Toms Gully Underground Project

Geochemistry Sampling Procedure

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Revision No.	Description of Revision	Date	Comment	Approved
1.0	First Issue	18/09/15	First issue released by GHD in 2015 for the purpose of the EIS draft.	
2.0	Second Issue	8/08/18	Revised and submitted for EIS Supplement	MQ

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1. Purpose

This site procedure outlines the methods required to collect and analyse geochemical samples at Toms Gully Underground (TGU) for the purposes of investigation, ongoing management and inventory of acid forming (PAF) material on site.

It is provided in support of the AMD Management Plan to ensure that the materials to be mined and processed are appropriately geochemically characterised, material movements are planned and consistent with the AMD strategy, appropriate records and reporting requirements are identified and completed, and continuous improvement assessed and implemented where appropriate.

2. AMD Management Strategy and Operational Controls

2.1. AMD Management Strategy

The overall AMD management strategy over the life of the Project assumes that all waste rock and tailings generated is PAF. The management strategy is twofold:

1. To minimise the risk of creating new AMD sources
2. To ensure that the existing and new tailings, and new waste rock is managed and placed in safe and secure long term storage using best available management practices.

2.2. AMD Operational Controls

The following operational controls form part of the ongoing AMD management onsite.

2.2.1. Ore and Waste Rock Controls:

- Implementation of the AMD Management Plan and this site procedure
- Implementation of the TGU Water Management Plan that includes the AMD water monitoring analytes
- All waste rock is assumed to be PAF and is to remain underground, or placed in the pit
- All of the ore unit is considered to be PAF and shall only be stockpiled underground or on the ROM pad
- No waste is to be disposed of outside of the pit.
- No waste rock is to be used for construction purposes, other than the DHW unit
- No waste rock from the existing sulfide or oxide waste rock dumps is to be used for construction purposes
- The existing sulfide and oxide waste rock dumps are to be maintained to ensure their integrity

2.2.2. Tailings Controls:

- All metallurgical tailings to be treated as PAF and placed in pit
- Implementation of the AMD Management Plan and this site procedure
- Implementation of the TGU Water Management Plan that includes the AMD water monitoring analytes
- The existing tailings in TSF1 and TSF2 placed in the pit beneath a water cover
- Place all future tailings into the pit beneath a water cover
- Development and implementation a tailings/pit operating manual / procedure (that incorporates TSF1 and 2 until the tails are removed and placed in the pit)

3. Roles, Responsibilities and Training

Ultimately the responsibility for AMD management is the General Manager Operations (GMO). The GMO shall ensure that the resources required to implement this procedure are made available and the responsibilities of other positions identified in Table 1 below are made clear.

General AMD management measures, the AMD Management Plan and this site procedure will be communicated to all site employees and contractors so they are aware of the management measures.

Table 1: Roles and Responsibilities

Task	Responsible
The identification and management of potentially acid forming waste rock and tailings	Manager Mine Geology
Accurate and timely information regarding waste rock and tailings characterisation and geochemical monitoring	Manager Mine Geology – to be conveyed to Mine Manager
Mine scheduling and strategic planning of mineral waste management. Ensuring that any material movements from the mine are consistent with this procedure and that material movements for waste types and volumes are recorded and retained. The Mining Department is responsