Kenogamisis Lake adjacent to the PDA where sounds levels are predicted to be between 45 to 50 dBA, which is considered consistent with the hum from an urban environment.

Vibration generated by the Project is not anticipated beyond the PDA. A forested buffer around the PDA, including the shoreline of Southwest Arm of Kenogamisis Lake, would attenuate Project sound levels. These predicted sounds and vibration levels are conservatively modelled as described in the "Technical Data Report – Hardrock Project: Acoustic Environment" (Appendix F2 of the Final EIS/EA) (e.g., construction activities occur along the perimeter of the PDA and road construction along the realigned Highway 11 within the right-of-way; no attenuation is provided by enclosures/structures; stationary sources emitting sound were modelled as concentrated point sources). Sensory disturbance to users due to Project-related emissions (e.g., dust, light, noise and vibration) in the Land and Resource Use VC LAA is not anticipated.

The visual setting in the will be permanently altered to varying degrees due to the WRSAs and TMF. The visual setting from several vantage points will be changed from existing conditions; the viewscape from Kenogamisis Lake will include the WRSAs and TMF. Change in land user experience will vary depending on proximity to the PDA and there is potential for some users to shift their activities to areas that are further away from the PDA. However, the predicted residual effect on visual quality is in the context of a local environment that has been disturbed by mining, forestry and development over the past 90 years. The existing visual character of the PDA consists of Highway 11, commercial and residential properties, deciduous and coniferous forest cover, wetlands such as swamps, marshes, bogs and fens, and historical mining area that were altered through past forestry and mining activities.

7.3.3.4 Change in Cultural Value or Importance Associated with Aboriginal Physical and Cultural Heritage

Changes to the cultural value or importance associated with Aboriginal physical and cultural heritage may take place through effects on tangible and intangible values. Through GGM's engagement program, it was identified that disturbance of the landscape and fears of contamination decreases the spiritual connection that Aboriginal community members feel towards the landscape. This statement identifies potential effects to tangible and intangible values associated with cultural value or importance of Aboriginal physical and cultural heritage. Disturbance of the landscape and contamination are potential effects on tangible values, as these effects are related to quantifiably measurable items such as clearing land, water and air quality, and noise. Concern regarding decrease in the spiritual connection to the landscape is a potential effect on an intangible value, as these items are conditional and experiential and cannot be observed or quantified in the same way.

Mitigation has been developed to address potential effects on both tangible and intangible values related to Aboriginal physical and cultural heritage. Effects on tangible values such as disturbance of the landscape are primarily addressed through Project design and siting, since the Project is a redevelopment of a previously disturbed brownfield site. Application of the mitigation measures presented in Section 6 of this report, such as limiting the construction footprint and the number of watersheds overprinted by the PDA, will also mitigate disturbance of the landscape. Historical mining in the area has affected water quality and Aboriginal communities have existing concerns regarding contamination. The Project is expected to improve rather than degrade overall water quality in Kenogamisis Lake and this positive effect may reduce contamination fears. Fears of contamination may still exist, however, and if identified as an ongoing concern by Aboriginal communities, GGM's engagement program will provide educational information on Project effects and focus engagement discussions on addressing these concerns.

It is acknowledged that effects to intangible values are not quantifiable in the same way that effects to tangible values are; therefore, identifying proven and effective mitigation measures for intangible values has limitations. However, since tangible and intangible values are often connected, mitigation measures aimed at avoiding or reducing effects to tangible values could also help to avoid or reduce effects to intangible values. Decreases in the spiritual connection to the landscape would be a personal, conditional subjective, and ultimately unmeasurable change to the cultural value or importance of Aboriginal physical and cultural heritage. The cultural value or importance of Aboriginal physical and cultural heritage is determined both individually by Aboriginal peoples as well as collectively by an Aboriginal community as a whole, and may also be unique for each Aboriginal community. LLFN noted that the value of heritage resources is dependent upon the value to the community. The possibility of encountering residual Project effects that would change intangible values will be reduced though careful Project design and application of mitigation measures presented in Section 6 of this report. However, in light of the subjective nature of intangible values, it is difficult to evaluate the how effective the mitigation might be. Residual effects will be managed through application of the environmental monitoring program. Should residual effects of the Project on intangible values be identified by Aboriginal communities as an ongoing concern, there are several mechanisms through which those effects may be mitigated. The environmental management and monitoring plans may be adapted based on feedback from Aboriginal communities. GGM has proposed to form Aboriginal Environment Committee(s) through which additional mitigation may be developed. GGM can also provide support for Aboriginal communities to continue cultural practices through TK studies or other efforts to maintain intangible component of physical and cultural heritage. Through these tangible and collaborative mechanisms, GGM will be able to work with Aboriginal communities to reasonably address concerns about effects to intangible values, should they arise during the Project.

7.3.4 Significance Determination for Valued Components Related to Aboriginal Physical and Cultural Heritage for Aboriginal People

The environmental effects assessments for the VCs related to Aboriginal physical and cultural heritage (Table 3-2 of this report) concluded that Project-related changes would not be significant. The following is a summary of the determinations of significance made by the Atmospheric Environment VC, Heritage Resources VC, and Traditional Land and Resource Use VC (Chapters 7.0, 17.0 and 18.0 of the Final EIS/EA, respectively) and where appropriate, cross-referenced VCs, and how they relate to Aboriginal physical and cultural heritage.

The Heritage Resources VC defines a significant residual adverse one that results in the loss of, change in access to, or change in cultural heritage value or interest of heritage resources where no appropriate retrieval of the resource has been undertaken and no prior approval from the appropriate agency has been sought. No residual environmental effects on archaeological and Euro-Canadian architectural and/or historical resources are anticipated. Consequently, there are no residual adverse effects carried forward for the determination of significance.

The Traditional Land and Resource Use VC concluded that the Project may result in a reduced access to land and availability of resources for the pursuit of traditional activities including access to (and use of) cultural or spiritual sites. The PDA is in a previously disturbed area from historical mining, forestry, aggregate extraction, highway transportation, mineral exploration, residential and industrial land uses, and most TLRU sites were identified outside of the PDA. While access to the PDA will be limited for the lifetime of the Project, rehabilitation will be undertaken during closure and TLRU sites and areas within the Traditional Land and Resource Use LAA, except for Lahtis Road, will continue to be accessible during Project construction, operation, and closure. The ability of Aboriginal communities to maintain TLRU outside of the PDA will be maintained with some access changes, as GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation.

The residual environmental effects from the Project on TLRU are determined to be not significant because they do not result in the long-term loss of availability of traditional use resources or access to lands relied on for traditional use practices or the permanent loss of traditional use sites and areas in the Traditional Land and Resource Use LAA and RAA. No residual environmental effects were identified by the Heritage VC. Overall, residual effects of the Project on the Aboriginal physical and cultural heritage are determined to be not significant.

The Atmospheric Environment VC assessment concluded that emissions of PoPCs will increase during Project construction and active closure primarily due to the combustion of diesel fuel in equipment and particulate matter from vehicle movement. Dispersion modelling predicted the effect of Project construction on air quality with results compared to local air quality regulations and national ambient air quality objectives. The residual effects of a change in ambient air quality parameters during Project construction resulted in an increase in PoPCs above baseline conditions, but are predicted to remain within regulatory air quality criteria/objectives, are reversible and restricted to the Atmospheric Environment LAA.

The residual effects of changes in ambient air quality parameters during Project operation are predicted to increase PoPCs above baseline conditions, but off-property residual effects would be within regulatory criteria/objectives (with two minor exceptions related to the infrequent exceedances of TSP and PM_{10}), are reversible and restricted to the Atmospheric Environment LAA.

Use of standard practices is proposed to reduce releases of PoPCs as much as practical during construction, operation and closure (see Section 7.4.2.2 of the Final EIS/EA). With the proposed mitigation and environmental protection measures incorporated into the assessment, the residual environmental effect of a change in ambient air quality during all phases is predicted to be not significant.

As also described in the Atmospheric Environment VC assessment, the Project's effect on ambient lighting is predicted to be below the relevant CIE Guideline levels at all the assessed receptors. With the proposed mitigation, the residual environmental effects of the Project on a change in lighting during all phases are rated not significant.

Predicted noise and vibration levels will be within the quantitative limits as prescribed by the applicable guidelines. With the application of mitigation measures incorporated in the acoustic models, the residual Project effects on the acoustic environment for all phases of the Project are predicted to be not significant.

As described in the Land and Resource Use VC assessment, residual effects on land and resource use (including residual effects due to sensory disturbance) are determined to be not significant. Residual effects on land and resource users due to sensory disturbance are not predicted to threaten the long-term viability of the recreational, commercial land use activity.

7.3.5 Overall Summary and Determination of Significance for Aboriginal Physical and Cultural Heritage

The Heritage Resources, Traditional Land and Resource Use, Atmospheric Environment, Acoustic Environment, and Land and Resource Use VCs concluded that the Project-related environmental effects to those VCs were not significant. Those VCs informed the discussion in relation to Key Topics associated with effects of changes to the environment on Aboriginal physical and cultural heritage. The possibility of encountering residual Project effects that might change the cultural value or importance associated with Aboriginal physical and cultural heritage may be reduced though careful Project design and the mitigation measures identified through these related VC assessments (also presented in Section 6 of this report). Residual effects on intangible values will be managed through the development and implementation of the environmental management and monitoring plans, creation of Aboriginal Environment Committees and GGM's support of cultural practices, among other commitments outlined in Section 6.3 of this report. Through these tangible and collaborative mechanisms, GGM will be able to work with Aboriginal communities to reasonably address concerns about effects to intangible values, should they arise during the Project.

In consideration of identified mitigation, information provided by Aboriginal communities, the context of the Project being located in large part on brownfield conditions with an ability to carry out enhanced reclamation of historical tailings that affect the main local resource (Kenogamisis Lake) under baseline conditions, and specific consideration of how the effects of those changes to the environment might affect Aboriginal physical and cultural heritage, the residual effects of changes to the environment on Aboriginal physical and cultural heritage are characterized as not significant for all Project phases.

7.4 CURRENT USE

7.4.1 Introduction

As required by the EIS Guidelines, this section provides a description and analysis of how changes to the environment caused by the Project may affect the current use. As identified in Section 3 of this report, the assessment of current use is drawn largely from Chapter 18.0 of the Final EIS/EA, Traditional Land and Resource Use. This section summarizes, at a high level, the main findings and conclusions of Chapter 18.0, provides GGM's conclusions regarding the overall characterization of residual effects on current use, and discusses the implications of those findings on GGM's understanding of potential effects on the ability to exercise of Aboriginal or treaty rights.

7.4.2 Summary of Findings for Relevant Valued Components

7.4.2.1 Assessment of Potential Environmental Effects on Traditional Land and Resource Use

As described in Chapter 18.0 of the Final EIS/EA, Project activities construction, operation, and closure phases are anticipated to have residual effects on TLRU. The analysis in Chapter 18.0 of the Final EIS/EA is divided into the following categories:

a) Availability of Plant Species and Access to Plant Harvesting Sites and Activities
b) Availability of Fish Species and Access to Fishing Areas and Activities
c) Availability of Hunted and Trapped Species and Access to Hunting and Trapping Areas and Activities
d) Cultural or Spiritual Practices, Sites, or Areas

Further information on the findings in each of these categories is provided below.

a) Availability of Plant Species and Access to Plant Harvesting Sites and Activities

As discussed in Section 18.4.2.3 of the Final EIS/EA, four Aboriginal communities (MNO, EFN, AFN, and LLFN) identified plant harvesting locations within the PDA; however, specific locations, details of access and whether these locations were unique or preferred were not disclosed.

Access restrictions to the PDA including the closure of Lahtis Road may alter the patterns of access to harvesting areas in the Traditional Land and Resource Use LAA. Access changes may also affect harvesting sites located southwest of the PDA (however, this area may be accessed via Goldfield Road), and along the shoreline of the Southwest Arm of Kenogamisis Lake.

Residual environmental effects on plant species and plant harvesting sites and activities are considered adverse because of the removal of plants and habitat which may affect the availability of resources, loss of habitat, and change of access in the PDA. However, these plant species are not limited to the habitat in the PDA or Traditional Land and Resource Use LAA, and the vegetation communities that support these plant species are common throughout the RAA. The removal of plant species of interest to Aboriginal communities that are located within the PDA is are not anticipated to affect the viability of these species occurring in the Traditional Land and Resource Use RAA. During construction, clearing of the PDA will result in a loss of existing vegetation, including plant species and potential plant harvesting sites identified by Aboriginal communities. Effects from dust deposition due to construction, operation and active closure activities will be localized to 30 m from the PDA. GFN, AZA and LLFN noted that too much dust on plants (e.g., berries) may result in less harvesting of traditional plants and medicines. Changes to access and navigation routes as a result of the Project will affect harvesting, navigation, and trail use areas in the PDA and along the shoreline of the Southwest Arm of Kenogamisis Lake in the Traditional Land and Resource Use LAA.

Changes to patterns of access within the PDA and Traditional Land and Resource Use LAA will result in an effect of continuous frequency throughout all Project phases. Effects extending into the Traditional Land and Resource Use LAA are anticipated to reduce but not eliminate TLRU (characterized as moderate in magnitude). The duration of the loss of plant species of Aboriginal interest will extend beyond the Project active closure (long-term in duration) and be irreversible, even with the reintroduction of species through rehabilitation and natural succession processes post-closure. In addition, effects to access will extend through construction, operation, and active closure (medium-term in duration) because access through the PDA will be restored following active closure. Rehabilitation of Project components will provide opportunities for regrowth of plant species of interest to Aboriginal communities but access will be limited while in progress. See Table 18-11 of the Final EIS/EA for additional information on the residual environmental effects on availability of plant species and plant harvesting sites and activities.

b) Availability of Fish Species and Access to Fishing Areas and Activities

As discussed in Sections 18.4.3.3 and 11.4.3.3 of the Final EIS/EA, effects on the sustainability and productivity of fish resources within the Traditional Land and Resource Use LAA are not anticipated. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek diversion. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. More than half of the 6.58 ha of fish habitat that will be altered or lost is comprised of artificial golf course pond and poor quality habitat such as roadside ditches.

GGM is required to restrict access to the PDA so that mining activities can be carried out in a safe manner without interfering with operation. AFN, AZA, EFN, GFN, LLFN, and MNO have identified fishing areas within the Traditional Land and Resource Use LAA. AZA, GFN, LLFN, and MNO reported fishing in Kenogamisis Lake and EFN identified subsistence areas at Kenogamisis Lake. MNO provided comments about access to Lahtis Road to reach the Southwest Arm of Kenogamisis Lake. The specific routes used to access these fishing areas and whether these locations were unique or preferred, however, are also unknown.

Although navigation in the PDA was not identified through consultation or TLRU studies residual effects are anticipated for access to: portions of the Southwest Arm Tributary and its online ponds (Ponds SWP1, SWP2, SWP3 and SWP4); Lake A-322; and parts of Kenogamisis Lake accessed via Lahtis Road. Travel by small craft (e.g., canoe) will continue to be possible with obstacles (e.g., beaver dams and vegetation obstructions) between Goldfield Lake and Kenogamisis Lake with the new Goldfield Creek diversion; however, access through this area will be restricted during construction, operation, and active closure. The closure of Lahtis Road will affect access to areas located to the southwest of the PDA (although this area may be accessed via Goldfield Road). Access restrictions will remain in place until the end of active closure. The change in access may require Aboriginal communities to seek alternative routes and methods of access (i.e., boat vs. vehicle). Access through the PDA will be restored following active closure.

Residual environmental effects on availability of fish species and access to fishing areas and activities is considered adverse as access restrictions and infilling of watercourses containing fish will result in the loss of availability of potential areas for fishing within the PDA and patterns of access to fishing areas in the Traditional Land and Resource Use LAA may be altered. Residual effects are not anticipated to reduce the ability to fish (characterized as low in magnitude) as effects on the sustainability and productivity of fish populations are not anticipated and there will be no net loss of fishing areas. Residual effects are predicted to occur continuously, extend to the Traditional Land and Resource Use LAA and take place throughout construction, operation, and active closure (medium-term in duration). As access through the PDA will be restored following active closure, residual effects are considered reversible. See Table 18-11 of the Final EIS/EA for additional information on the residual environmental effects on availability of fish species and access to fishing areas.

c) Availability of Hunted and Trapped Species and Access to Hunting and Trapping Areas and Activities

As discussed in Section 18.4.4.3 of the Final EIS/EA, residual effects are anticipated for TLRU locations in the PDA. AFN, EFN, LLFN, and MNO identified land use sites within the PDA. GFN, LLFN, and MNO reported hunting and trapping activities at Kenogamisis Lake, and EFN identified subsistence areas at Kenogamisis Lake. The specific routes used by Aboriginal communities to access these areas whether these areas were unique or preferred is also unknown. Patterns of access to hunting and trapping in the LAA may be altered by access restrictions to the PDA, including the closure of Lahtis Road. Access changes may affect hunting and trapping areas located southwest of the PDA (however, this area may be accessed via Goldfield Road), and along the shoreline of the Southwest Arm of Kenogamisis Lake.

During construction, clearing of the PDA will result in a loss of wildlife habitat. In particular, wetland and forest areas will have some irreversible loss of associated wildlife habitat. During operation, hunted and trapped species will be affected because of indirect loss or alteration by sensory disturbance (habitat avoidance or under-utilization due to human activity); however, this is not predicted to affect the continued viability of wildlife within the RAA. The residual adverse effect on mortality risk during construction, operation and closure is predicted to be within the normal variability of existing conditions. The residual adverse effect on mortality risk will extend into the LAA and is considered reversible.

Access to areas used for hunting and trapping and trails and waterways will be changed in the PDA and hunting and trapping will be affected in the Traditional Land and Resource Use LAA due to the Project altering access conditions and navigability.

Residual environmental effects on hunted and trapped species, hunting and trapping sites, and activities or access to these, are considered adverse as Project activities will result in a loss of wildlife habitat, including hunting and trapping areas identified by Aboriginal communities and may alter patterns of access to hunting and trapping in the Traditional Land and Resource Use LAA. The removal of wildlife habitat, including hunting and trapping areas identified by Aboriginal communities within the PDA and alteration of patterns of access is predicted to reduce but not eliminate opportunities for hunting and trapping (moderate in magnitude). Changes to patterns of access within the PDA and Traditional Land and Resource Use LAA will result in an effect of continuous frequency throughout construction, operation, and active closure (medium-term duration). It is expected that effects on hunted and trapped species and hunting and trapping sites will be reversed (except for some areas of the PDA) following the completion of rehabilitation during closure. See Table 18-11 of the Final EIS/EA for additional information on the residual environmental effects on availability of hunted and trapped species and access to hunting and trapping areas and activities.

d) Cultural or Spiritual Practices, Sites, or Areas

The Project is anticipated to result in residual effects on cultural and spiritual areas that were identified by Aboriginal communities, see bulleted list below. Patterns of access to cultural or spiritual sites (where they may exist), or areas in the Traditional Land and Resource Use LAA may be altered by access restrictions to the PDA, including the closure of Lahtis Road. These changes are predicted to result in changes in access to areas located southwest of the PDA (however, this area may be accessed via Goldfield Road), and along the shoreline of the Southwest Arm of Kenogamisis Lake. The following cultural and spiritual areas or sites are anticipated to experience residual adverse effects:

- Four “land use” sites identified by LLFN in the PDA. The “Traditional Knowledge Assessment Related to the Premier Gold Mines Hardrock Project: prepared for Long Lake #58 First Nation” (Hensel Design Group Inc. 2015) identifies four campsite or cabin areas in the PDA. In addition, comments from LLFN to the CEA Agency identified a heritage site located within the proposed realignment of Highway 11. During GGM and LLFN follow-up meetings on April 18 and 19, 2017, LLFN confirmed there are a total of four land use sites within the PDA. LLFN also confirmed that these are not sacred sites and further detail is confidential. GGM and LLFN have agreed upon a path forward for these sites.
- A tent or temporary structure, as well as a route connecting Mosher Lake and Highway 11, both within the PDA (MNO). Based on the layout of the PDA, Mosher Lake will remain accessible during all phases of the Project.

- A snowmobile trail through the PDA (AFN). The Lahtis Road portion of the snowmobile trail (maintained by the Greenstone Snowmobile Club) was not open during the 2015 season and as of 2016 the snowmobile club did not have plans to maintain the trail.

Within the PDA, residual environmental effects to cultural or spiritual sites and areas are considered adverse and are expected during construction of the Project because of removal of cultural and spiritual sites. Construction activities will result in permanent removal of the sites identified by LLFN, MNO and AFN. Residual effects on cultural or spiritual sites within the PDA are predicted to be a single event characterized as high in magnitude as it will eliminate TLRU. Once removed, cultural and spiritual sites cannot be renewed or returned to baseline conditions, therefore residual effect will extend beyond active closure (long term in duration) and will be irreversible. See Table 18-11 of the Final EIS/EA for additional information on the residual environmental effects on cultural and spiritual areas or sites within the PDA.

GGM remains committed to continuing its outreach activities, to keep Aboriginal communities informed of the Project and to provide transparency about GGM's environmental management and monitoring performance as well as to continue to provide opportunities to discuss interests and comments, and resolve issues, related to the Project.

Within the Traditional Land and Resource Use LAA, residual environmental effects on availability of or access to cultural or spiritual practices, sites or areas are considered adverse and are expected through construction, operation, and closure phases of the Project because of disturbance of sites and changes to access conditions. The residual environmental effect will alter but not eliminate the ability to use the LAA for cultural and spiritual practices, sites and areas (moderate magnitude). Effects on the ability to access potential cultural or spiritual areas within the of the Traditional Land and Resource Use LAA will occur continuously throughout construction, operation, and active closure (medium -term) but are likely to be reversed after active closure as access to the PDA will be restored. See Table 18-11 of the Final EIS/EA for additional information on the residual environmental effects on cultural and spiritual areas or within the Traditional Land and Resource Use LAA.

7.4.2.2 Assessment of Potential Environmental Effects on the Atmospheric Environment

a) Assessment of Change in Ambient Air Quality

The Atmospheric Environment VC assessment presented in Chapter 7.0 of the Final EIS/EA concluded that, during Project construction, emissions of air parameters of potential concern may result from site preparation activities and the construction of Project components. These emissions would include particulate and combustion gases from construction equipment, and particulate (dust) emissions caused by such things as the operation of heavy earth-moving equipment and wind erosion. Many of the construction activities would not occur continuously (i.e., intermittent), nor would all activities occur concurrently at any given time. Construction activities would occur during daytime hours over the duration of the construction phase.

During Project operation, emissions of air parameters of potential concern may result from the combustion of diesel fuel in mining equipment, natural gas combustion in the power plant, and other stationary equipment used during operation.

Active closure emissions are expected to be less than construction emissions (as no ore extraction or tailings management facility construction would be occurring). The post-closure phase is expected to generate negligible air emissions.

Emissions of parameters of potential concern will occur during Project construction and closure primarily due to the combustion of diesel fuel from construction equipment. These activities are minor and are not predicted to result in emissions that exceed provincial air quality regulations or national objectives.

Results of the air dispersion modelling for operation indicate that there would be an increase in parameters of potential concern above baseline conditions that will extend beyond the Project development area, but be within regulatory limits and objectives at all outside modelled property boundary receptor locations (non-GGM owned/leased land) with the exception of infrequent 24-hour average of particulate matter close to the modelled property boundary (e.g., no more than 6 days in 5-years, or 0.3% of the time). At inside modelled property boundary receptors (primarily GGM owned/leased land), infrequent exceedances of particulate matter and manganese were predicted during the first two years of operation, and at the Kenogamisis Golf Club during operation. Residual concentrations of benzene and benzo(a)pyrene from vehicle tailpipe emissions also exceeded applicable criteria at inside and outside modelled property boundary receptors as the baseline levels of both benzene and benzo(a)pyrene are above applicable air quality criteria. These infrequent and minor increases above applicable regulatory criteria were further evaluated in the human and ecological risk assessment. Overall, they represent a negligible human health risk.

b) Assessment of Change in Lighting

The assessment of changes in lighting presented in Chapter 7.0 of the Final EIS/EA concluded that, during construction, operation, and active closure it is predicted that changes to ambient lighting will extend beyond the Project development area and into the local assessment area. However, the Project's effect on ambient lighting is predicted to be below the relevant International Commission on Illumination guideline levels (CIE Guidelines) at all assessed receptors (refer to Chapter 7.0 of the Final EIS/EA for further information). The waste rock storage areas (WRSAs) will act as a barrier to light from the process plant and mobile equipment. Forested areas are also predicted to reduce the effect of process plant lighting and mobile equipment.

7.4.2.3 Assessment of Potential Environmental Effects on the Acoustic Environment

The Acoustic Environment VC assessment presented in Chapter 8.0 of the Final EIS/EA concluded that noise levels within the Acoustic Environment VC LAA will increase primarily due to the operation of equipment and blasting within the open pit; however, the predicted noise emission levels at points of reception and points of interest will comply with applicable guideline criteria and thresholds. In general, the predicted sound levels for the areas adjacent to PDA (including the Southwest Arm of Kenogamisis Lake and Mosher Lake) could be between 40 to 45 dBA. These sound levels would be characteristic of a rural environment where sounds of the natural environment dominate, such as the sounds of water (i.e., waves), rustling leaves or other sounds heard in a forested area. Exceptions would include the area along the shoreline of the Southwest Arm of Kenogamisis Lake (adjacent to the PDA) where sounds levels are predicted to be between 45 to 50 dBA, a sound level that is consistent with the hum experienced in an urban environment.

In addition, the assessment concluded that the predicted vibration levels at points of reception and points of interest will comply with applicable guideline criteria and thresholds. Vibration generated by the Project is not anticipated to extend beyond the PDA. A forested buffer around the PDA (including the shoreline of Southwest Arm of Kenogamisis Lake) would attenuate Project sound levels.

The predicted sounds and vibration levels were conservatively modelled as described in the "Technical Data Report – Hardrock Project: Acoustic Environment" (Appendix F2) of the Final EIS/EA (e.g., construction activities occur along the perimeter of the PDA and road construction along the realigned Highway 11 within the right-of-way; no attenuation is provided by enclosures/structures; stationary sources emitting sound were modelled as concentrated point sources).

7.4.2.4 Assessment of Potential Environmental Effects on Land and Resource Use (Visual Quality)

As discussed in Chapter 16.0 of the Final EIS/EA, Project-related vegetation clearing, timber harvesting and the construction of Project components will cause changes in the local visual setting. These changes will continue during the operations phase with the development of the tailings management facility (TMF) and WRSAs. During operation, the area covered by the WRSAs and TMF and their height above ground level and existing tree line will continue to increase. These two Project components are predicted to be the most visually prominent features in the Land and Resource Use LAA. The distance from the peak of WRSA A to the closest point of shoreline along the Southwest Arm of Kenogamisis Lake is approximately 340 m. The visual setting will be permanently altered to varying degrees due to the WRSAs and TMF. Land user experience in proximity to the PDA will be permanently altered. The visual setting from several vantage points will be changed from existing conditions; in particular, the viewscape from Kenogamisis Lake will include the WRSAs and TMF. From other vantage points in the Land and Resource Use LAA, Project components may not be visible or will be only partially visible relative to the existing landscape.

7.4.3 Summary of Residual Effects Related to Current Use

This section considers how residual effects may affect current use. The information provided by Aboriginal communities regarding current use was conducive to allow for a separation of residual effects discussions for individual Aboriginal communities. In an effort to have individual Aboriginal communities have standalone sections, these discussions are necessarily repetitive.

7.4.3.1 Summary of Residual Effects Related to Current Use

7.4.3.1.1 Availability of Species and Access to Harvesting and Use Sites

a) Animbiigoo Zaagi'igan Anishinaabek

Secondary source information and consultation input has confirmed that AZA TLRU practices include plant harvesting, fishing, hunting and trapping. AZA members fish in Longlac and Kenogamisis Lake and AZA reported that Elders drink water from Kenogamisis Lake and harvest a variety of game in the Traditional Land and Resource Use RAA. As noted in Chapter 18.0 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Issues of importance identified by AZA related to the harvesting of plants, fish, and wildlife, and the associated effects of development on the ability to access TLRU sites include:

- loss of plant harvesting sites
- loss of habitat for fish and wildlife species disturbance.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific AZA fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during

construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

b) Aroland First Nation

AFN confirmed that their full TK study is confidential, however they approved the use of a summary document to inform the Final EIS/EA. AFN TLRU practices in the RAA include hunting, fishing, trapping, gathering, travel routes, camp sites, cultural sites, habitation sites, and sites of traditional ecological knowledge. AFN identified traditional plants, fish and wildlife of importance to their diet, economy, and cultural, spiritual, and recreational activities. Through consultation with the CEA Agency, AFN members identified the following fish species of importance: whitefish, walleye, sucker, sturgeon, trout, dace, and minnows. Through consultation, moose hunting was also identified as important to AFN. AFN members use cultural areas, including travel routes, sacred areas, communal gathering areas, and habitation sites which may occur in the PDA or Traditional Land and Resource Use LAA or RAA. As noted in Chapter 18.0 of the Final EIS/EZ TLRU locations and activities were assumed to occur within the RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Issues of importance identified by AFN related to the harvesting of plants, fish, and wildlife, and the associated effects of development on the ability to access TLRU sites include:

- loss or contamination of plant species of importance including wild rice and weekah (assumed to be wike [sweet flag])
- loss and degradation of the quality of lands and resources for fish, wildlife and traditional purposes
- loss of access to/use of lands and resources for traditional purposes (e.g., snowmobile trails through the PDA [Lahtis Road]).

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific AFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

c) Biigtigong Nishnaabeg

Consultation input from Biigtigong Nishnaabeg raised comments regarding health effects on wildlife, including moose and bears from the TMF (Record of Consultation; Appendix C3). In addition to consultation results, no TLRU information relevant to Biigtigong Nishnaabeg has been identified through a review of publicly available information. As noted in Chapter 18 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses. The Project is expected to result in the reduction of habitat used by animals due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

d) Biinijitiwaabik Zaaging Anishinaabek

During consultation, BZA requested information regarding fish species in Goldfield Creek as well as fish spawning activity. In addition to consultation results, no TLRU information relevant to BZA has been identified through a review of publicly available information. As noted in Chapter 18.0 of the Final EIS/EA TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific BZA fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

e) Bingwi Neyaashi Anishinaabek

During consultation, BNA provided comments about hunting areas identified around the Project and requested information regarding effects on swamplands in Geraldton; BNA also requested information regarding groundwater seepage and hydrogeology modelling and stated the importance of water treatment and controlling the release of contaminated water. In addition to consultation results, no TLRU information relevant to BNA has been identified through a review of publicly available information. As noted in Chapter 18.0 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA. Swamplands in Geraldton are outside the PDA and Traditional Land and Resource Use LAA. Effects are not predicted to extend beyond the LAA boundary, therefore swamplands located in Geraldton are not addressed in the Final EIS/EA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

f) Constance Lake First Nation

During consultation for the Project, CLFN requested information regarding effects on fish migration and spawning activities, including the Goldfield Creek and Southwest Arm Tributary drainages as well as potential effects on fish, wildlife and harvesting as a result of contamination resulting from the Project. CLFN also requested information regarding mitigation measures to manage water quality during Project activities and to address potential effects on fish habitat. In addition to consultation results, no TLRU information relevant to CLFN has been identified through a review of publicly available information. As noted in Chapter 18 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific CLFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

g) Eabametoong First Nation

A Project-specific TK study has confirmed that EFN's TLRU practices include fishing, hunting, and cultural continuity. EFN member identified plant harvesting as important, in particular gathering blueberries within the LAA. Fishing is also important to EFN members as several species including northern pike, minnow, pickerel, and whitefish are reported to be harvested within the PDA. EFN members also noted the importance of fish spawning within the PDA. Hunting and trapping is important to EFN members' way of life and reported a rabbit snaring site within the PDA. EFN define cultural and traditional practices as cultural continuity, which can include teachings, travelling, place-based stories and values, spirituality, burial sites, and subsistence activities such as plant and medicine gathering. Several sites of cultural continuity were identified within the Traditional Land and Resource Use LAA and RAA. EFN provided comments regarding the effects of contamination on the landscape and that reduced access and availability of TLRU may have effects on cultural transmission. As noted in Section Chapter 18 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Issues of importance identified by EFN related to the harvesting of plants, fish, and wildlife; cultural continuity; and, the associated effects of development on the ability to access TLRU sites include:

- change to plant harvesting in the Traditional Land and Resource Use LAA (e.g., dust on berries)
- loss of fish harvesting in the PDA
- loss of hunting areas in the PDA
- loss of access to/use of TLRU areas leading to a decreased time being spent on the land and transmission of knowledge.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. EFN has identified subsistence sites in the PDA that may include fishing sites (EFN Knowledge and Use Study; Appendix J5). The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during

construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

h) Ginoogaming First Nation

A Project-specific SIA study has confirmed that GFN TLRU practices include harvesting plants for food, medicine, and cultural purposes; fishing; hunting and trapping; and cultural practices. GFN members noted the importance of moose as a source of meat. Kenogamisis Lake was noted as important habitat for sweetgrass and for fishing and hunting. GFN members highlighted the importance of these traditional and cultural uses and their connection to the land for healing practices. GFN indicated that the decrease in the availability and access to fish, wildlife, and traditional plants could diminish the strong connection that GFN members have to the land and their traditional practices. As noted in Chapter 18.0 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Issues of importance identified by GFN related to the harvesting of plants, fish, and wildlife; cultural practices; and, the associated effects of development on the ability to access TLRU sites include:

- loss of plant harvesting in the Traditional Land and Resource Use LAA (e.g., sweetgrass along the shores of Kenogamisis Lake).
- loss of fish harvesting in the PDA.
- loss of hunting areas in the PDA (e.g., loss of moose foraging habitat in the PDA).
- increased pressure on resources (e.g., hunting and fishing pressure from mine workers).

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific GFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during

construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

i) Long Lake #58 First Nation

A Project-specific TK Assessment has confirmed that LLFN's TLRU practices in the Traditional Land and Resource Use RAA include gathering berries and plants for medicinal uses and firewood, hunting, trapping, camping, ceremonies, and teaching. Locally caught fish are an important part of LLFN members diet. The LLFN TK Assessment (Appendix J1) identifies four campsite or cabin areas in the PDA. In addition, comments from LLFN to the CEA Agency identified a heritage site "located within the proposed realignment of Highway 11". During GGM and LLFN follow-up meetings on April 18 and 19, 2017 LLFN confirmed there are a total of four "land use" sites within the PDA. LLFN also confirmed that these are not sacred sites and further detail is confidential. The land use sites are in the same general locations as the campsite or cabin areas identified in the TK Assessment. GGM and LLFN have agreed upon a path forward for these sites. As noted in Chapter 18.0 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Issues of importance identified by LLFN related to the harvesting of plants, fish, and wildlife; cultural practices; and, the associated effects of development on the ability to access TLRU sites include:

- loss of plant species in the Traditional Land and Resource Use LAA (e.g., loss of sweetgrass if water levels rise in Kenogamisis Lake).
- loss of fish harvesting in the PDA (e.g., walleye).
- loss of wildlife harvesting in the Traditional Land and Resource Use LAA.
- loss of access to sites and activities within the PDA (e.g., four campsite/cabin sites).

Where there is interest, GGM will provide opportunities to local communities for harvesting of plants for traditional purposes prior to construction. The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the LAA. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is not aware of specific LLFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

j) Marten Falls First Nation

Secondary source information and consultation results indicate that MFFN TLRU practices include traditional activities such as moose hunting. As noted in Section Chapter 18.0 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Issues of importance identified by MFFN related to water quality, harvesting of wildlife and effects of development on the ability to access TLRU sites include loss of hunted species in the Traditional Land and Resource Use LAA such as moose.

The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

k) Métis Nation of Ontario

A Project-specific TKLU study has confirmed that MNO's TLRU practices include hunting, fishing and gathering activities. MNO members have identified key plant species including ferns, berries (blueberries and raspberries), herbs, chanterelle and shaggy mane mushrooms, chaga mushrooms, and trees. Fish species of importance to MNO members include trout, northern pike, walleye, whitefish, and sturgeon. Fishing areas of importance are Kenogamisis Lake, Goldfield Lake, Magnet Creek, and Moser Lake. Important species that are harvested by MNO members include moose, deer, ruffed grouse, geese, and various duck species. Sacred areas, including those associated with harvesting, are important to MNO members. MNO reported a tent or temporary structure south of Mosher Lake and a route connecting Highway 11 with Mosher Lake, both located within the PDA. As noted in Chapter 18.0 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Issues of importance identified by MNO related to the harvesting of plants, fish, and wildlife; cultural practices; and, the associated effects of development on the ability to access TLRU sites include:

- loss of plant harvesting sites in the Traditional Land and Resource Use LAA including perceived contamination in areas near the Southwest Arm of Kenogamisis Lake
- loss of fishing in the PDA
- reduction in the availability of hunted and trapped species in the Traditional Land and Resource Use LAA
- loss of access to land use areas and Kenogamisis Lake through Lahtis Road.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. MNO has identified the Southwest Arm Tributary as a fishing site within the PDA (MNO TKLU Study; Appendix J3 of the Final EIS/EA). The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

l) Pays Plat First Nation

A Project-specific Watershed study has confirmed that PPFN's TLRU practices include harvesting plants, fishing, hunting, trapping, using trails and travelways, and holding ceremonies. Of particular importance to PPFN members are wildlife populations including moose. As noted in Chapter 18.0 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the

RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses.

Issues of importance related to the harvesting of plants, fish, and wildlife and effects of development on the ability to access TLRU sites include:

- loss of plant harvesting sites in the Traditional Land and Resource Use LAA
- loss of fishing in the PDA
- loss of hunting areas in the PDA (e.g., loss of moose foraging habitat in the PDA)
- loss of access to land use areas and Kenogamisis Lake through Lahtis Road.

The Project is expected to result in the loss of plant harvesting sites within the PDA due to vegetation clearing and effects from dust deposition extending approximately 30 m from the PDA boundary. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific PPFN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur. The closure of Lahtis Road at Highway 11 will alter access to TLRU areas located adjacent to the PDA along the shoreline of the Southwest Arm of Kenogamisis Lake. GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The Project is expected to result in the reduction of wildlife habitat due to vegetation clearing in the PDA and sensory disturbance that may extend into the Traditional Land and Resource Use LAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

m) Pic Mobert First Nation

Through consultation, PMFN provided comments regarding Project effects on commercial traplines near Caramat Road, which is outside the TLRU RAA (Record of Consultation; Appendix C3 of the Final EIS/EA). In addition to consultation results, no TLRU information relevant to PMFN has been identified through a review of publicly available information. As noted in Chapter 18 of the Final EIS/EA, TLRU locations and activities were assumed to occur within the Traditional Land and Resource Use RAA, even if an Aboriginal community did not specifically identify these activities or site-specific uses. The Project is predicted to have no effects on the traplines identified by PMFN as they are outside the Traditional Land and Resource Use RAA.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

n) Red Sky Métis Independent Nation

Through consultation, RSMIN members provided comments regarding Project effects on fish habitat in Goldfield Creek (Record of Consultation; Appendix C3 of the Final EIS/EA). In addition to consultation results, no TLRU information relevant to RSMIN has been identified through a review of publicly available information. Fish habitat that is altered or lost will be offset by creating new habitat within the Goldfield Creek realignment. A conservative approach will be taken, whereby a greater area of new habitat will be created than the area lost or altered. Overall, there will be no net loss of areas for fishing as a result of the Project. However, due to safety concerns, access to the PDA will be restricted during construction and continue through operation and active closure, resulting in the loss of availability of some fishing sites in the PDA and altered access to some fishing areas within the Traditional Land and Resource Use LAA. GGM is not aware of specific RSMIN fishing sites in the PDA, but acknowledges the potential for Aboriginal fishing to occur.

Overall, the Project is not expected to limit the availability of traditional resources within the Traditional Land and Resource Use LAA or RAA.

7.4.3.2 Sensory Disturbance

While sensory disturbance due to changes in air quality, ambient lighting, acoustics and vibration and changes in visual setting is predicted for users of traditional use sites and areas, that disturbance will be experienced primarily in areas located very near to the PDA and will decrease substantially or be eliminated entirely as distance from the PDA boundary increases.

Project-related emissions of particulate matter (dust) are predicted to meet regulated requirements for all Project phases except for a small area close to the PDA where the increase in particulate matter above MOECC guidelines will be infrequent (i.e., no more than 0.1% of the time) and limited to the first phase operation of the mill (refer to Figure 7-7 in the Atmospheric Environment VC Chapter 7.0 of the Final EIS/EA). The Project's effect on ambient lighting is predicted to be below the relevant CIE Guideline levels at all the assessed receptors (refer to Chapter 7.0 of the Final EIS/EA for further information). The WRSAs will act as a barrier to light from the process plant and mobile equipment. Forested areas are also predicted to reduce the effect of process plant lighting and mobile equipment.

Predicted increases in Project-related noise and vibration will comply with applicable regulations at all assessed points of reception including the points of interest located within MacLeod Provincial Park. In general, the predicted sound levels for the areas adjacent to PDA including the Southwest Arm of Kenogamisis Lake and Mosher Lake are between 40 to 45 dBA. These sounds levels are characteristic of a rural environment where sounds of the natural environment dominate such as the sounds of water (i.e., waves), rustling leaves or other sounds heard in a forested area. Exceptions include the area along the shoreline of Southwest Arm of Kenogamisis Lake adjacent to the PDA where sounds levels are predicted to be between 45 to 50 dBA, which is considered consistent with the hum from an urban environment. Vibration generated by the Project is not anticipated beyond the PDA. A forested buffer around the PDA including the shoreline of Southwest Arm of Kenogamisis Lake would attenuate Project sound levels. It should be noted that these predicted sounds and vibration levels are conservatively modelled as detailed in the "Technical Data Report – Hardrock Project: Acoustic Environment" (Appendix F2 of the Final EIS/EA) (e.g., construction activities occur along the perimeter of the PDA and road construction along the realigned Highway 11 within the right-of-way; no attenuation is provided by enclosures/structures; stationary sources emitting sound were modelled as concentrated point sources). Sensory disturbance to users due to Project-related emissions (e.g., dust, light, noise and vibration) in the Land and Resource Use VC LAA is not anticipated.

Changes to the visual setting will commence during construction with the start of vegetation clearing, timber harvesting and the construction of Project components. Changes to the visual landscape will continue throughout the operation phase with the development of the TMF and WRSAs. During operation, the WRSAs and TMF will continue to increase in geographic extent and height above ground level and the surrounding tree line. These two Project components are predicted to be the most visually prominent features in the LAA. The WRSAs are predicted to be visible from the four vantage points as shown on Appendix N of the Final EIS/EA. The distance from the peak of WRSA A to the closest point of shoreline along the Southwest Arm of Kenogamisis Lake is approximately 340 m. Given the orientation of the campsites at MacLeod Provincial Park, it is not expected that campers at the park will have a direct view of the PDA. The approximate distance from campsite 38 (the closest campsite to the Project) to the peak of WRSA A is 1,580 m, while the distance from the closest shoreline of MacLeod Provincial Park to the peak of WRSA is 955 m. It is expected that users of the recreational trail and day-use area including the beach within MacLeod Provincial Park would see the WRSA from vantage points within the Park.

The visual setting in the will be permanently altered to varying degrees due to the WRSAs and TMF. The visual setting from several vantage points will be changed from existing conditions; the viewscape from Kenogamisis Lake will include the WRSAs and TMF. Change in land user experience will vary depending on proximity to the PDA. There is potential for some users to shift their activities to areas that are further away from the PDA. However, the predicted residual effect on visual quality is in the context of a local environment that has been disturbed by mining, forestry and development over the past 90 years. The existing visual character of the PDA consists of Highway 11, commercial and residential properties, deciduous and coniferous forest cover, wetlands such as swamps, marshes, bogs and fens, and historical mining area that were altered through past forestry and mining activities.

7.4.3.3 Change to Cultural Value or Importance Associated with Current Use

Changes to the cultural value or importance associated with current use may take place through effects on tangible and intangible values. AFN noted that land use is important to traditional and cultural life and provides a social fabric to relationships with other AFN members. Potential effects on individual and community TK and skills because of loss of lands and resources used for traditional purposes were also identified by AFN. LLFN noted that areas used to teach are a vital source of information that cannot be replaced if damaged. EFN identified the potential for decreased transmission of knowledge and time being spent on the land arising from the degradation of harvestable resources and restricted access to TLRU areas. These comments identify potential effects to both tangible and intangible values associated with cultural value or importance of current use. A loss of lands or resources, including the degradation of harvestable resources and restricted access to TLRU areas, are potential effects on tangible values, as these effects are related to quantifiably measurable items such as changes in areas of cleared land, wildlife, vegetation and fish, and access conditions. Changes to individual and community traditional knowledge and skills, decreased transmission of knowledge and altered relationships with other community members (identified by AFN, EFN but which may be experienced by other Aboriginal communities as well) are potential effects on intangible values, as these items are conditional and experiential and cannot be observed or quantified in the same way.

Mitigation has been developed to address potential effects on both tangible and intangible values related to current use. Effects on tangible values such as a loss of lands and resources are primarily addressed through Project design and siting, since the Project is a redevelopment of a previously disturbed brownfield site. Application of the mitigation measures presented in Section 6 of this report, such as limiting the construction footprint and the number of watersheds overprinted by the PDA, will also mitigate loss of lands and resources. Restricting vegetation clearing activities to the PDA and implementing the used of mechanical vegetation removal practices when possible will mitigate degradation of harvestable resources. Restricted access to TLRU areas will be addressed through several mitigation measures including GGM's commitment to maintain alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation. The LLFN Traditional Knowledge Assessment noted "…no uses were highlighted which create a potential no-go area…", and as a result residual effects on LLFN teaching areas are not expected.

It is acknowledged that effects to intangible values are not quantifiable in the same way that effects to tangible values are. However, since tangible and intangible values are often connected, mitigation measures aimed at avoiding or reducing effects to tangible values could also help to avoid or reduce effects to intangible values. Changes to individual and community traditional knowledge and skills, decreased transmission of knowledge, and altered relationships with other community members would be personal and subjective changes to the cultural value or importance of current use. The cultural value or importance of current use is determined both individually by Aboriginal peoples as well as collectively by an Aboriginal community as a whole, and may also be unique for each Aboriginal community. The possibility of encountering residual Project effects that would change intangible values will be reduced though careful Project design and application of mitigation measures presented in Section 6 of this report. However, in light of the subjective nature of intangible values, it is difficult to evaluate the how effective the mitigation might be. Residual effects will be managed through application of the environmental monitoring program and other commitments outlined in Section 6.3 of this report. Should residual effects of the Project on the cultural value or importance of current use be identified by Aboriginal communities as an ongoing concern, there are several mechanisms through which those effects may be mitigated. The environmental management and monitoring plans may be adapted based on feedback from Aboriginal communities. GGM has proposed to form Aboriginal Environment Committee(s) through which additional mitigation may be developed. GGM can also provide support for Aboriginal communities to continue cultural practices through TK studies or other efforts to maintain intangible component of current use. Through these tangible and collaborative mechanisms, GGM will be able to work with Aboriginal communities to reasonably address concerns about effects to intangible values, should they arise during the Project.

7.4.4 Significance Determination for VCs Related to Current Use

The Project may result in reduced access to land and a reduction in the availability of resources relied upon for the pursuit of traditional activities such as plant harvesting, fishing, hunting, trapping, and access to cultural or spiritual sites (where they may exist). The PDA is in a previously disturbed area from historical mining, forestry, aggregate extraction, highway transportation, mineral exploration, residential and industrial land uses, and most TLRU sites were identified outside of the PDA. While access to the PDA will be limited for the lifetime of the Project, rehabilitation will be undertaken during closure and TLRU sites and areas within the Traditional Land and Resource Use LAA, except for Lahtis Road, will continue to be accessible during Project construction, operation, and closure.

The residual environmental effects from the Project on current use are determined to be not significant because they do not result in the long-term loss of availability of traditional use resources or access to lands relied on for traditional use practices or the permanent loss of current sites and areas in the Traditional Land and Resource Use LAA and RAA. The ability of Aboriginal communities to maintain current use outside of the PDA will be maintained with some access changes, as GGM is committed to maintaining alternate access within the PDA to the Southwest Arm of Kenogamisis Lake during construction and operation.

7.4.5 Aboriginal and Treaty Rights

As discussed in Section 2.3 of this report, for the purposes of this assessment, effects on potential or established Aboriginal or treaty rights are addressed through the assessment of TLRU. By acknowledging a link between practice-based rights and TLRU activities, this assessment anticipates that if significant residual effects on TLRU were to occur, they would have a consequent effect on the ability of Aboriginal people to exercise potential or established Aboriginal and treaty rights. Residual effects for the potential Project effects on availability of plant species and access to plant harvesting areas and activities, availability of fish species and access to fishing areas and activities, availability of hunted and trapped species, and access to hunting and trapping areas and activities are summarized in Section 7.4.3 of this report. Due to access restrictions and disturbance of the PDA to enable the Project to proceed, Aboriginal communities will not be able to exercise Aboriginal or treaty rights within the PDA. Effects of the Project are not anticipated to result in the long-term loss of availability of traditional resources, or loss of access to lands relied on for traditional use practices, or the permanent loss of current sites and areas outside of the PDA. Thus effects on TLRU have been characterized as not significant. As a result, it is anticipated that Aboriginal communities will continue to have the ability to exercise Aboriginal and treaty rights outside of the PDA.

7.4.6 Overall Summary and Determination of Significance for Current Use

The Traditional Land and Resource Use, Atmospheric Environment, Acoustic Environment and Land and Resource Use VCs concluded that Project-related environmental effects were not significant. Those VCs informed the discussion in relation to Key Topics associated with effects of changes to the environment on current use. The possibility of encountering residual Project effects that might change the cultural value or importance associated with current use may be reduced through careful Project design and the mitigation measures identified through these related VC assessments (also presented in Section 6 of this report). Residual effects on intangible values will be managed through the development and implementation of the environmental management and monitoring plans, creation of Aboriginal Environment Committee(s), and GGM's support of cultural practices, among other commitments listed in Section 6.3 of this report. Through these tangible and collaborative mechanisms, GGM will be able to work with Aboriginal communities to reasonably address concerns about effect to intangible values, should the arise during the Project.

In consideration of identified mitigation, information provided by Aboriginal communities, the context of the Project being located in large part on brownfield conditions with an ability to carry out enhanced reclamation of historical tailings that affect the main local resource (Kenogamisis Lake) under baseline conditions, and specific consideration of how the effects of those changes to the environment might affect current use, the residual effects of changes to the environment on current use are characterized as not significant for all Project phases. In light of this conclusion, it is anticipated that Aboriginal communities will continue to have the ability to exercise Aboriginal and treaty rights outside of the PDA (see Sections 2.3 and 7.5.4 of this document).

8.0 CUMULATIVE ENVIRONMENTAL EFFECTS

8.1 CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT

8.1.1 Introduction

The purpose of this section is to consider whether there are cumulative environmental effects resulting from the interaction of residual effects from this Project with the residual effects of other past, present, and reasonably foreseeable future projects or activities that may cause a change to one or more of the Section 5(1)(c) Factors.

The following sections describe how cumulative environmental effects were assessed for the Project (Chapter 20.0 of the Final EIS/EA; Stantec 2017d). The conclusions that were drawn in identifying the VCs that would be carried forward for assessment were examined to verify that the perspective of potential effects on Aboriginal persons was considered in these determinations. A summary of the assessment for each VC is provided and provides the background and context for the discussion of whether the identified cumulative environmental effects would combine to cause a change to one or more of the Section 5(1)(c) Factors.

8.1.2 Selection of VCs for Cumulative Environmental Effects Assessment

Two conditions were used to determine which VCs would be carried forward for an assessment of cumulative effects in the EIS/EA: 1) that there are adverse residual effects identified for the VC in question; and 2) that the residual effects of the Project overlap spatially or temporally with the residual effects from other past, present, or reasonably foreseeable future projects or activities.

Using these criteria, the six VCs described below were not carried forward for assessment of cumulative effects.

Human and Ecological Health: The assessment of human and ecological health in Chapter 19 of the Final EIS/EA determined that the Project will have a minimal effect on air quality and that this change will have a negligible effect on human and ecological health. The assessment also determined that the Project will have a minimal effect on surface water quality, and for some metals, may improve existing surface water quality. The assessment also determined that there would be negligible changes (and for some metals improvements) in the human health and ecological risks related to drinking surface water and eating fish from Kenogamisis Lake. Monitoring will confirm future metal concentrations in surface water and fish tissue. The Project will have negligible effects on human and ecological health, which were determined to be not significant. This means that there is no mechanism through which the Project could result in overlapping cumulative effects with other projects or activities. Therefore, it was determined that no assessment of cumulative effects of human and ecological health was warranted.

The Human and Ecological Health VC (Chapter 19.0 of the Final EIS/EA; Stantec 2017d), and the HHERA upon which that assessment is based, included consideration of Aboriginal peoples through the inclusion of community receptors for air quality modelling and Aboriginal/High Use Receptors. Therefore, the rationale provided for excluding human and ecological health from the assessment of cumulative environmental effects is reasonable in consideration of the potential effects of changes to the environment on Aboriginal people.

Acoustic Environment: The Project will result in an increase in noise and vibration levels. The predicted noise and vibration levels at each point of reception will be within the quantitative limits as prescribed by the applicable guidelines. With the application of mitigation measures incorporated in the acoustic models, the residual Project effects on the acoustic environment for all phases of the Project are predicted to be not significant. None of the future project or activities are located within the acoustic RAA, as such no spatial overlap could occur and therefore is no pathway for cumulative effects to occur. As such, no cumulative effects assessment is warranted.

Heritage Resources: With the proposed mitigation (creation of buffer zones, documentation and salvage, and commemoration), no residual adverse effects on heritage resources are anticipated. In the absence of measurable residual effects, there is no pathway through which the Project could result in overlapping cumulative effects with other future projects or activities; as such, no cumulative effects assessment is warranted. This determination is reasonable in consideration of the potential effects of changes to the environment on Aboriginal people.

Groundwater: Two potential future projects were identified that may have a potential spatial and temporal overlap with the Project (Geraldton subdivision, Union Gas pipeline). The magnitude of any drawdown is anticipated to be low due to the limited depths that these types of infrastructure are typically installed. The effect of drawdown would be confined to the area directly around the infrastructure, and is considered short term as it will only occur during construction. With the implementation of current best management and design mitigation measures, it was determined that neither project is anticipated to result in overlapping residual effects with the Project on groundwater quantity, and therefore cumulative effects with the Project are not anticipated.

Surface Water: One future project, the Bankfield West Mineral Exploration, may have a potential spatial and temporal overlap with the Project. It is assumed that no temporary camp will be required for the exploration project and no Environmental Compliance Approval for discharge will be required. With the implementation of mitigation, this project is not anticipated to result in overlapping residual effects with the Project on surface water quality, and therefore cumulative effects with the Project are not anticipated.

Fish and Fish Habitat: None of the future activities identified are considered likely to interact cumulatively with the Project because they are either not located within the Kenogamisis River watershed or there is no physical connection to surface water. As there are no identified residual effects from other activities that would overlap with the residual effects of the Project, cumulative effects with the Project are not anticipated.

The remaining seven VCs met both identified criteria and were carried through a cumulative effects assessment.

8.2 EFFECTS OF CUMULATIVE CHANGES TO THE ENVIRONMENT ON ABORIGINAL PEOPLE

A cumulative effects assessment was carried out in the Final EIS/EA for the seven remaining VCs: atmospheric environment; vegetation communities; wildlife and wildlife habitat; labour and economy; community services and infrastructure; land and resource use; and TLRU. The following sections consider how the results of the cumulative effects assessment may contribute to changes in conditions for Aboriginal people.

8.2.1 Aboriginal Health Conditions

The VCs that contribute most directly to potential changes in Aboriginal health conditions are atmospheric environment; acoustic environment; groundwater; surface water; fish and fish habitat; vegetation communities; wildlife and wildlife habitat; and human and ecological health. As discussed above, a number of these were not carried forward for consideration of cumulative effects. Therefore, the VCs that are related to Aboriginal health conditions, which were carried forward for the assessment of cumulative effects are: atmospheric environment; vegetation communities; and wildlife and wildlife habitat.

With mitigation, the maximum predicted concentrations of all PoPC were below applicable criteria during operation at all of the assessed property modelling locations with the exception of infrequent 24-hour averages of PM_{10} and $PM_{2.5}$ close to the modelled property boundary. Given the proximity and description of future physical activities, Project environmental effects will likely act cumulatively with those of other physical activities, but the resulting cumulative effects are unlikely to exceed acceptable levels with the application of management practices and proposed mitigation measures at each project. This assessment included consideration of receptors representing Aboriginal land and resource use; therefore, it is applicable in the consideration of the Key Topics related to Aboriginal health conditions.

A cumulative change in the abundance of plant species of interest to Aboriginal communities is predicted. Potential habitats for the plant species of interest to Aboriginal communities are common and widespread in the RAA (Chapter 12.0 of the Final EIS/EA; Stantec 2017d) and the viability and distribution of populations of these species are not expected to be adversely affected in the RAA. The residual adverse cumulative effects on vegetated ecosites supporting vegetation species of interest, vegetation communities, and function, connectivity and quality of vegetation communities are predicted to not affect the long-term continued viability of vegetation communities identified in this assessment in the RAA and are therefore predicted to be not significant. This assessment of vegetation communities included consideration of Aboriginal use; therefore, it is applicable in the consideration of the Key Topics related to Aboriginal health conditions.

The residual cumulative environmental effects from the Project and other future physical activities on wildlife and wildlife habitat are determined to be not significant because they do not threaten the long-term persistence or viability of a wildlife species (including species at risk, species of conservation concern, and species of stakeholder concern) within the RAA. The overall cumulative environmental effect on mortality risk and movement within the RAA is expected to have a similar profile to the existing condition. Sources of mortality risk are unlikely to affect the long-term persistence or viability of any species within the RAA. Disruption of wildlife movement from Highway 11 and urban and industrial development in the northern half of the RAA is unlikely to affect the long-term persistence or viability of any species within the RAA. The assessment of wildlife species included consideration of Aboriginal use; therefore, it is applicable in the consideration of the Key Topics related to Aboriginal health conditions.

As the potential cumulative environmental effects for the VCs related to Aboriginal peoples' health conditions have been determined to be not significant, it expected that cumulative environmental effects on Aboriginal health conditions will be not significant.

8.2.2 Aboriginal Socio-Economic Conditions

The VCs that contribute most directly to potential changes in Aboriginal socio-economic conditions are: labour and economy, community services and infrastructure, and land and resource use. Each of these was carried forward for the assessment of cumulative effects.

The cumulative demands of the Project will not result in an adverse effect on labour in the RAA during construction or operation. The cumulative effects of Project closure on labour conditions in the RAA are difficult to accurately predict and it is assumed that some residual cumulative effects at closure. Construction and operation of the future projects will result in increased opportunities for businesses in the RAA and may generate municipal government revenues, affect the land base that supports forestry operations, and may affect businesses that are dependent on tourism. Based on labour force conditions in the RAA, it is expected that the cumulative effects on the RAA of constructing and operating future projects would likely be positive. While the potential long-term loss of forested land based associated with each of the future projects is unknown, it is expected affected merchantable timber would be salvaged in accordance with provincial requirements. There would be limited adverse effects on businesses that directly or indirectly rely on timber harvesting in the FMU. The assessment of labour and economy is inclusive of the general labour force, regional economies and Aboriginal businesses; therefore, it is applicable in the consideration of labour and economy to the Key Topics related to Aboriginal socio-economic conditions.

There were no potential cumulative interactions identified between future projects and the potential for change in capacity of municipal and provincial services and infrastructure, or for the potential for change in the capacity of transportation services and infrastructure. These effects were therefore not carried through the assessment. The rationale provided is that the labour requirements needed for projects that overlap spatially or temporally would be minimal and not enough to cause a change to services. Landfill planning and highway upgrades are anticipated to improve the capacity of municipal and provincial services and infrastructure and transportation services and infrastructure in the RAA. The potential for future projects to have an adverse effect on the capacity of housing and accommodations was carried through the assessment. The only project expected to result in an increased demand for accommodations is the planned Geraldton subdivision. Future residential developments are unlikely to lead to an increase in the population of the RAA as they are planned to address current housing needs, and thus an increase in the demand on community services and infrastructure. The assessment of community services and infrastructure is inclusive of the general population, including use by Aboriginal peoples; therefore, it is applicable in the consideration of community services and infrastructure to the Key Topics related to Aboriginal socio-economic conditions.

There were no potential cumulative interactions identified between future projects and the potential for change in navigation, as there are no future projects that overlap with this effect. The residual cumulative effects on recreational land and resource use are expected to result in a loss of area for recreational use that is equivalent to 1.5% of the RAA. The residual cumulative effects consist of loss of accessible area, interruptions to trail use, changes in the availability of wildlife resources and sensory disturbance to resource users. Given the existing level of disturbance in the LAA, it is considered that recreational users are accustomed to the types of disturbance that will result from the interaction of the Project and the identified future physical activities. Given the existing level of disturbance, the abundance of wildlife resources and recreational opportunities, the residual cumulative effects are not anticipated to affect the long-term viability of recreational land and resource use.

Residual cumulative effects will remove area and change access to trapping, guide outfitting, and bait harvesting areas. They will also affect harvesting activity through changes as a result of the displacement of wildlife resources and sensory disturbance to users, similarly to the cumulative effects on recreational land and resource use. The residual cumulative effects will affect a small number of commercially-based land and resource users differently. Potential cumulative effects are expected for the Aboriginally held trapline area GE021 (held by a member of AZA) and GE022 (non-Aboriginal licence holder) and bear management areas GE-19-027 and GE-21A-032. The cumulative loss of accessible area will represent about 15% of trapline area GE022 (non-Aboriginal licence holder), 1% of bear management area GE-21A-032, and less than 1% of trapline area GE021 (held by a member of AZA) and one other affected tenure (non-Aboriginal licence holder). Potential cumulative effects on access may occur in bait harvesting areas NI5036, NI5027 and NI5028, which are held by non-Aboriginal licence holders, and NI5035 which is held by an Aboriginal licence holder.

Project effects related to loss of access to areas within harvesting and other tenures will be managed by communicating Project activities to tenure holders and entering into negotiations with affected tenure holders. It is reasonably expected that proponents of future physical activities would also communicate activities to local stakeholders and to enter into negotiations, as appropriate. In so doing, the cumulative effects on loss of access to tenure areas will be mitigated. Considering the mitigation proposed, the existing levels of disturbance, the size of tenure areas and access options, and the relatively low level of disturbance to harvesting activities in the RAA, the residual cumulative effects are not anticipated to affect the long-term viability of commercially-based land and resource use. The assessment of land and resource use included consideration of Aboriginal use; therefore, it is applicable in the consideration of the Key Topics related to Aboriginal socio-economic conditions.

Cumulative environmental effects for the VCs related to Aboriginal peoples' socio-economic conditions (labour and economy, community services and infrastructure, and land and resource use) have been determined to be not significant. It is expected that cumulative environmental effects on Aboriginal socio-economic conditions will also be not significant.

8.2.3 Aboriginal Physical and Cultural Heritage

As discussed above, the heritage resources VC did not identify residual Project effects and the VC was not carried forward to a cumulative effects assessment. The heritage resources VC assessment considered potential effects on archaeological resources and Euro-Canadian architectural and/or historical resources. Archaeological resources are evidence of Aboriginal populations' occupation of the area; therefore, this is determination is applicable in the consideration of the Key Topics related to Aboriginal physical and cultural heritage.

Project effects on Aboriginal architectural and/or historical resources were assessed as part of the TLRU VC. Aboriginal architectural and/or historical resources such as cabins, campsites, travel routes, ceremonial and sacred areas were considered in the assessment of change to cultural or spiritual practices, sites, or areas, as the value placed on these resources is intrinsically linked with the traditional use of the areas by Aboriginal communities. Cumulative effects on Aboriginal architectural and/or historical resources are addressed in TLRU portion of the Cumulative Effects Assessment (Section 20.12 of the Final EIS/EA; Stantec 2017d) and are also discussed in Section 8.2.4 of this report.

Cumulative environmental effects for current use have also been determined to be not significant, see Section 8.2.4 below. TLRU included an assessment of effects on cultural of spiritual practices, sites or areas which are relevant to Aboriginal physical and cultural heritage.

With mitigation, the maximum predicted concentrations of all PoPCs were below applicable criteria during operation at all off assessed property modelling locations with the exception of infrequent 24-hour average PM_{10} and $PM_{2.5}$ concentrations close to the modelled property boundary. Given the proximity and description of future physical activities (Table 20-2 of the Final EIS/EA), Project-specific residual environmental effects will likely act cumulatively with those of other physical activities, but the resulting cumulative effects are unlikely to exceed acceptable levels with the application of management practices and proposed mitigation measures at each project. The Project contribution to the overall cumulative environmental effect is discussed in Section 20.3.8.1 of the Final EIS/EA.

The residual cumulative effects of a change in ambient air quality during Project operation were assessed to result in an increase in PoPC ambient concentrations above baseline conditions but to be not significant. With the proposed mitigation and environmental protection measures incorporated into the Project and future activities, the residual cumulative environmental effect of a change in air quality is predicted as not significant.

Due to the proximity of the proposed Geraldton Subdivision in the vicinity of the PDA, there is potential for a cumulative effect for increased sky glow due to the combination of these light sources. Light emissions from the proposed subdivision would be expected to occur from street lighting and residential lights. Project construction and operation will require night-time lighting, however, interactions with the Project and other future industrial activities in the RAA are not anticipated. Lighting effects, including sky glow, will not overlap with these other projects due to the distances between these projects within the RAA and as a result there is no cumulative effect pathway and assessment is not required.

With the proposed mitigation for the Geraldton Subdivision and the Project, a residual cumulative effect on lighting is anticipated to be adverse in direction, low in magnitude, confined to the LAA, medium-term in duration, continuous, reversible and occur within a lighting environment that is typical of a rural environment with low night-time brightness. Timing is not considered applicable as light emissions are not likely to be substantially affected by seasonality.

The Project’s effect on ambient lighting is predicted to be below the relevant Commission Internationale de L’Éclairage Guideline levels at all the assessed receptors. With the proposed mitigation for the Geraldton Subdivision and the Project, the residual cumulative environmental effect of a change in lighting is predicted as not significant.

Cumulative environmental effects for heritage resources, TLRU, the atmospheric environment and land and resource use have been determined to be not significant. Given these conclusions, it is expected that cumulative environmental effects on Aboriginal physical and cultural heritage will also be not significant.

8.2.4 Current Use

The assessment of cumulative effects on TLRU is provided in Section 20.16 of the Final EIS/EA (Stantec 2017d) and considers the cumulative effects addressed for the following related VCs: atmospheric environment; vegetation communities; wildlife and wildlife habitat; and land and resource use.

The cumulative effects assessment for the atmospheric environment (Section 20.3 of the Final EIS/EA; Stantec 2017d) determined that Project residual effects are likely to interact with the environmental effects of other past, present, or reasonably foreseeable future projects or activities. Effects on air quality and visual aesthetics may result in indirect sensory disturbance to Aboriginal land users; however, residual environmental effects and the overall effect on the atmospheric environment within its RAA is determined to be not significant. As a result, the residual adverse cumulative effects on atmospheric environment are not predicted to compromise the continued viability of TLRU within the RAA for the atmospheric environment.

The cumulative effects assessment for vegetation communities (Section 20.7 of the Final EIS/EA; Stantec 2017d) predicts that Project residual effects are likely to interact with the environmental effects of other past, present, or reasonably foreseeable future projects or activities. Clearing of vegetation from past, present, and future projects, combined with the Project's clearing during construction, will result in an incremental loss of plant species of interest to Aboriginal communities, upland vegetation communities, and wetlands in the RAA for vegetation communities. However, these losses represent a small proportion of each resource within the RAA and the residual adverse cumulative effects on vegetation communities are not predicted to threaten their long-term viability or continued viability of vegetation, thus cumulative effects are determined to be not significant.

The cumulative effects assessment for wildlife and wildlife habitat (Section 20.8 of the Final EIS/EA; Stantec 2017d) identified residual cumulative effects for change in habitat, change in wildlife mortality risk and change in movement. The Project and past, present, and reasonably foreseeable future projects or activities will contribute to change in habitat within the RAA for wildlife and wildlife habitat (primarily through vegetation clearing). With respect to change in mortality risk, the cumulative effects were predicted to be minor relative to existing conditions. For change in wildlife movement, there may be localized effects on the movements of some species, but hunted and trapped wildlife species of interest for TLRU activities are highly mobile and are able to adjust their local movement patterns in response to changes in habitat configuration. Overall, the Project and past, present, and future projects or activities are not anticipated to contribute substantially to change in habitat, change in mortality risk, and change in movement and is not predicted to compromise the continued viability of wildlife and wildlife habitat within the RAA for wildlife and wildlife habitat and cumulative effects are thus determined to be not significant.

The cumulative effects assessment for land and resource use (Section 20.11 of the Final EIS/EA; Stantec 2017d) cumulative effects assessment determined that there are Project residual effects that are likely to interact with the environmental effects of other past, present, or reasonably foreseeable future projects or activities. With respect to residual cumulative effects on change in recreational land, the PDA and LAA for land and resource use include areas disturbed from previous human activity and development that have had existing effects on access, wildlife resources, and sensory disturbance. As a result, recreational land and resource users may already be accustomed to disturbed conditions, although some users may relocate to other areas in the RAA for land and resource use. With respect to residual cumulative effects on change in commercially-based land and resource use, these are related to access, availability, and competition for wildlife resources, and sensory disturbance. These are similar to the cumulative effects for recreational land and resource users for the same reasons of past disturbance. Overall, both recreational and commercially-based land and resource use is predicted to be adversely affected within the LAA for land and resource use. However, given the existing disturbance within the LAA for land and resource use and the abundance and diversity of land and resource opportunities within its RAA, the cumulative effects on recreational land users are not significant.

TLRU information has been shared during consultation activities for the Project. TLRU sites and areas were acknowledged to be within the PDA, LAA and RAA for TLRU, although precise locations were not disclosed, except for in non-confidential TK and TLRU reports. Cumulative effects on TLRU areas may occur where Aboriginal people move across the landscape. Taking the conservative approach, the movement by Aboriginal harvesters will effectively tie together effects on TLRU sites across the RAA and therefore cumulative effects can be assumed to occur throughout the assessment area.

When the effects of past, present, and reasonably foreseeable future projects or activities on the landscape are determined in combination with the residual effects of the Project, the Project's contributions to cumulative effects on TLRU are not anticipated to reduce the ability of Aboriginal people to pursue TLRU activities within the RAA. Considering the cumulative effects assessments for VCs related to TLRU and the characterization of residual effects, the cumulative effects on current use are also anticipated to be not significant.

9.0 FOLLOW-UP

Under the CEAA 2012, an EA must consider the need for, and the requirements of, follow-up and monitoring programs. A follow-up program under CEAA 2012 has the following objectives:

- to verify the accuracy of the EA predictions
- to determine the effectiveness of measures taken to mitigate the adverse environmental effects of a project.

These objectives have been expanded to include monitoring for the purpose of determining:

- compliance with environmental approvals, permits and authorizations
- adaptive management measures in the case that environmental effects differ from that predicted, or incorporate new information that becomes available
- support environmental management plans used to manage environmental effects of the Project.

As described in the EIS Guidelines, the goal of the environmental monitoring program is to confirm that the Project is implemented as proposed and that mitigation measures to reduce environmental effects are effectively implemented, and to provide action plans and emergency response procedures.

A number of comments were received from Aboriginal communities that identified the need to include additional information on monitoring and follow-up programs in the Final EIS/EA. As a result, GGM has provided various conceptual Project-specific environmental management and monitoring plans (EMMPs), a "Hardrock Project - Conceptual Closure Plan" (Stantec 2017b), and a Draft Fisheries Offset Plan (AMECFW 2017) as appendices to the Final EIS/EA (Stantec 2017d).

The full list of conceptual EMMPs for the Project is provided in Table 23-1 of the Final EIS/EA, with the plans themselves provided as Appendix M1 to M14 of the Final EIS/EA. Many of the plans listed in Table 23-1 of the Final EIS/EA are associated with VCs that may be linked to potential effects on Aboriginal health conditions, socio-economic conditions, physical and cultural heritage, and current use of lands and resources for traditional purposes.

Of those plans listed in Table 23-1 of the Final EIS/EA, some are intended specifically as follow-up measures to verify the environmental effects predictions or the effectiveness of mitigation as defined in CEAA 2012. The specific EMMPs that are intended as follow-up measures as defined in CEAA 2012 are the following:

- Appendix M10, Conceptual Noise and Vibration Management and Monitoring Plan, to verify the effectiveness of noise and vibration mitigation measures;
- Appendix M1, Water Management and Monitoring Plan, to verify the effects predictions and effectiveness of seepage mitigation for surface water (and, in turn, for groundwater and human and ecological health);
- Appendix M13, Conceptual Biodiversity Management and Monitoring Plan, to verify the effects predictions and the effectiveness of mitigation for vegetation communities and for wildlife; and
- Appendix M7, Conceptual Air Quality Management and Monitoring Plan, to verify the effects predictions for the atmospheric environment and human and ecological health; and
- Appendix M12, Conceptual Aquatic Management and Monitoring Plan, to verify the effects predictions for fish and fish habitat as well as for human and ecological health.

In addition, as an additional follow-up measure not listed in the EMMPs but rather committed to in the heritage resources VC, Stage 3 and 4 archaeological investigations will be conducted under the *Ontario Heritage Act* to verify the effects predictions for heritage resources.

Other plans are intended generally for compliance monitoring or other purposes. The reader is referred to Chapter 23.0 of the Final EIS/EA for further details.

Input from Aboriginal communities has informed development of the Conceptual EMMPs listed in Table 23-1 of the Final EIS/EA, as demonstrated by the following examples:

- AFN requested further information on emergency response measures related to certain events which have been incorporated into the Conceptual ERP (GGM 2017d). The Conceptual ERP also defines appropriate communications protocols, including procedures to contact relevant Aboriginal communities related to an accident or malfunction event and follow-up actions that will be taken.
- AFN comments regarding the potential effects of spills and the response methods were considered during development of the Conceptual SPRP (GGM 2017f).
- Further information on waste rock management has been added to the Conceptual WRMP (Stantec 2017c) in response to a request by the MNO.
- AFN and LLFN requested the development of a surface water monitoring plan to account for unexpected results. GFN requested adaptive management practices related to: water treatment and the potential for seasonal turnover to affect the ability to discharge water due to quality issues and historical tailings, drainage collection, and the TMF and WRSAs. The WMMP includes adaptive management practices related to surface water and considers seasonal variation in water quality.

- Additional downstream monitoring stations were added to the WMMP (Stantec 2017e) to address comments from LLFN during consultation about conditions downstream of Kenogamisis Lake, Kenogamisis River, and outflow to Long Lake.
- Based on comments from consultation, fish sampling programs in the Conceptual AMMP (Stantec 2017a) will be expanded to obtain data on species Aboriginal communities have identified as being traditionally important (e.g., White Sucker). This will include the analysis of whole bodied fish to reflect the ways Aboriginal peoples prepare and consume fish (AFN, LLFN).
- The Conceptual BMMP (GGM 2017c) and Conceptual Closure Plan (Stantec 2017b) address requests from Aboriginal communities for additional information on the establishment and monitoring for vegetation and response in the event that rehabilitation strategies do not result in intended outcomes.
- A number of comments were received from Aboriginal communities with regard to waterfowl and migratory bird use of the TMF. The Conceptual BMMP (GGM 2017c) includes a discussion regarding monitoring waterfowl activity on the TMF to confirm EIS/EA assumptions, and includes adaptive management measures to deter waterfowl from coming in contact with tailings pond water.
- Wildlife protection measures and monitoring is addressed in the Conceptual BMMP in consideration of comments received from Aboriginal communities with regard to wildlife monitoring.
- In response to the interest expressed during consultation, GGM will participate in an MNRF-led moose health (i.e., tissue sampling) study with local Aboriginal communities during Project operation.
- As a result of Aboriginal consultation input, an AHRMP has been prepared. GGM will also work collaboratively with local Aboriginal communities to develop a protocol for communications should previously undocumented archaeological resources be discovered.

GGM will continue to consider Aboriginal input in confirming proposed mitigation measures and will consult with local Aboriginal communities on the next iteration of the 14 EMMPs to advance the concepts as the Project progresses. GGM will also work with communities to provide the opportunity to form Aboriginal Environment Committee(s) as the Project progresses. If parties are not open to forming a committee, GGM will work with local Aboriginal communities individually throughout the Project.

Consultation has been ongoing prior to and throughout the EA process, and will continue with government agencies, local Aboriginal communities, and stakeholders through the life of the Project. TK sharing will occur throughout the life of the Project and GGM will review the results of TK information received after submission of the Final EIS/EA against the conclusions of the TLRU assessment, to determine whether additional mitigation is required with respect to Project design and environmental management and monitoring plans.

10.0 CONCLUSION

In this report, Stantec provides an assessment of the effects of changes to the environment on Aboriginal peoples that may result from the development, construction, operation, and eventual closure of the Hardrock project, an open pit gold mine and mill to be developed in the Municipality of Greenstone, Ward of Geraldton, approximately 275 km northwest of Thunder Bay, Ontario.

This assessment was conducted in accordance with the requirements of Section 5(1)(c) of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and Section 6.3.4 of the "Guidelines for the Preparation of an Environmental Impact Statement pursuant to the *Canadian Environmental Assessment Act, 2012* – Hardrock Deposit Project: Premier Gold Mines Hardrock Inc." (EIS Guidelines; CEA Agency 2014, 2016).

In consideration of the effects of changes to the environment, the identified mitigation, information provided by Aboriginal communities, and specific consideration of how the effects of those changes to the environment might affect Aboriginal persons, the residual effects on Section 5(1)(c) Factors (including Aboriginal health conditions, Aboriginal socio-economic conditions, Aboriginal socio-economic conditions, and current use) are characterized as not significant for all Project phases. Further, based on this assessment of effects on current land use and consultation with Aboriginal communities, it is anticipated that Aboriginal communities will continue to have the ability to exercise Aboriginal and treaty rights outside of the PDA.

GGM will continue to engage affected Aboriginal communities through the life of the Project and will consider, and strive to adapt to and address, new information in relation to the Section 5(1)(c) Factors that may arise from Aboriginal communities as part of such engagement.

11.0 REFERENCES

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“HARDROCK TAILINGS MANAGEMENT FACILITY, TMF DESIGN OVERVIEW” MEMO (AMEC 2018)

TECHNICAL MEMORANDUM

To	**Bertho Caron** **Steve Lines (GGM)**	File no Rev	**TC150320** **0A.**
From	**Matt Soderman/Prabhat Habbu** **Laszlo Bodi**	Copy	
Tel	**1 905 568 2929**		
Email	**Prabhat.habbu@woodplc.com**	Review:	
Date	**January 10, 2018**		

Subject **Hardrock Tailings Management Facility**
TMF Design Overview

Wood/Amec has prepared this memo in response to comments on the Final EIS/EA and recent discussions with agencies to address key topics on the TMF design particularly the design measures addressing TMF dam stability, seepage through TMF dams, and contingency measures for seepage collection to mitigate potential seepage bypassing the seepage collection system.

This memorandum is being presented to further support of the TMF design with inherent safety measures to address failure risk and seepage mitigation measures.

1.0 TMF DAM DESIGN

In order to address the risk of potential dam failure, the TMF dams are designed for inherent safety. The proximity of the TMF to Kenogamisis Lake has been factored into every aspect of the design. The TMF is being designed, and will be built by the best available technology (BAT) and best available practices (BAP). The key TMF design considerations include the following:

- Geotechnical Investigations
- Dam design;
- Tailings deposition plan;
- Seepage mitigation and collection;
- Early pro-active establishment of an Independent Technical Review Board.
- Instrumentation and monitoring plan;
- Construction approach and QA/QC;
- Annual dam safety inspections and dam safety reviews

1.1 Geotechnical Investigations

Feasibility study level geotechnical investigations have been carried out along the TMF perimeter dam alignment footprint to characterize the subsurface conditions to facilitate implementation of adequate foundation design measures. The subsurface characteristics are typical of those encountered in northern Ontario. Additional investigations are planned for 2018 to support detailed engineering. The investigations to date included borehole drilling, test pitting, *in-situ* testing to determine the relative density of the foundation soils, groundwater conditions, hydraulic conductivity of the soils and underlying bedrock and laboratory testing of soil samples to determine their index and strength properties. Cone penetration tests have been carried out to determine the soil types, in-situ strengths and pore pressure responses. The subsurface characterization has formed a key basis for the TMF dam design.

Additional geotechnical investigations have been planned this winter (Q1 2018) to further advance the detailed knowledge of sub surface conditions along the TMF dam footprints. This investigation will refine the spacing and number of investigation locations for verifying subsurface conditions and provide additional details in subsurface soil properties to support the detailed design. These extensive investigations provide assurance that all unsuitable soils will be identified and removed from the entire footprint of the dams, and the structures will then be constructed on competent subgrade soils or bedrock, to support the dams with adequate safety against any potential slope failures.

1.2 Dam Design

The TMF dams will be built out of robust mine rock with rockfill embankment dam design considerations to optimize the overall stability of the dam. The upstream slopes of the dams will include a low permeability glacial till core to mitigate seepage. Adequately designed filter and transition zones will be provided abutting the till core to prevent erosion of fines from the till core and also act as grade separators between various sized particles. A foundation filter is included in the design to prevent piping of the fines from the soil foundation into the downstream rockfill shells.

As stated previously all unsuitable soils will be removed from the entire footprint of the dams, and the structures will be constructed on competent subgrade soils or bedrock, to support the dams with adequate safety against any potential slope failures. A typical cross section of the dam is presented in the following Figure 1 indicating the upstream low permeability core, seepage cut-off system and downstream raise method of construction.

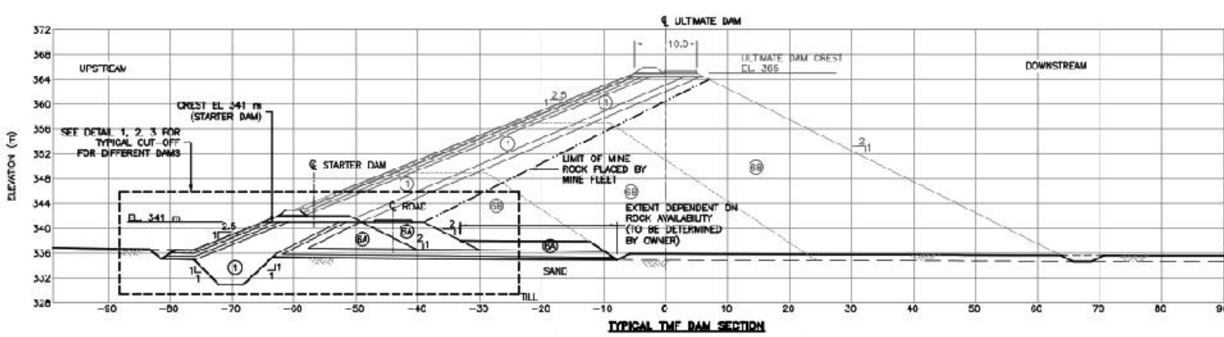

Figure 1: Typical dam section showing the Starter and Ultimate dams

1.3 Downstream Raising of dams

Recognizing the proximity to Kenogamisis Lake, the entire TMF perimeter dams will be raised over the Starter dam by "downstream raising" method using mine rock. In this method, the entire footprint of the perimeter dams will be founded on prepared/treated foundation surface unlike 'centreline raise' or 'upstream raise' tailings dams wherein part or entire raised footprint of the dam is built over tailings. The downstream raising results in a robust structure and increases the stability of perimeter dams as there is full control on foundation preparation.

Construction of the dam by the downstream method is also of benefit with regard to demonstrating the environmental performance of the TMF dams. The upstream till core toe of the dam, will be about 350 to 400 m away from Kenogamisis Lake, with the downstream toe of the Starter dam being 250 to 300 m from the Lake Kenogamisis. Through raising, the downstream toe of the dam will move incrementally closer to Lake Kenogamisis ultimately to a point about 200 m from the Kenogamisis Lake. Instrumentation will be installed and monitored both during and following construction of the Starter dam and subsequent raises. Performance of the dam will be closely observed and assessed. The downstream raise method provides the flexibility to modify the design or construction approach for subsequent raises of the dam following performance review of the Starter dam.

1.4 Design as per LRIA and CDA Guidelines

As per Lakes and Rivers Improvement Act (LRIA) and Canadian Dam Association (CDA) guidelines the TMF dams are designed for probable maximum flood (PMF) and maximum credible earthquake (MCE) which is assumed to be close to 1:10,000 year annual exceedance probability. Essentially, the dams have been designed for ultimate flood and maximum credible seismic conditions. Following LRIA recommendation a site specific seismic hazard study is also in progress to assess the earthquake design ground motion (EDGM) for Hardrock project site.

The design of the TMF dams for stability exceeds the required target factors of safety in accordance with the LRIA criteria and the CDA guidelines.

Emergency Spillways

Adequately designed emergency spillways will be constructed and maintained at every stage of dam raise designed to pass the PMF safely with required freeboard to the dam crest. This is provided as a dam safety measure to protect against any significant departures from the design intent, or water management associated with extreme storm events. The spillways will be inspected and maintained regularly for their functionality as a part of the maintenance and surveillance operations of the TMF dams.

1.5 Tailings Deposition Plan

The tailings deposition plan has been developed to enhance dam safety during operations and in the post-closure period while maintaining flexibility to adapt closure design to meet water quality objectives.

The tailings deposition plans have been developed in such way that the tailings pond is pushed to the natural ground on the west side of the TMF footprint such that pond water is not abutting the perimeter dam. Thus, the tailings pond will be located approximately 1,500 m from Kenogamisis Lake. This approach is due to the wide tailings beaches that separate the tailings pond from the perimeter dams. These measures further enhance the stability of the perimeter dams, reduce hydraulic gradients and seepage. The following figure provides end of mine tailings deposition plan.

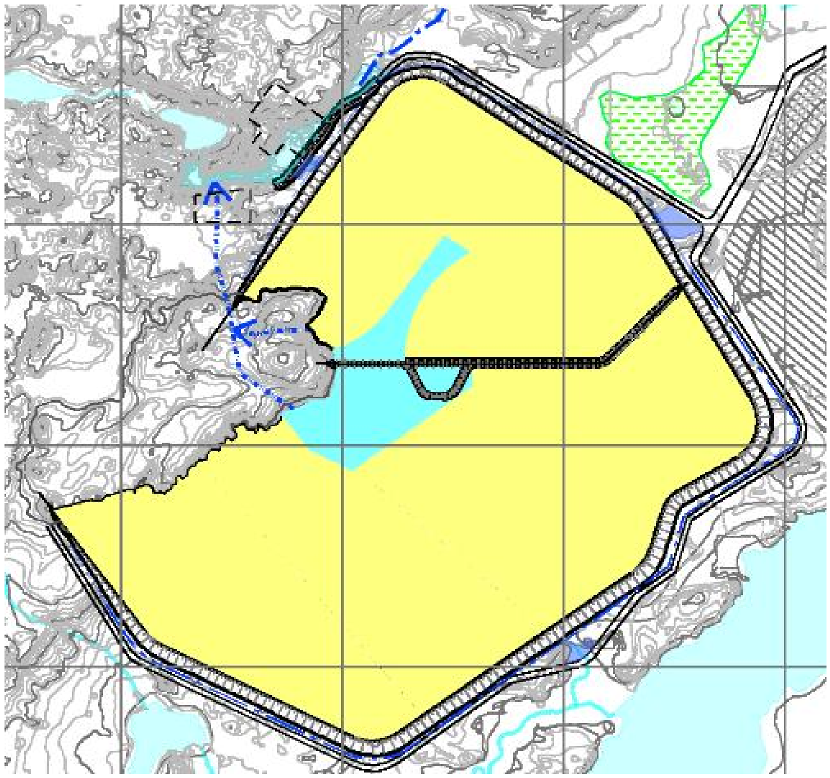

Figure 2: Tailings Deposition Plan End of Mine Life

1.6 Seepage Mitigation Measures

The TMF design includes a low permeability upstream till core, foundation seepage cut-off system along the upstream toe of the dam and seepage collection system.

The upstream till core will be sourced from a till borrow area close to TMF. Geotechnical investigations have been carried out in the borrow source area with sampling and laboratory testing of the native till deposit. The laboratory tests have confirmed that the till core will be low permeable, typical of compacted till material.

The foundation cut-off system in native overburden soils penetrates the upper relatively high permeability soils and will be tied into low permeability silt/silty clay or till. Where fractured bedrock is encountered consolidation grouting of the upper bedrock to a depth of 5 m will be carried out to seal the fissures.

During construction the entire foundation will be exposed as the construction progresses and the foundation conditions are required to be approved by the quality assurance engineer. The stringent QA/QC program which will be enforced during construction will ensure construction of foundation cut-off and all other construction procedure to progress diligently.

More than 500 m wide tailings beaches between the perimeter dams and tailings ponds further mitigate seepage through the dam body and foundation seepage.

Seepage Collection System

The seepage collection system comprises perimeter ditches downstream of the ultimate toe of the dam and three seepage collection ponds. The seepage collection ditches and ponds will collect runoff from the downstream watershed area, from the crest of the dam to the ditch in addition intercepting seepage from the foundation and dam body. The collected seepage and runoff will be pumped back to TMF.

The seepage collection ponds will be maintained at levels lower than the ambient ground levels to create a positive hydraulic gradient to prevent seepage migrating from the seepage collection ditches and ponds.

Contingency Seepage Collection Measures

The efficacy of the seepage collection system will be monitored with instrumentation during the early stage of operations. In the highly unlikely event of seepage bypassing the collection system presents adverse effects on Kenogamisis Lake, adequate space (more than 10 m) has been provided for deep groundwater collection wells that could effectively be established in the area between the seepage collection ditching and access/haul road.

1.7 Independent Technical Review Board

An independent technical review board(ITRB) has been established for the TMF consisting of independent experts in the field of tailings management. The first ITRB meeting was held between 11th to 15th December 2017 at Geraldton, Ontario. The establishment of an ITRB this early in the planning process is a global best practice that GGM has successfully implemented for the Project. The initial ITRB meeting will help shape the additional geotechnical work in 2018 to support detailed engineering.

1.8 Instrumentation and Monitoring Program

In order to monitor the performance of the dam an instrumentation and monitoring plan will be implemented. During Starter dam construction and subsequent raising of dams the instrumentation will provide information on pore pressure development if any, in the foundation units and would guide the rate of construction of the raises. Installed instrumentation during dam raising will also provide movements observed if any, so that remedial action by way of toe buttress/loading berms could be incorporated in the design.

The proposed instrumentation include nested vibrating wire piezometers, inclinometers and survey monuments.

1.9 Operation, Maintenance and Surveillance Manual

An Operations, Maintenance and Surveillance (OMS) Manual will be produced prior to operation of the TMF to assist with training new staff, clarify responsibilities, and explain the design and operation objectives, and set-out surveillance and monitoring procedures.

Surveillance and monitoring observations will be tailored to focus on potential dam failure modes. The OMS will include guidance for operators on how to respond to anomalous observations of monitoring data, with “trigger” and “alarm” levels set to engage management and the Engineer-of-Record, or initiate emergency response procedures, respectively.

The OMS manual will also indicate frequency of TMF inspections such as weekly, monthly, quarterly and annually. It will also indicate mill, engineering and environmental personnel and their roles and responsibilities including preparation of inspection reports detailing the performance of the TMF dams and complete photographic documentation.

Key performance indicators to demonstrate TMF operation according to the design intent include:

- Maintenance of a wide tailings beach.
- Raising of the rockfill shell in accordance with the dam raising schedule.
- Stable piezometric levels and embankment movement trends.
- Maintenance of pond volume tracking and water balance.

1.10 Dam Safety Inspections and Dam Safety Review

Dam safety inspections (DSI) are essential part of the TMF dam maintenance and will be carried out annually by a qualified geotechnical engineer. The inspection will include a thorough inspection of the TMF dams, review of the weekly, monthly, quarterly inspection reports prepared by the TMF management team. The inspection will highlight the performance of the dam over the year, any distress conditions noted and would recommend remedial measures as necessary.

Dam safety review(DSR) will be carried out periodically (currently scheduled for every 5 years). In this review, in addition to the dam safety inspection the TMF dam designs will be reviewed in relation to the hydrology and seismicity of the area. Hydro-meteorological database updated over the past five years will be reviewed in conjunction with the historic data to review and revise if necessary, hydrology and hydraulic design of the TMF. Impacts due to climate change are effectively addressed in the DSR.

Seismic database updated to include the data over the past five years on the observed seismic events in the vicinity will be considered for updating the seismic design of the dam.

2.0 CONSTRUCTION

A construction execution plan will be prepared for implementation during construction. The dam will be constructed by contractors according to technical specifications, quality control and quality assurance inspection procedures set by the Engineer-of-Record (EoR) and as-built reports will be prepared.

Each staged dam raise is based on the observed behaviour and environmental performance of the previous stage. If required, design revisions or changes are incorporated into the construction sequence based on operational performance monitoring data obtained during the dam construction program.

2.1 QA/QC During Construction

The Engineer-of-Record will deploy a qualified team for quality assurance and quality control so that the TMF dams are built in accordance with the design intent, construction drawings and technical specifications.

GGM will also deploy qualified geotechnical engineers on site during construction to ensure the construction proceeds as per the design. Periodic visits will be carried out by senior geotechnical engineers to inspect the construction.

2.2 Instrumentation During Construction

Foundation response monitoring forms an integral part of the construction program especially in fine grained soil foundations. Nested vibrating wire piezometers will be provided in the foundation units to measure change in pore pressures during construction. Additional monitoring locations will be provided as the footprint of the TMF dam increases during subsequent raises. The monitoring program will provide guidance to the rate of raise of the dams as well as to inform if design or construction modifications are required.

3.0 SUMMARY

The TMF designs have been carried out based on best available technology and best available practices. The following are the principal design features of the TMF are as follows.

- Feasibility level Geotechnical Investigations
- Robust Dam design following LRIA and CDA guidelines;
- Seepage cut-off and seepage collection system
- Wide tailings beaches between perimeter dams and tailings pond;
- Early pro-active establishment of an Independent Technical Review Board.
- OMS manuals;
- Instrumentation and monitoring plan;
- Construction approach and QA/QC during construction;
- Annual dam safety inspections and dam safety reviews.

In light of the above there is high degree of confidence in the TMF design approach and construction. Seepage issues have been adequately mitigated and failure risks are fully addressed.

<Original signed by>

Prabhat Habbu M.Tech, P.Eng.
Associate Geotechnical Engineer

<Original signed by>

Laszlo Bodi, M.Sc.; P.Eng.,
Principal Civil/Geotechnical Engineer

HARDROCK PROJECT
Final Environmental Impact Statement / Environmental Assessment: Summary of Environmental Effects within Federal Jurisdiction

Prepared for:
Greenstone Gold Mines GP Inc.

Prepared by:
Stantec Consulting Ltd.
1-70 Southgate Drive
Guelph ON N1G 4P5

Project Number: 160961223
February 2018

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1.0 SUMMARY OF ENVIRONMENTAL EFFECTS WITHIN FEDERAL JURISDICTION

This report provides a summary of environmental effects within federal jurisdiction, pursuant to Section 5 of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012). This report is intended to complement the information provided in the Final Environmental Impact Statement/Environmental Assessment (Final EIS/EA) for the Hardrock Project, prepared by Stantec Consulting Ltd. (Stantec) on behalf of Greenstone Gold Mines G.P. Inc. (GGM), dated June 2017 (Stantec 2017).

Section 5 of CEAA 2012 describes specific categories of direct and indirect environmental effects that must be considered in the environmental assessment. These include:

- changes to components of the environment within federal jurisdiction [Section 5(1)(a) of CEAA 2012];
- changes to the environment that would occur on federal or transboundary lands [Section 5(1)(b) of CEAA 2012];
- effects of changes to the environment on Aboriginal peoples [Section 5(1)(c) of CEAA 2012]; and
- changes to the environment that are directly linked or necessarily incidental to federal decisions, and the effects of those changes in the human environment [Section 5(2) of CEAA 2012].

A summary of federal areas of interest under CEAA 2012, and the associated potential changes to the environment, is provided in Table 1-1.

Table 1-1: Summary of Federal Areas of Interest under the *Canadian Environmental Assessment Act, 2012*

Federal Area of Concern	Potential Changes to the Environment
Changes to Components of the Environment within Federal Jurisdiction [CEAA 2012, Section 5(1)(a)]	
Fish and Fish Habitat	• Lethal and Sub-lethal Effects on Fish • Permanent Alteration of Fish Habitat • Loss of Fish Habitat
Aquatic Species at Risk (SAR)	• Aquatic SAR are included as part of the Fish and Fish Habitat VC, above
Migratory Birds (subcomponent of Wildlife VC)	• Change in Habitat • Change in Mortality Risk • Change in Movement

Table 1-1: Summary of Federal Areas of Interest under the *Canadian Environmental Assessment Act, 2012*

Federal Area of Concern	Potential Changes to the Environment
Changes to the Environment that Would Occur on Federal or Transboundary Lands [CEAA 2012, Section 5(1)(b)]	
Changes on Federal Lands	• None
Changes on Transboundary Lands	• None
Changes to the Environment on Aboriginal Peoples [CEAA 2012, Section 5(1)(c)]	
Health and Socio-economic Conditions	• Change in Air Qualiy • Change in Quality and Availability of Country Foods • Change in Drinking Water Quality or Quantity • Change in Noise or Vibration Exposure
Physical and Cultural Heritage (including any structure, site or thing that is of historical, archaeological, palentological, or architectural significance)	• Change in Physical or Cultural Heritage
Current use of lands and resources for traditional purposes	• Change in Current Use
Changes to the Environment that are Directly Linked or Necessarily Incidental to Federal Decisions, and Effects of those Changes [CEAA 2012, Section 5(2)] (Required Federal Permits as Listed in Table 1-1 of the Final EIS/EA)	
Fisheries Act	• Change in fish populations – an authorization under Section 35(2) of the *Fisheries Act* will authorize serious harm to fish by allowing fish habitat to be altered or destroyed to enable the Project to be carried out. Residual environmental effects would be offset in concert with this authorization.
Metal Mining Effluent Regulations (MMER)	• Change in fish populations – an authorization under MMER will authorize the use of fish bearing waters to deposit mine effluent, waste rock, and tailings. An environmental effects monitoring program would be required with this authorization and residual environmental effects would be mitigated.
Navigation Protection Act (NPA)	• Change in navigation - approval under the NPA would authorize interference with the public right of navigation by allowing construction of any structure in, over, under or through navigable water (e.g., a bridge, boom, pipeline, outfall, diffuser or dam).
Explosives Act	• Authorization under the *Explosives Regulations*, *2013* authorizes the manufacturing, transportation, use, and storage of blasting explosives.
Transportation of Dangerous Goods Act (TDGA)	• Requirements under the *TDGA* are intended to minimize environmental effects from the transportation of hazardous materials.

1.1 CHANGES TO COMPONENTS OF THE ENVIRONMENT WITHIN FEDERAL JURISDICTION

Pursuant to Section 5(1)(a) of CEAA 2012, the components of the environment within the legislative authority of Parliament are:

- fish as defined in Section 2 of the Fisheries Act and fish habitat as defined in subsection 34(1) of that Act;
- aquatic SAR as defined in subsection 2(1) of the Species at Risk Act (SARA);
- migratory birds as defined in subsection 2(1) of the Migratory Birds Convention Act, 1994 (MBCA); and
- any other component of the environment that is set out in Schedule 2 of CEAA 2012.

A summary of changes to these components as a result of the Project are described below by first discussing potential effects pathways, followed by applicable mitigation to avoid or minimize effects, followed by discussion of residual effects.

1.1.1 Fish and Fish Habitat

Environmental effects on fish and fish habitat were assessed in Chapter 11 of the Final EIS/EA, entitled “Assessment of Potential Environmental Effects on Fish and Fish Habitat”. A high-level summary of the environmental effects assessment as it relates to fish and fish habitat, as detailed in Chapter 11 of the Final EIS/EA, is provided below.

1.1.1.1 Potential Environmental Effects Pathways Prior to Mitigation

Potential effects pathways were identified as: lethal and sub-lethal effects on fish, permanent alteration of fish habitat, and loss of fish habitat.

Lethal and Sub-Lethal Effects on Fish

As described in Section 11.4.2.1 of the Final EIS/EA, potential pathways for lethal and sub-lethal effects on fish that have the potential to occur without the application of mitigation are categorized by Project phase.

During construction, potential pathways for lethal and sub-lethal effects on fish are listed below:

- Mobilization and transport of sediment into fish habitat (e.g., while working near water during excavation, grading, channel construction, vegetation clearing, culvert installation and culvert removal) that results in mortality of fish eggs caused by sedimentation, or disruption of biological processes caused by high total suspended solids (TSS) (e.g., gill inflammation and limited foraging ability).

- Change in timing, duration, and frequency of flow, which can lead to change in fish mortality by displacing or stranding fish or by preventing access to spawning areas.
- Dewatering work areas, which has the potential to strand, entrain, and impinge fish.
- Destruction of fish eggs by equipment during instream work.
- Stranding of fish within a work area during isolation activities.
- Entry of deleterious materials into fish habitat through point and non-point sources.
- Use of explosives in or near water, which produces shock waves that can damage fish swim bladders and rupture internal organs and vibrations that may kill or damage eggs or larvae.

During operation, potential pathways for lethal and sub-lethal effects on fish are as follows:

- Entrainment and impingement of fish on the freshwater intake structure in Kenogamisis Lake.
- Use of explosives in or near water, which produces shock waves that can damage fish swim bladders and rupture internal organs and vibrations that may kill or damage eggs or larvae.
- Entry of deleterious materials into fish habitat through minor spills or leaks from vehicles, equipment, storage containers/facilities. Major spills are covered in Chapter 22.0 of the Final EIS/EA(potential accidents and malfunctions).
- Entry of deleterious materials into fish habitat through point and non-point sources.
- Maintenance or replacement of in-water structures (e.g., culvert replacement, maintenance of water intake structures).

During active closure, some construction activities and heavy equipment use will be required. Activities include site grading, and removal of culverts and in-water Project infrastructure (e.g., water intake and treated effluent discharge pipelines) where necessary. Although these activities will be on a smaller scale than for the construction phase, the same potential pathways will exist (except for blasting, which is not anticipated to occur during closure).

After active closure, TMF surface runoff will flow passively via a closure spillway to the Goldfield Creek diversion. Once the water level in the open pit reaches approximately 331.0 m above mean sea level (amsl) elevation, water from the pit lake will drain passively via a closure spillway into the Southwest Arm of Kenogamisis Lake.

Permanent Alternation of Fish Habitat

As described in Section 11.4.3.1 of the Final EIS/EA, potential effects pathways for the permanent alteration of fish habitat are categorized by Project phase, and have the potential to occur without the application of mitigation or offsetting.

The following construction activities have the potential for permanent alteration of fish habitat in the absence of mitigation:

- Discharge of treated effluent, or groundwater discharge originating from the waste rock storage areas (WRSAs) and tailings management facility (TMF) into the Southwest Arm of Kenogamisis Lake could lead to permanent alteration of fish habitat by causing; a change in water temperature, a change in dissolved oxygen (DO), a change in nutrient concentrations leading to eutrophication, a change in water chemistry, a change in sediment chemistry such that ecological functions of sediments are impaired, effects on aquatic biota (phytoplankton, zooplankton, benthic invertebrates) that provide or support food sources for fish, effects on aquatic plants that provide in-water structure, cover and feeding habitat, and/or deposition of suspended sediment from treated effluent, altering the ecological function and condition of lake sediments.
- Planting riparian vegetation can lead to the permanent alteration of fish habitat through: disruption of bank material, which may lead to a change in sediment concentrations, altering canopy cover, which may change water temperature and/or altering riparian vegetation, which may result in a change in habitat structure, cover, and food and nutrient supply.
- Use of explosives in and adjacent to fish habitat can lead to the permanent alteration of fish habitat by altering shoreline and bank habitat, which may lead to a change in sediment concentrations and infilling of sediment interstitial spaces.
- Use of heavy equipment in and adjacent to fish habitat can lead to permanent alteration of fish habitat by altering bank stability and increasing erosion potential, leading to change in sediment levels.
- Use of heavy equipment in water can lead to permanent alteration of fish habitat by direct disruption/compression of substrates and in-stream cover and increasing erosion potential by disruption of natural substrates.
- Vegetation clearing can lead to the permanent alteration of fish habitat by causing: a change in habitat structure and cover, a change in sediment concentrations and/or a change in food supply.
- Altering the volume, timing, duration or frequency of flow can lead to the permanent alteration of fish habitat by: altering food supply (e.g., reduction in nutrients supporting lower trophic levels), altering bank vegetation and shoreline/bank habitat and cover, scouring of channel beds and eroding banks, leading to a change in habitat structure and cover and/or mobilization and deposition of sediment through shoreline/bank erosion.
- Dredging may be required to bury the freshwater intake and treated effluent discharge pipes in the near shore area of Kenogamisis Lake, and can lead to permanent alteration of fish habitat by causing: mobilization and deposition of sediments and/or a change in habitat structure and cover (e.g., aquatic vegetation and substrate characteristics).
- Placement of material or structures in water (e.g., culverts, water intake pipe and treated effluent discharge pipe) can lead to the permanent alteration of fish habitat by replacing existing habitat or altering flow regimes.

- Removal of non-natural in-water structures such as existing culverts (e.g., at Goldfield Creek and at watercourse WC-L) can lead to mobilization of sediment or alter flow regimes, causing a change in habitat structure and cover.
- TMF reclaim pipeline crossings of the Goldfield Creek diversion could lead to a change in bank structure and cover or mobilization and deposition of sediment.

The following activities during operation may result in permanent alteration of fish habitat:

- Discharge of treated effluent, or groundwater discharge originating from the WRSAs and TMF into the Southwest Arm of Kenogamisis Lake could lead to permanent alteration of fish habitat by causing; a change in water temperature, a change in DO, a change in nutrient concentrations leading to eutrophication, a change in water chemistry, a change in sediment chemistry such that ecological functions of sediments are impaired, effects on aquatic biota (phytoplankton, zooplankton, benthic invertebrates) that provide or support food sources for fish, effects on aquatic plants that provide in-water structure, cover and feeding habitat, and/or deposition of suspended sediment from treated effluent, altering the ecological function and condition of lake sediments
- Water extraction (e.g., pit dewatering) can lead to the permanent alteration of fish habitat through water table drawdown effects.
- Maintenance of roads, work areas, water crossings and water intake can lead to sedimentation of watercourses.
- Use of explosives in and adjacent to fish habitat can lead to the permanent alteration of fish habitat by altering shoreline and bank habitat, which may lead to a change in sediment concentrations and infilling of sediment interstitial spaces.

The following activities during closure may lead to permanent alteration to fish habitat, including:

- continued input of nutrients to Southwest Arm of Kenogamisis Lake from the TMF, WRSA and, once the pit lake has filled, natural drainage from the pit lake area
- erosion and sedimentation caused from the removal of culverts, water intake, and other infrastructure.

Loss of Fish Habitat

As discussed in Section 11.4.4.1 of the Final EIS/EA, potential effects pathways that, unmitigated, would result in loss of fish habitat include the placement of material or structures in water can lead to loss of fish habitat by direct overprinting. Table 11-3 of the Final EIS/EA provides a description of potential effects pathways for the loss of fish habitat for individual watercourses. No Project activities that result in loss of fish habitat have been identified during operation or closure because any loss of fish habitat would have occurred during the construction phase.

1.1.1.2 Mitigation Measures

A number of key design features have been incopoprated in the design of the Project, as listed in Section 1.5 of the Final EIS/EA. For water quality and fish and fish habitat, these include, among others, relocating a portion of the historical MacLeod and Hardrock tailings to the new TMF, and implementing an enhanced cover, stability measures and seepage collection for the remaining historical MacLeod tailings to reduce seepage, provide safety and long-term stability of structures, thereby substantially reducing environmental effects to groundwater and surface water quality from these historical tailings during operation through post closure.

In addition to the key design features of the Project that are summarized in Section 1.5 of the Final EIS/EA, the mitigation measures listed in Table 1-2 below (which reproduces Table 11-9 of the Final EIS/EA) will be used to protect fish from lethal and sub-lethal effects and mitigate the permanent alteration or loss of fish habitat due to potential Project-related effects.

Table 1-2: Mitigation Measures for Fish and Fish Habitat

Mitigation Category	Mitigation Number	Mitigation Measure	Potential Project Effect		
			Lethal and Sub-lethal effects	Permanent Alteration of Fish Habitat	Loss of Fish Habitat
Project Planning (Timing)	1	Limit duration of in-water work.	✓	-	-
	2	Conduct instream work during periods of low flow (e.g., summer, fall, or winter) to further reduce the risk to fish and their habitat or to allow work in water to be isolated from flows.	✓	-	-
	3	Within the construction timing window, schedule in-water work to avoid wet, windy, and rainy periods that may increase erosion and sedimentation.	✓	-	-
	4	Design and plan activities and works in waterbodies such that loss or disturbance to aquatic habitat is limited and sensitive habitats are avoided.	✓	✓	-
	5	Comply with spring timing window for in-water work. The timing window for Northwestern Ontario restricts in-water work from April 1 to June 20 for spring spawning species (e.g., Northern Pike and Walleye). This timing restriction would apply to work within and adjacent to water (i.e. within 30 m of water) for the entire Project development area (PDA). Where a timing window exemption may be required, work with MNRF and Fisheries and Oceans Canada (DFO) to seek an exemption and avoid adverse effects on fish.	✓	-	-
	6	Comply with coldwater timing window for in-water work. The timing window for Northwestern Ontario restricts in-water work between September 1 and May 31 for fall spawning species present in the LAA (e.g., Cisco and Lake Whitefish). This timing restriction would will apply to work within and adjacent to Kenogamisis Lake (i.e. within 30 m) and other work areas with the potential to affect Cisco and Lake Whitefish spawning activity. Work in Kenogamisis Lake would will follow both the spring and fall avoidance periods, unless approved beforehand by the Ministry of Natural Resources	✓	-	-

Table 1-2: Mitigation Measures for Fish and Fish Habitat

Mitigation Category	Mitigation Number	Mitigation Measure	Potential Project Effect		
			Lethal and Sub-lethal effects	Permanent Alteration of Fish Habitat	Loss of Fish Habitat
		and Forestry (MNRF) and DFO, resulting in an in-water construction window of June 21 to August 30. Where a timing window exemption may be required, work with MNRF and DFO to seek an exemption and avoid adverse effects on fish.			
Project Planning (Containment and Spill Management)	7	Plan activities near water such that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, or other chemicals do not enter the watercourse.	✓	-	-
	8	Treat and handle building material used in water in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish.	✓	-	-
	9	Follow the "Hardrock Project Conceptual Water Management and Monitoring Plan" (Conceptual WMMP; Appendix M1 of the Final EIS/EA), which been developed to divert noncontact water around Project components and to collect and manage contact water.	✓	✓	✓
	10	Implement a Spill Prevention and Response Plan immediately in the event of a sediment release or spill of a deleterious substance and an emergency spill kit will be kept onsite.	✓	✓	✓
Shoreline Revegetation and Stabilization	11	Keep clearing of riparian vegetation to a minimum: use existing trails, roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. When practicable, prune or top the vegetation instead of grubbing/uprooting.	-	✓	-
	12	Limit the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or the bed of the waterbody below the ordinary high water mark. If material is removed from the waterbody, set it aside and return it to the original location once construction activities are completed.	-	✓	-

Table 1-2: Mitigation Measures for Fish and Fish Habitat

Mitigation Category	Mitigation Number	Mitigation Measure	Potential Project Effect		
			Lethal and Sub-lethal effects	Permanent Alteration of Fish Habitat	Loss of Fish Habitat
	13	Design and construct approaches to waterbodies such that they are perpendicular to the watercourse to reduce loss or disturbance to riparian vegetation.	✓	✓	-
	14	Promptly stabilize shoreline or banks disturbed by activities associated with the Project to prevent erosion and/or sedimentation, preferably through revegetation with native species appropriate for the site.	✓	✓	-
	15	Restore bed and banks of the waterbody to their original contour and gradient; if the original gradient cannot be restored due to instability, a stable gradient that does not obstruct fish passage would be restored.	-	✓	-
	16	Where replacement rock reinforcement or armouring is required to stabilize eroding or exposed areas, use appropriately-sized, clean rock, and install rock at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.	-	✓	-
	17	Remove all construction materials from site upon Project completion.	-	✓	-

1.1.1.3 Residual Environmental Effects

Lethal and Sub-Lethal Effects on Fish

As summarized in Section 11.4.2.3 of the Final EIS/EA, concentrations of parameters of potential concern (PoPCs) in the mixing zone will not be acutely lethal to fish. The magnitude of sub-lethal effects is considered low because, due to the geographic range of fish, long-term exposure is not anticipated, especially given the overall predictions of generally improved water quality on a lake-wide basis. Conservative modelling of a worst-case scenario for arsenic concentrations suggests they will be below the PWQO (100 µg/L) in treated effluent and decrease to 20 µg/L within 30 m of the treated effluent discharge location and to the CWQG-FAL and Interim PWQO (5 µg/L) within 2 km of the treated effluent discharge location. Removal of portions of the historical MacLeod and Hardrock tailings to the TMF will result in an approximately 60% decrease in arsenic concentrations in Barton Bay, Central Basin, and Outlet Basin during operation, compared to baseline, resulting in overall improvement of water quality in Kenogamisis Lake. Furthermore, baseline data from Barton Bay, where concentrations of arsenic are currently higher than those predicted for all other basins as a result of the Project, do not indicate adverse effects on fish or other aquatic species tested. The sustainability and productivity of commercial, recreational, or Aboriginal (CRA) fisheries will not be affected.

Permanent Alternation of Fish Habitat

As summarized in Section 11.4.3.3 of the Final EIS/EA, the alteration to fish habitat is predicted to be less than applicable guidelines, legislated requirements and/or federal and provincial management objectives. As noted above, predicted concentrations of arsenic at the discharge location and within 30 m of the treated effluent discharge location are lower than the Interim provincial water quality objectives (PWQO), and the trophic status , as defined in the *Lakeshore Capacity Assessment Handbook* will be maintained. Effects on sustainability and productivity of CRA fish populations within the LAA are not anticipated.

Loss of Fish Habitat

As discussed in Section 11.4.4.3 of the Final EIS/EA, with implementation of the Fisheries Offset Plan (Appendix F10 of the Final EIS/EA) including most notably the Goldfield Creek diversion that will replace some marginal habitat affected by the Project, no residual effects on fish habitat will occur as a result of loss of fish habitat. The majority of habitat loss will occur during the construction phase and the offsetting strategy will also be implemented during this time period. No further habitat losses are identified for the operation and closure phases beyond those that will occur during construction.

1.1.1.4 Summary for Fish and Fish Habitat

In summary, as was concluded in Section 11.4.5 of the Final EIS/EA, significant residual environmental effects (i.e., serious harm to fish) are those that affect the productivity and sustainability of a CRA fishery. Through avoidance, mitigation and offsetting, the residual effects of the Project on fish and fish habitat during all phases are considered not significant. Changes to fish sustainability and productivity are not anticipated.

1.1.2 Aquatic Species at Risk

Aquatic SAR were addressed in Chapter 11 of the Final EIS/EA, Fish and Fish Habitat. As discussed in Section 11.2.2.2 of the Final EIS/EA, field studies conducted within the local assessment area (LAA) by Stantec between September 2013 and September 2016 resulted in capture of more than 6,000 fish, consisting of 25 species (as listed in Table 11-6 of the Final EIS/EA). No species identified in these or in previous studies were listed as federal or provincial SAR, nor are aquatic SAR expected to occur in the LAA.

As such, no aquatic SAR listed under the *Species at Risk Act* are known to have the potential to be affected by the Project.

1.1.3 Migratory Birds

Environmental effects on migratory birds were assessed in Chapter 13 of the Final EIS/EA, entitled "Assessment of Potential Environmental Effects on Wildlife and Wildlife Habitat". A high-level summary of the environmental effects assessment as it relates to migratory birds, as detailed in Chapter 13 of the Final EIS/EA, is provided below.

1.1.3.1 Potential Environmental Effects Pathways Prior to Mitigation

Potential key effects were identified as: change in habitat, change in mortality risk, and change in movement.

Change in Habitat

As described in Section 13.4.2.1 of the Final EIS/EA, the Project will result in the direct loss of 111 ha of confirmed and 1,742 ha of potential Canada warbler breeding habitat (Table 13-10, Figure 13-8 of the Final EIS/EA). Canada warbler is a SAR and is listed as "threatened" on Schedule 1 of SARA. An additional 620 ha is considered lost through indirect effects, though Project-specific predictions for noise suggest this estimate may be conservative. Habitat to support Canada warbler (forest and treed wetland) is common in a regional context and, through direct and indirect effects, the Project will result in an estimated loss of 1.9% of the potential Canada warbler breeding habitat within the regional assessment area (RAA).

The Project will result in the direct loss of of 8 ha of confirmed and 320 ha of potential eastern wood-pewee breeding habitat (Table 13-10, Figure 13-8 of the Final EIS/EA). Eastern wood-pewee is a species of conservation concern (SOCC) and is listed as "special concern" on Schedule 1 of SARA. An additional 169 ha is conservatively considered lost through indirect effects, though Project-specific predictions for noise suggest this estimate may be conservative. Through direct and indirect effects, the Project will result in an estimated loss of 1.7% of the potential eastern wood-pewee breeding habitat within the RAA.

The Project will result in the direct loss of barn swallow nesting habitat; two buildings that support 15 active nests will be removed (Table 13-10, Figure 13-7 of the Final EIS/EA). Barn swallow is a SAR and is listed as "threatened" under Schedule 1 of SARA. Buildings suitable to support barn swallow nesting occur in Geraldton and throughout the RAA, though the number of active nests within the RAA is unknown. The Project will also result in the direct loss of 8 ha and an indirect loss of 5 ha of Category 3 (foraging habitat) associated with the open lands surrounding the existing MTO Patrol Yard. No additional Category 1, 2 or 3 habitat for barn swallow is expected to be lost through indirect effects as the third building where barn swallow nesting was confirmed is more than 200 m from the PDA. The implementation of mitigation measures such as the creation of replacement habitat for the damage or destruction of existing structures that provide nesting habitat will reduce adverse effects to barn swallow habitat and result in no measurable change to barn swallow nesting habitat availability in the LAA.

The Project will result in the direct loss of 321 ha of common nighthawk breeding habitat within the PDA during construction (Table 13-10, Figure 13-7 of the Final EIS/EA). Common nighthawk is a SAR and is listed as "threatened" on Schedule 1 of SARA. An additional 52 ha is considered lost through indirect effects, though Project-specific predictions for noise suggest this estimate may be conservative. Through indirect and direct effects, the Project will result in an estimated loss of 20% of the potential common nighthawk breeding habitat within the RAA. However, the abundance and distribution in the RAA of the open habitat that is required by common nighthawk will fluctuate over time with the creation and regeneration of forested areas as the result of human activities (e.g., logging) and natural events (e.g., fire).

The Project will result in the direct loss of 87 ha of potential breeding habitat for non-treed wetland birds (Table 13-10, Figure 13-7 of the Final EIS/EA). An additional 77 ha is considered lost through indirect effects, though Project-specific predictions for noise suggest this estimate may be conservative. There are 7,571 ha of non-treed wetland within the RAA. Through direct and indirect effects, the Project will result in a loss of 2.2% of the potential breeding habitat for non-treed wetland birds within the RAA.

The Project will result in the direct loss of 208 ha of significant wildlife habitat for waterfowl nesting with an additional 87 ha considered lost through indirect effects. Through direct and indirect effects, the Project will result in a loss of 2.9% of the potential waterfowl nesting habitat within the RAA.

Although Project activities will result in the direct loss or alteration of migratory bird habitat through vegetation clearing, regionally these habitats are common and the percent loss of migratory bird habitat is low. Sensory disturbance to migratory birds is expected to be minimal and habitat conservatively considered lost as a result of sensory disturbance will be regained following the cessation of operations and the completion of active closure activities. Loss of habitat and sensory disturbance is not expected to affect the long-term persistence or viability of migratory bird populations.

No new areas will experience ground disturbance as a result of operation activities, therefore no new direct loss of wildlife habitat is predicted for the operation phase.

The indirect effects (e.g., sensory disturbance), discussed above are expected to continue and be more pronounced during operation as some species might exhibit habitat avoidance because of noise and artificial lights.

During active closure, Project infrastructure, equipment, and ancillary facilities will be removed and areas directly affected by the Project will be rehabilitated. Some permanent infrastructure will remain. Once decommissioning and active rehabilitation activities are completed, most areas will become accessible again and wildlife is expected to return to the LAA and PDA. Some species (i.e., common nighthawk) may return to the PDA soon after active closure to use recently rehabilitated areas, while other species that require mature forest stands (i.e., woodland forest migratory breeding birds, including Canada warbler and eastern wood-pewee) may not return to the PDA for several years to decades following closure.

Change in Mortality Risk

As described in Section 13.4.3.1 of the Final EIS/EA, for the construction phase, vegetation and overburden clearing (including timber harvesting) is the primary effect mechanism for the change in mortality risk followed by traffic, and adverse human-wildlife encounters. These effects pathways may result in the direct mortality of migratory birds in the absence of mitigation. A similar level of onsite human activity can be conservatively assumed for the closure phase.

For the operation phase, in the absence of mitigation, traffic is the primary effect mechanism which may result in the direct mortality of wildlife as well as potential wildlife interactions with the TMF. Common nighthawk may be particularly susceptible to road mortality.

Change in Movement

The components of the Project will be crossable and are not considered to present an impermeable barrier for species that can fly, including migratory birds.

1.1.3.2 Mitigation Measures

Project planning and design and the application of proven mitigation measures will be used to reduce adverse effects on migratory birds.

Change in Habitat

As were listed in Section 13.4.2.2 of the Final EIS/EA, mitigation measures for a change in habitat include:

- Mitigation for potential effects from lighting in Chapter 7.0 of the Final EIS/EA (atmospheric environment valued component (VC)).
- Mitigation for potential effects from noise and vibration described in Chapter 8.0 of the Final EIS/EA (acoustic environment VC).
- Mitigation measures related to vegetation described in Chapter 12.0 of the Final EIS/EA (vegetation communities VC).
- Implement measures detailed in the Conceptual Closure Plan (see Appendix I of the Final EIS/EA) including the revegetation plan.
- Obtain proper authorizations under the Ontario *Endangered Species* Act (ESA), including Ontario Regulation 242/08 (as applicable) for damage or destruction of habitat protected under the ESA and implement measures required by the authorization.
- Prior to construction flag environmentally sensitive areas adjacent to work areas (e.g., key habitat features such as stick nests) prior to clearing and construction, and evaluate the features for additional mitigation measures (e.g., timing windows and/or setbacks).
- Retain actual or potential wildlife trees (e.g., cavity trees or snags) in areas where it is safe to do so.
- Managing vegetation cover along the boundaries of high activity areas (e.g., access roads) where adjacent to wildlife habitat to reduce sensory (noise and visual) disturbance.
- Avoid use of herbicides where feasible or practical.
- Progressive rehabilitation of disturbed areas used during construction.
- Use of directional light fixtures to avoid the transmission of light outside of the PDA.

Change in Mortality Risk

As discussed in Section 13.4.3.2 of the Final EIS/EA, mitigation measures for a change in mortality risk include:

- Implementation of a Biodiversity Management and Monitoring Plan (BMMP).
- Implement mitigation measures in the Conceptual Explosives and Blasting Management Plan, Conceptual Spill Prevention and Contingency Plan, and Conceptual Waste Management Plan.

- Report the discovery of active nests during all Project phases to the Project Environmental Department who will refer to the BMMP for direction on follow-up actions.
- Maintain the Project site in a manner that reduces the risk that wildlife will encounter potential hazards, such as ropes, wires and holes.
- Avoid situations that can lead to the creation of problem wildlife. Although food wastes are the typical wildlife attractant implicated in the creation of problem wildlife, there are other attractants that may be a concern, specifically roadside wildlife carcasses and vegetation. Project personnel and contractors will be required to report roadside wildlife sightings or interactions to the Project Environmental Department for initiation of follow-up actions to address these concerns.
- Report wildlife-vehicle collisions, near misses or observations of a wildlife road mortality on Project roads to the Environmental Department. Implement adaptive management measures where high frequency locations of wildlife-vehicle interactions are identified.
- Require Project personnel and contractors to report wildlife incidents and encounters related to garbage or other attractants to the Environmental Department so that corrective action can be initiated.
- Require Project personnel and contractors working in active zones (e.g., mine site) to relay wildlife sightings to other workers as soon as possible (e.g., by radio).
- Implement road safety measures (e.g., speed limits and signage) and yield the right of way to wildlife on Project roads to reduce wildlife road mortality.
- Address incidental take of migratory birds. GGM recognizes that scheduling vegetation clearing and site preparation activities outside the breeding period for migratory birds is the best way to reduce the risk of incidental take. If activities that could result in incidental take cannot be avoided, GGM will prepare a Bird Nest Mitigation Plan that outlines how risk of incidental take will be managed in accordance Environment and Climate Change Canada (ECCC) guidance.
- Carry out the removal of structures supporting barn swallow nesting outside of the active nesting season (approximately May- August; O.Reg. 242/08, s.23.5).
- Clear area of wildlife before blasting.
- To reduce use of the ponds by waterfowl for foraging or breeding, no vegetation will be planted on the embankments of the TMF or the water management collection ponds. Vegetation that naturally regenerates around seepage and water collection ponds and the TMF will be removed as required.
- Monitor wildlife use (primarily targeting waterfowl) and water quality of the TMF, open aquatic areas and other key Project locations and implement adaptive management measures (e.g., deterrents and/or exclusionary measures) as required.

Change in Movement

There are no specific mitigation measures listed in Section 13.4.4.2 of the Final EIS/EA in relation to mitigating effects to migratory birds arising from a change in movement; however, mitigation measures above for change in habitat and change in mortality risk may also serve to mitigate effects arising form a change in movement.

1.1.3.3 Residual Environmental Effects

Change in Habitat

As discussed in Section 13.4.2.3 of the Final EIS/EA, it is predicted that vegetation clearing and sensory disturbance will result in habitat loss or alteration or a reduction in habitat patch size for the wildlife habitats assessed. For barn swallow breeding habitat, there will be no net loss of habitat, and common nighthawk breeding habitat is expected to increase upon closure. The loss of habitat is unlikely to affect the long-term persistence or viability of migratory birds in the RAA. It is expected that effects on all migratory bird habitats will be partially reversed following the cessation of operation when migratory bird habitat considered lost as a result of avoidance due to sensory disturbance will be regained. Some migratory bird habitat will also be restored through the implementation of the Closure Plan (a Conceptual Closure Plan is provided in Appendix I of the Final EIS/EA), however, other migratory bird habitats, particularly those that are associated with wetlands and forest habitats will have some irreversible loss of habitat. Habitat conservatively considered lost as a result of sensory disturbance will be regained following the cessation of operations and the completion of active closure activities.

Change in Mortality Risk

As discussed in Section 13.4.3.3 of the Final EIS/EA, throughout construction, operation and active closure, an increased risk of mortality to migratory birds within the LAA as a result of Project activities is anticipated. Mitigation measures are expected to limit the effects on migratory bird mortality and the residual adverse effect on mortality is predicted to be within the normal variability of baseline conditions and is not expected to affect the long-term persistence or viability of migratory birds within the RAA.

No measurable residual effect resulting in direct loss and harm to migratory birds, their eggs and nests is expected following the implementation of a Bird Nest Mitigation Plan. The Bird Nest Mitigation Plan will be prepared in accordance with ECCC guidance and will include mitigation measures to minimize the risk of incidental take and to help maintain sustainable populations of migratory birds.

Change in Movement

For species that can fly (e.g., migratory birds), Project components are not expected to create an imperbeable barrier and their movement is not expected to be disrupted as a result of the Project. No adverse effect on migratory bird movement is expected.

1.1.3.4 Summary for Migratory Birds

In summary, as was concluded in Section 13.4.5 of the Final EIS/EA, the residual environmental effects from the Project on migratory birds were determined to be not significant because they do not threaten the long-term persistence or viability of a migratory bird species within the RAA. Evidence to support this determination is as follows:

- No critical habitat as defined by SARA is present within the LAA; therefore, the Project does not result in loss of critical habitat for a SARA listed species.
- Canada warbler (SAR) and common nighthawk (SAR) are ranked S4B (apparently secure – uncommon, not rare) in Ontario (Section 13.5 of the Final EIS/EA) and suitable breeding habitat is common within the RAA. Birds displaced by the Project are likely to find breeding habitat elsewhere within the LAA or RAA. Potential habitat for common nighthawk is expected to increase upon closure.
- With the implementation of mitigation measures, there is no measurable effect of the Project on barn swallow (SAR) breeding habitat.
- Eastern wood-pewee (SOCC) is ranked S4B (apparently secure – uncommon, not rare) in Ontario (Table 13-6) and suitable breeding habitat is common within the RAA. Birds displaced by the development are likely to find breeding habitat elsewhere within the LAA or RAA. The percentage of potential habitat lost in the RAA upon closure is 0.6%.
- The irreversible loss of bird significant wildlife habitat as a result of the Project is estimated as 42 ha (non-treed wetland bird breeding habitat) and 163 ha (waterfowl nesting habitat) and is 0.6% and 2%, respectively, of the potential habitat available within the RAA.
- The wildlife habitat types within the LAA are common within a regional context (RAA) with the loss of habitat within the RAA ranging from 0.1-2.7%. This is supported by the findings of the vegetation communities assessment regarding the ecosite types identified within the LAA (Chapter 12.0 of the Final EIS/EA; vegetation communities VC).
- Rehabilitation (which will be progressive throughout operation) will restore some wildlife habitat value to the PDA over time.
- Increased mortality risk as the result of the Project is primarily confined to the construction phase, and this risk is highest for nesting birds. Mortality risk will return to baseline levels upon closure. The actual incidence of direct mortality as the result of the Project is expected to be reduced through implementation of a suite of mitigation measures (as outlined above), in particular the implementation of timing windows for vegetation clearing and the development of a Bird Nest Mitigation Plan.

1.2 CHANGES TO THE ENVIRONMENT THAT WOULD OCCUR ON FEDERAL OR TRANSBOUNDARY LANDS

Pursuant to Section 5(1)(b) of CEAA 2012, a federal EA must consider a change that may be caused to the environment that would occur on federal lands, in a province or territory other than the one in which the act or thing is done or where the physical activity, the designated project or the project is being carried out, or outside Canada.

No effects to federal lands or other provincial or territorial lands outside of Ontario are predicted for the Project. No transboundary changes are therefore predicted for the Project.

1.3 EFFECTS OF CHANGES TO THE ENVIRONMENT ON ABORIGINAL PEOPLES

Pursuant to Section 5(1)(c) of CEAA 2012, a federal EA must consider, with respect to Aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on:

- health and socio-economic conditions;
- physical and cultural heritage;
- the current use of lands and resources for traditional purposes; and
- any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

These effects are assessed in updated Appendix O of the Final EIS/EA entitled "Hardrock Project – Effects of Changes to the Environment on Aboriginal Peoples – In Accordance with Section 6.3.4 of the EIS Guidelines issued by the CEA Agency – February 2018 Update" (Stantec 2018). Further, the current use of lands and resoruces for traditional purposes is assessed in Chapter 18.0 of the Final EIS/EA.

The assessment of effects of changes to the environment on Aboriginal peoples is complex and difficult to summarize at a high level without providing the explicit context and information that leads the reader to the overall conclusions of that assessment. Rather than to attempt to summarize those effects here (which would be difficult to achieve in a concise manner for the purposes of this document), the reader is referred to the updated version of Appendix O of the Final EIS/EA (February 2018) for a discussion and significance conclusions of the effects of changes to the environment on Aboriginal peoples. As concluded in the updated Appendix O of the Final EIS/EA (February 2018), the effects of changes to the environment on Aboriginal health conditions, Aboriginal socio-econojmic conditions, Aboriginal physical and cultural heritage (including any structure, site of thing that is of historical, archaeological, paleontological, or architectural significance), and current use of lands and resources for traditional purposes were determined to be not significant.

1.4 CHANGES TO THE ENVIRONMENT THAT ARE DIRECTLY LINKED OR NECESSARILY INCIDENTAL TO FEDERAL DECISIONS

Pursuant to Section 5(2)(a) of CEAA 2012, a federal EA must evaluate changes to the environment that are directly linked or necessarily incidental to federal decisions as a result of the Project.

In addition to federal EA requirements, key federal permits and approvals potentially required for the Project and the associated consultation requirements are listed in Table 1-3 below (as reproduced from Table 1-1 of the Final EIS/EA).

Table 1-3: Key Federal Environmental Permits / Approvals

Permits / Approvals	Activities Associated with the Project	Permit-Specific Consultation Requirements	Potentially Affected Valued Components
Authorization for Works Affecting Fish Habitat • Legislation: *Fisheries Act* • Responsible Agency: DFO (with some provisions administered by ECCC)	• Work that may result in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery.	• Applicants are encouraged to engage with DFO early in the planning process. • Consultation with Aboriginal communities required when the activity has the potential to adversely affect Aboriginal or treaty rights.	• Fish and Fish Habitat
Metal Mining Effluent Regulations (MMER) • Legislation: *Fisheries Act* • Responsible Agency: ECCC	• Use of fish bearing waters to deposit mine effluent, waste rock, and tailings. • Environmental effects monitoring program.	• Consultation on the MMER amendment is conducted during the EA process in order to be considered for exemption from pre-publication in Canada Gazette, Part I. • The regulatory amendment and the regulatory impact analysis statement are published in Part II of the Canada Gazette.	• Fish and Fish Habitat
Approval of Works in Navigable Waters • Legislation: *Navigation Protection Act* • Responsible Agency: Transport Canada	• Although none anticipated, potential interference of navigability to non-scheduled waterbodies.	• Requirement for environmental review and consultation is determined by the Navigation Protection Program Officer.	• Land and Resource Use • Traditional Land and Resource Use
Explosives Regulations • Legislation: *Explosives Act*	• Manufacturing, use/storage of blasting explosives.	• Explosives permits are typically carried by specialist contractors, who would confirm	• Atmopsheric Environemnt • Acoustic Environment

Table 1-3: Key Federal Environmental Permits / Approvals

Permits / Approvals	Activities Associated with the Project	Permit-Specific Consultation Requirements	Potentially Affected Valued Components
• Responsible Agency: NRCan		consultation requirements.	• Surface Water • Land and Resource Use • Traditional Land and Resource Use
Transportation of Dangerous Goods • Legislation: *Transportation of Dangerous Goods Act* • Responsible Agency: Transport Canada	• Transportation of hazardous materials.	• Permits for the transportation of dangerous goods are typically carried by specialist contractors, who would confirm consultation requirements are met.	• None applicable.

A discussion of potential changes to the environment that are directly linked or necessarily incidental to these federal decisions is provided in the following subsections.

1.4.1 Fisheries Act

The *Fisheries Act* administered by DFO includes prohibitions against causing "serious harm" to fish that are part of or support a commercial, recreational, or Aboriginal (CRA) fishery (Section 35) in addition to provisions for flow (Section 20), fish passage (Section 21), and deleterious substances (Section 36). Section 36 is administered by ECCC. When serious harm to fish cannot be avoided or mitigated, a subsection 35(2) authorization with appropriate offsetting of residual adverse effects is required. Section 6 of the *Fisheries Act* lists the factors taken into account by the Minister when considering the approval of an authorization, which are:

(a) contribution of the relevant fish to the ongoing productivity of a CRA fisheries

(b) fisheries management objectives

(c) whether there are measures and standards to avoid, mitigate or offset serious harm to fish that are part of a CRA fishery, or that support such a fishery

(d) the public interest.

The purpose of Section 35 and other provisions identified in Section 6 of the *Fisheries Act* relates to the sustainability and ongoing productivity of CRA fisheries. The *Fisheries Act* defines "serious harm to fish" as "the death of fish or any permanent alteration to, or destruction of, fish habitat". These are further defined in the *Fisheries Act* as follows:

- death of fish
- permanent alteration to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes
- destruction of fish habitat of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes. For the purpose of this Final EIS/EA, destruction of fish habitat is referred to as loss of fish habitat.

Serious harm to fish can be offset, if approved by the Minister of Fisheries and Oceans, through the restoration and creation of fish habitat or other means that will replace the loss to fisheries productivity.

In order for the Project to proceed, DFO will need to issue an authorization to the Project under Section 35(2) of the *Fisheries Act* due to serious harm to fish that will be caused by the loss of fish habitat in order to make way for the construction and operation of certain components of the Project. Environmental effects of the Project on fish and fish habitat, including those that cause serious harm to fish, will be avoided or reduced through the implementation of mitigation measures listed in Table 1-2 above. Residual effects that remain after the application of those mitigation measures will be offset through the development of the Goldfield Creek diversion, in accordance with the "Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting" (DFO 2013) such that there are no residual effects to fish and fish habitat resulting from the Project. Thus, by issuing an authorization under Section 35(2) of the *Fisheries Act* in consideration of the effects of the Project, mitigation to be implemented, and offsetting residual effects to the extent that they are not significant, DFO will be carrying out its legislated mandate in accordance with the requirements of the *Fisheries Act* and its offsetting policies as they were intended by legislation and policy and in such a manner that the changes to the environment arising from issuing this authorization are also not significant. As such, the federal decision to be made by DFO in relation to issuing an authorization under Section 35(2) of the *Fisheries* Act will not result in significant changes to the environment, either directly or indirectly, as a result of the Project.

1.4.2 Metal Mining Effluent Regulations

The *Metal Mining Effluent Regulations* (MMER), developed under Section 36 of the *Fisheries Act* and administered by ECCC, regulate the deposit of mine waste into natural waters frequented by fish (ECCC 2016).

Water features located within the footprint of the Project are under consideration by ECCC to determine Schedule 2 triggers under the MMER. If required, part of the process associated with adding a waterbody to Schedule 2 is the development of an alternatives assessment report and fish habitat compensation plan as per Section 27.1 of the MMER, to offset the loss of fish habitat resulting from the deposition of the deleterious substances into naturally occurring fish bearing waters. Normally, an offsetting plan and authorization issued pursuant to Section 35(2) of the *Fisheries Act* are also sufficient for the purpose of compensating for loss of fish habitat as a result of the MMER Schedule 2 amendment. Additional fisheries values affected by the Project due to works, undertakings or activities (e.g., dewatering, open pit development, creek diversion) other than mine waste deposition, have been identified by the DFO to likely result in serious harm to fish as per Section 35 of the *Fisheries Act*, and as such will also require compensatory measures through implementation of a fisheries offset plan (discussed in Section 1.4.1 above).

Offset ratios are determined by DFO and take into consideration the types of fisheries resources affected, the magnitude and extent of the impacts, the types of offsetting proposed and potential delays between impacts occurring and the implementation of offsetting measures. GGM intends to construct the realigned Goldfield Creek and fisheries offsets early in the project development, thereby minimising any delay between impacts and offsets. The proposed offsetting approach (Draft Offset Plan included as Appendix F10 to the Final EIS/EA) achieves a positive balance to replacing fish habitat that supports game and sustenance fish communities in Kenogamisis Lake. Discussions with ECCC and DFO have confirmed that GGM will work in cooperation with DFO to develop an acceptable combined fisheries offset plan that will include compensation fish habitat if required for Schedule 2 waterbody impacts, and fisheries offset measures for the effects arising from Section 35 authorization.

The regulations form the basis of the federal mine effluent standards by, among other requirements, defining authorized limits for releasing selected deleterious substances outlined in Schedule 4 of the Regulations (pH, total suspended solids, arsenic, copper, lead, nickel, zinc, radium-226, cyanide), from mining operations. The release of contact water and treated effluent to Kenogamisis Lake is subject to the MMER. Effluent will be treated to levels that are not acutely toxic to fish, and will be below MMER effluent criteria as described in Section 10 4.3.2 of Chapter 10.0 (surface water VC) of the Final EIS/EA for modelled effluent criteria for the effluent treatment plant (ETP). Therefore, mitigation will reduce the magnitude of effects, and no residual environmental effects are expected.

Table 8-1 of Appendix M12 of the Final EIS/EA provides a summary of conceptual monitoring activities that will be carried out in accordance with environmental effects monitoring (EEM) requirements.

The construction and operation of the TMF will result in effects to fish and fish habitat (through the loss or alteration of fish habitat), vegetation communities (through change in abundance of vegetation, change in connectivity, or change in plant species of interest), and wildlife and wildlife habitat (through change in habitat). These changes will be avoided or reduced through the implementation of mitigation measures identified in Chapters 11.0, 12.0, and 13.0 of the Final EIS/EA as well as through offsetting for the residual effects associated with the loss of fish habitat through the Goldfield Creek diversion so that effects are not significant. EEM studies under Schedule 5 of the MMER and the application and enforcement of discharge limits under Schedule 4 of the MMER are routine operational and monitoring activities for mines that do not result in significant environmental effects as long as requirements are met.

1.4.3 Navigation Protection Act

Potential effects of Project activities on navigation are subject to the Common Law right to navigation. In addition, the *Navigation Protection Act* (NPA), administered by Transport Canada, applies to the construction of works that affect the navigability of waters. Approval from the Minister of Transport is required for construction of any structure in, over, under or through navigable water (e.g., a bridge, boom, pipeline, outfall, diffuser or dam) that would interfere with navigation.

In the local assessment area (LAA), navigation is reported to occur in conjunction with recreational boating, including canoeing, and the use of Aboriginal travelways. Navigation may be associated with other activities such as fishing, hunting, bait harvesting, trapping and guide outfitting. Although navigation may be carried out for commercial purposes such as harvesting there are no commercial navigation activities, such as ferry services or water transport operations, in the LAA. None of the watercourses in the RAA are listed on the NPA schedule of navigable waters. None of the watercourses in the PDA or LAA are listed on the NPA schedule of navigable waters. Navigation has not been confirmed within the PDA through consultation input, TK and TLRU studies or observations made during fieldwork (Table 16-7 of the Final EIS/EA). Transport Canada has reviewed the Final EIS/EA documents and confirmed that there are no waterways within the Project site that are listed on the Schedule to the NPA, and therefore regulatory authorization under the NPA is not required for works on navigable waterways. As such, givent that no federal decision is required by the Minister of Transport under the NPA, no significant changes to the environment, either directly or indirectly, as a result of the Project are anticipated.

1.4.4 Explosives Act

Explosives needed for the Project will be prepared in a dedicated explosives manufacturing facility in which a licence will be required as per *Part 5* of the *Explosives Regualtions, 2013* under the federal *Explosives Act*. The facility will be constructed and operated by an explosives contractor and will be sited in accordance with Natural Resources Canada (NRCan) requirements by the explosives contractor. The facility will store bulk ingredients required for producing the emulsion explosives used in blasting activities for the Project. It will be equipped to deal with spills of hazardous materials.

Specifications for the manufacturing plant and the explosives storage magazines and the locations of these facilities must adhere to the *Explosives Act* and regulations as published by the Explosives Regulatory Division of NRCan. The location of the manufacturing plant and the explosives magazines are determined by NRCan's Quantity-Distance Principles, which specify required distances to features such as roads and buildings. The location of the manufacturing plant and explosives magazines will be reviewed and approved by NRCan.

Magazines will be utilized in the PDA to store packaged explosive products and blasting accessories at the Project in which a magazine licence will be required as per Part 6 of the *Explosives Regulations*, *2013*. Magazines will be kept locked when an authorized person is not present. Clearly visible signage according to NRCan standards will be posted on the magazines and warning signs will be on the road approaching the storage areas. The magazines will be dedicated to storing blasting accessories such as boosters, delays, detonating cord and detonators, as well as a limited quantity of packaged explosives for specialty blasting purposes. The detonators and delays will be stored in a separate magazine as required by regulations.

Access to the magazines will be restricted by a locked gate to authorized personnel and logbooks will be kept in each magazine for tracking purposes. The magazines will be supplied by owner/operator and permitted in coordination with the contractor.

With the implementation of the above-noted mitigation measures, no residual environmental effects are expected from the issuance of licences under the *Explosives Regulations*, 2013 and the *Explosives Act.* As such, the federal decision to be made by NRCan to issue an authorization to the Project under the *Explosives Act* and its regulations will not result in significant changes to the environment, either directly or indirectly, as a result of the Project.

1.4.5 Transportation of Dangerous Goods Act

It is expected that materials transported to the mine site will include various dangerous goods (e.g., mill reagents, fuel, explosives) which will be subject to the requirements of the TDGA and regulations. A description of fuel and hazardous materials transportation and storage is provided in Section 5.4.21 of the Final EIS/EA. The transportation of dangerous goods to the Project site will be undertaken by third party carriers according to applicable guidelines, acts and regulations.

Fuel storage and distribution infrastructure will be constructed to current engineering standards and in accordance with federal and provincial requirements including the Canadian Council of Ministers of the Environment (CCME) Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products (CCME 2003) and the National Fire Code of Canada (National Research Council Canada 2015).

Mill reagents will be delivered to the Project in accordance with *Transportation of Dangerous Goods Regulations* and stored onsite in secure locations. Some reagents will be delivered in bulk, while other reagents will be delivered in super bags, tote bins or drums, depending on the application. Management of cyanide reagent will be in accordance with the recommendations and principles of the *International Cyanide Management Code For the Manufacture, Transport, and Use of Cyanide In the Production of Gold* (International Cyanide Management Institute 2002).

The transportation of dangerous goods occurs throughout Canada on a regular basis and the applicable regulations are well understood by carriers. No residual environmental effects are expected to occur from the transportation of dangerous goods for the Project, except in the unlikely event of an accident. Regardless, given these routine matters, the federal decision to subject the Project to, and monitor compliance with, the TDGA will not result in significant changes to the environment, either directly or indirectly, as a result of the Project.

1.4.6 Summary

As noted above, in order for the Project to proceed, federal actions are required in relation to the *Fisheries Act*, *Metal Mining Effluent Regulations*, *Navigation Protection Act*, *Explosives Act*, and *Transportation of Dangerous Goods Act*. In carrying out their legislated mandates under these Acts, the Government of Canada and its respective federal authorities would be basing their federal decisions to issue authorizations , and in view of the no significant adverse effects from the Project after mitigation or offsetting measures have been applied. In all cases, the environmental effects of the Project on the related valued components that are associated with those federal actions were determined to be not significant. It therefore follows that, any change to the environment that is directly linked or necessarily incidental to those federal decisions as a result of the Project, are also not significant. In fact, considering the key design features of the Project including relocating a portion of the historical tailings, and implementing an enhanced cover, stability measures and seepage collection for the remaining historical MacLeod tailings to reduce seepage, will substantially reduce environmental effects to water quality from these historical tailings and thus result in an overall improvement in water quality in Kenogamisis Lake, with reduced concentrations of many parameters on a lake-wide basis.

Overall, changes to the environment from the Project that are directly linked or necessarily incidental to a federal decision are not predicted to be significant.

1.4.7 Effects of a Change to the Environment

Pursuant to Section 5(2)(b) of CEAA 2012, a federal EA must evaluate changes to the environment that are directly linked or necessarily incidental to federal decisions as a result of the Project that result in an effect to health or socio-economic conditions, physical and cultural heritage, or any site or thing that is of historical, archaeological, paleontological or architectural significance.

Potential federal permits related to the Project were listed in Table 1-3 and include:

- Authorization for serious harm to fish under Section 35(2) of the Fisheries Act
- Amendment to Schedule 2 of the *Metal Mining Effluent Regulations* to include the TMF and WRSAs as approved disposal facilities
- Authorization under the *Navigation Protection Act* for effects on navigation
- Explosives permits under the *Explosives Act*
- Compliance with the *Transportation of Dangerous Goods Act*.

Changes to the environment from the Project that are directly linked or necessarily incidental to a federal decision are not predicted to result in an effect to health or socio-economic conditions, physical and cultural heritage, or any site or thing that is of historical, archaeological, paleontological or architectural significance.

1.5 SUMMARY OF RESIDUAL ENVIRONMENTAL EFFECTS

No Project-related significant adverse residual environmental effects were identified through the environmental effects assessment. As summarized in Table 1-4 below, all Project-related environmental effects were determined to be not significant.

Table 1-4: Summary of Environmental Effects within Federal Jurisdiction

Component	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Components and Physical Activities	Mitigation	Residual Effect
Changes to Components of the Environment within Federal Jurisdiction [CEAA 2012, Section 5(1)(a)]					
Fish and Fish Habitat	s. 5(1)(a)(i)	Lethal and sub-lethal effects on fish	Mobilization and transport of sediment into fish habitat (e.g., while working near water during excavation, grading, channel construction, vegetation clearing, culvert installation and culvert removal) that results in mortality of fish eggs caused by sedimentation, or disruption of biological processes caused by high TSS (e.g., gill inflammation and limited foraging ability). Change in timing, duration, and frequency of flow, which can lead to change in fish mortality by displacing or stranding fish or by preventing access to spawning areas. Dewatering work areas, which has the potential to strand, entrain, and impinge fish. Destruction of fish eggs by equipment during instream work. Stranding of fish within a work area during isolation activities. Entry of deleterious materials into fish habitat through point and non-point sources. Use of explosives in or near water, which produces shock waves that can damage fish swim bladders and rupture internal organs and vibrations that may kill or damage eggs or larvae. Entrainment and impingement of fish on the freshwater intake structure in Kenogamisis Lake. Entry of deleterious materials into fish habitat through minor spills or leaks from vehicles, equipment, storage containers/facilities. Maintenance or replacement of in-water structures (e.g., culvert replacement, maintenance of water intake structures).	see Table 1-2	**Sub-lethal effects on fish due to PoPC inputs from treated effluent and non-point sources:** • Concentrations of parameters of potential concern (PoPCs) in the mixing zone will not be acutely lethal to fish. The magnitude of sub-lethal effects is considered low because, due to the geographic range of fish, long-term exposure is not anticipated, especially given the overall predictions of generally improved water quality on a lake-wide basis. Removal of portions of the historical MacLeod and Hardrock tailings to the TMF will result in an approximately 60% decrease in arsenic concentrations in Barton Bay, Central Basin, and Outlet Basin during operation, compared to baseline, resulting in overall improvement of water quality in Kenogamisis Lake. Furthermore, baseline data from Barton Bay, where concentrations of arsenic are currently higher than those predicted for all other basins as a result of the Project, do not indicate adverse effects on fish or other aquatic species tested. The sustainability and productivity of commercial, recreational, or Aboriginal (CRA) fisheries will not be affected.Effects were determined to be not significant.
		Permanent alteration of fish habitat	Discharge of treated effluent, or groundwater discharge originating from the WRSAs and TMF into the Southwest Arm of Kenogamisis Lake Planting riparian vegetation Use of explosives in and adjacent to fish habitat Use of heavy equipment in and adjacent to fish habitat Use of heavy equipment in water Vegetation clearing Altering the volume, timing, duration or frequency of flow		**Permanent alteration of fish habitat due to nutrient inputs from treated effluent and non-point sources:** • The alteration to fish habitat is predicted to be less than applicable guidelines, legislated requirements and/or federal and provincial management objectives. Predicted concentrations of arsenic at the discharge location and within 30 m of the treated effluent discharge location are lower than the Interim

Component	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Components and Physical Activities	Mitigation	Residual Effect
Fish and Fish Habitat *Cont.*	s. 5(1)(a)(i) *Cont.*		Dredging which may be required to bury the freshwater intake and treated effluent discharge pipes in the near shore area of Kenogamisis Lake		provincial water quality objectives (PWQO), and the trophic status, as defined in the *Lakeshore Capacity Assessment Handbook* will be maintained. Effects on sustainability and productivity of CRA fish populations within the LAA are not anticipated. Effects were determined to be not significant.
			Placement of material or structures in water (e.g., culverts, water intake pipe and treated effluent discharge pipe)		
			Removal of non-natural in-water structures such as existing culverts (e.g., at Goldfield Creek and at WC-L) can lead to mobilization of sediment or alter flow regimes, causing a change in habitat structure and cover.		
			TMF reclaim pipeline crossings of the Goldfield Creek diversion could lead to a change in bank structure and cover or mobilization and deposition of sediment.		
		Permanent alteration of fish habitat *Cont.*	Water extraction (e.g., pit dewatering)		
			Maintenance of roads, work areas, water crossings and water intake		
			Continued input of nutrients to Southwest Arm of Kenogamisis Lake from the TMF, WRSA and, once the pit lake has filled, natural drainage from the pit lake area		
			Erosion and sedimentation caused from the removal of culverts, water intake, and other infrastructure.		
		Loss of Fish Habitat	Placement of fill and structures in water can lead to the loss of fish habitat direct by directly overprinting.		**No residual effect expected.** With implementation of the Fisheries Offset Plan (Appendix F10 of the Final EIS/EA) including most notably the Goldfield Creek diversion that will replace some marginal habitat affected by the Project, no residual effects on fish habitat will occur as a result of loss of fish habitat. The majority of habitat loss will occur during the construction phase and the offsetting strategy will also be implemented during this time period. No further habitat losses are identified for the operation and closure phases beyond those that will occur during construction.
			Contact water collection system, process water supply		
Aquatic Species at Risk	s. 5(1)(a)(ii)	N/A - No aquatic SAR listed under the *Species at Risk Act* are known to have the potential to be affected by the Project	N/A	N/A	N/A
			Site Preparation (removal of existing buildings and associated infrastructure, timber harvesting, vegetation clearing, earthworks, overburden and topsoil stockpiling, temporary effluent treatment and discharge)	Table 1-2	**Project activities will result in the direct loss or alteration of migratory bird habitat through vegetation clearing.** • For barn swallow breeding habitat and American white pelican stopover and foraging habitat there will be no net loss of habitat and common nighthawk
			Watercourse Crossings and Goldfield Creek Diversion		
			Pre-Production Mining and Development of Mine Components (open pit, waste rock storage areas (WRSAs), ore stockpile, water management facilities, Phase 1 of TMF)		

Component	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Components and Physical Activities	Mitigation	Residual Effect
Migratory Birds	s. 5(1)(a)(iii)	Change in habitat	Buildings and Supporting Infrastructure (process plant, temporary camp, STP, mine dry, administration building, truckshop, warehouse and offices, power plant)	see Section 1.1.3.2	breeding habitat is expected to increase upon closure. Regionally these habitats are common and the percent loss of migratory bird habitat is low and is not expected to affect the long-term persistence or viability of migratory bird populations. • Sensory disturbance to migratory birds is expected to be minimal and is not expected to affect the long-term persistence or viability of migratory bird populations.
			Linear and Ancillary Facilities (site roads and parking areas, onsite pipelines, power lines/transformer station, fuel supply, storage and distribution)		
			Highway 11 Realignment and MTO Patrol Yard Relocation		
			Aggregate Sources (excavation and dewatering related to aggregate source development and extraction)		
			Open Pit Mining (drilling, blasting, loading and hauling of ore and waste rock)		
			Waste Rock Disposal		
Migratory Birds *Cont.*		Change in habitat Cont.	Ore Processing (ore crushing and conveyance, ore milling)	see Section 1.1.3.2	• Habitat conservatively considered lost as a result of sensory disturbance will be regained following the cessation of operations and the completion of active closure activities. • Effects were determined to be not significant.
			Site Buildings, Linear Facilities and Associated Infrastructure (site roads, power plant, explosives facility, fuel supply, storage and distribution		
			Active Closure (primary decommissioning and rehabilitation)		
			Post-Closure (pit filling and monitoring)		
		Change in Mortality Risk	Site Preparation (removal of existing buildings and associated infrastructure, timber harvesting, vegetation clearing, earthworks, overburden and topsoil stockpiling, temporary effluent treatment and discharge)		**Increase in mortality risk to migratory birds:** • Throughout construction, operation and active closure, an increased risk of mortality to wildlife within the LAA as a result of Project activities is anticipated. With the implementation of the mitigation measures, the residual adverse effect on wildlife mortality is predicted to be within the normal variability of baseline conditions and is not expected to affect the long-term persistence or viability of wildlife within the RAA. Mitigation measures are expected to limit the effects on migratory bird mortality. • No measurable residual effect resulting in direct loss and harm to migratory birds, their eggs and nests is expected following the implementation of a Bird Nest Mitigation Plan. • The Bird Nest Mitigation Plan includes appropriate preventive and mitigation measures to minimize the risk of incidental take and to help maintain
			Watercourse Crossings and Goldfield Creek Diversion		
			Pre-Production Mining and Development of Mine Components (open pit, waste rock storage areas (WRSAs), ore stockpile, water management facilities, Phase 1 of TMF)		
			Buildings and Supporting Infrastructure (process plant, temporary camp, STP, mine dry, administration building, truckshop, warehouse and offices, power plant)		
			Linear and Ancillary Facilities (site roads and parking areas, onsite pipelines, power lines/transformer station, fuel supply, storage and distribution)		
			Highway 11 Realignment and MTO Patrol Yard Relocation		
			Aggregate Sources (excavation and dewatering related to aggregate source development and extraction)		
			Open Pit Mining (drilling, blasting, loading and hauling of ore and waste rock)		
			Tailings Management (including excavation and removal of historical tailings)		
			Site Buildings, Linear Facilities and Associated Infrastructure (site roads, power plant, explosives facility, fuel supply, storage and distribution)		

Component	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Components and Physical Activities	Mitigation	Residual Effect
			Active Closure (primary decommissioning and rehabilitation)		sustainable populations of migratory birds. • Effects were determined to be not significant.
		Change in Movement	N/A		**No residual effect expected.** For species that can fly (e.g., migratory birds), Project components are not expected to create an impermeable barrier and their movement is not expected to be disrupted as a result of the Project. No adverse effect on migratory bird movement is expected.
Changes to the Environment that Would Occur on Federal or Transboundary Lands [CEAA 2012, Section 5(1)(b)]					
Changes on Federal Lands	s. 5(1)(b)(i)	N/A	N/A. No Project components or physical activities will result in changes on federal lands.	N/A	**No residual effect expected.**
Changes on Transboundary Lands	s. 5(1)(b)(ii) s. 5(1)(b)(iii)	N/A	N/A. No Project components or physical activities will result in changes in another province or territory, or outside Canada.	N/A	**No residual effect expected.**
Changes to the Environment on Aboriginal Peoples [CEAA 2012, Section 5(1)(c)]					
Effects of Changes to the Environment on Aboriginal Peoples	s. 5(1)(c) (i) to (iv)	Aboriginal Health Conditions Aboriginal Socio-economic Conditions Aboriginal Physical and Cultural Heritage (including any structure, site or thing that is of historical, archaeological, paleontological, or architectural significance) Current Use of Lands and resources for Traditional Purposes by Aboriginal Peoples	Construction, Operation, and Closure of all Project components.	Please refer to the updated Appendix O.	Please refer to the updated Appendix O. Effects were determined to be not significant.

Component	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Components and Physical Activities	Mitigation	Residual Effect
Changes to the Environment that are Directly Linked or Necessarily Incidental to Federal Decisions, and Effects of those Changes [CEAA 2012, Section 5(2)]					
Fisheries Act	s. 5(2)	Please refer to Fish and Fish Habitat above	All Project components and physical activities during Construction, Operation, and Closure that affect fish or fish habitat. Please refer to Fish and Fish Habitat above.	Please refer to Fish and Fish Habitat above.	**No residual effect expected.** By issuing an authorization under Section 35(2) of the *Fisheries Act* in consideration of the effects of the Project, mitigation to be implemented, and offsetting residual effects to the extent that they are not significant, DFO will be carrying out its legislated mandate in accordance with the requirements of the *Fisheries Act* and its offsetting policies as they were intended by legislation and policy and in such a manner that the changes to the environment arising from issuing this authorization are also not significant. As such, the federal decision to be made by DFO in relation to issuing an authorization under Section 35(2) of the *Fisheries* Act will not result in significant changes to the environment, either directly or indirectly, as a result of the Project.
Metal Mining Effluent Regulations	s. 5(2)	Please refer to Fish and Fish Habitat above	All Project components and physical activities related to the construction, operation, and closure of the tailings management facility (TMF)	Please refer to Fish and Fish Habitat above.	**No residual effect expected.** Water features located within the footprint of the Project are under consideration by ECCC to determine Schedule 2 triggers under the MMER. If required, part of the process associated with adding a waterbody to Schedule 2 is the development of an alternatives assessment report and fish habitat compensation plan as per Section 27.1 of the MMER, to offset the loss of fish habitat resulting from the deposition of the deleterious substances into naturally occurring fish bearing waters. The proposed offsetting approach (Appendix F10 to the Final EIS/EA) achieves a positive balance to replacing fish habitat that supports game and sustenance fish communities in Kenogamisis Lake. Discussions with ECCC and DFO have confirmed that GGM will work in cooperation with DFO to develop an acceptable combined fisheries offset plan that will include compensation fish habitat if required for Schedule 2 waterbody effects, and fisheries offset measures for the effects arising from Section 35 authorization.

Component	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Components and Physical Activities	Mitigation	Residual Effect
					EEM studies under Schedule 5 of the MMER and the application and enforcement of discharge limits under Schedule 4 of the MMER are routine operational and monitoring activities for mines that do not result in significant environmental effects as long as requirements are met.
Explosives Act	s. 5(2)(a)	• Change in ambient air quality • Change in noise levels • Change in vibration levels • Change in surface water • Change in recreation land and resource use • Change in commercially - based land and resource use • Change in traditional land and resource use	Blasting activities associated with construction activities Blasting within the open pit during Operation	• Blast design to meet MOECC's criteria • Advise nearby residents of planned blasting activities • Where possible, GGM will conduct blasting primarily on weekdays, typically mid-day. GGM will also endeavor to avoid blasting on statutory holidays. • Implement an Explosives Management Plan	• Change in ambient air quality due to an increase in particulate emissions • Change in noise levels • Change in vibration levels • Change in surface water quality • Change in recreational land and resource use • Change in commercially-based land and resource use • Change in traditional land and resource use • With the implementation of mitigation, no residual environmental effects are expected from the issuance of licences under the Explosives Regulations, 2013 and the Explosives Act. As such, the federal decision to be made by NRCan to issue an authorization to the Project under the Explosives Act and its regulations will not result in significant changes to the environment, either directly or indirectly, as a result of the Project.

Component	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Components and Physical Activities	Mitigation	Residual Effect
Transportation of Dangerous Goods Act	s. 5(2)(a)	N/A – the transportation of dangerous goods occurs throughout Canada on a regular basis and the applicable regulations are well understood by carriers. Environmental effects are not expected to occur from the transportation of dangerous goods for the Project.	Transportation of dangerous goods to and from the Project location (e.g., reagents, liquefied natural gas (LNG), fuels, concentrates to markets)	N/A	**No residual effect expected.** The transportation of dangerous goods occurs throughout Canada on a regular basis and the applicable regulations are well understood by carriers. No residual environmental effects are expected to occur from the transportation of dangerous goods for the Project, except in the unlikely event of an accident. Regardless, given these routine matters, the federal decision to subject the Project to, and monitor compliance with, the TDGA will not result in significant changes to the environment, either directly or indirectly, as a result of the Project.

Environmental Effects under CEAA, 2012:
5(1)
(a) a change that may be caused to the following components of the environment that are within the legislative authority of Parliament:
- (i) fish as defined in section 2 of the *Fisheries Act* and fish habitat as defined in subsection 34(1) of that Act,
- (ii) aquatic species as defined in subsection 2(1) of the *Species at Risk Act*,
- (iii) migratory birds as defined in subsection 2(1) of the *Migratory Birds Convention Act*, 1994, and
- (iv) any other component of the environment that is set out in Schedule 2 of [CEAA, 2012];

(b) a change that may be caused to the environment that would occur
- (i) on federal lands,
- (ii) in a province other than the one in which the act or thing is done or where the physical activity, the designated project or the project is being carried out, or
- (iii) outside Canada; and

(c) with respect to Aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on
- (i) health and socio-economic conditions,
- (ii) physical and cultural heritage,
- (iii) the current use of lands and resources for traditional purposes, or
- (iv) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

Certain additional environmental effects must be considered under section 5(2) of CEAA, 2012 where the carrying out of the physical activity, the designated project, or the project requires a federal authority to exercise a power or perform a duty or function conferred on it under any Act of Parliament other than CEAA, 2012.
5(2)
(a) a change, other than those referred to in paragraphs (1)(a) and (b), that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated project or the project; and
(b) an effect, other than those referred to in paragraph (1)(c), of any change referred to in paragraph (a) on
- (i) health and socio-economic conditions,
- (ii) physical and cultural heritage, or
- (iii) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

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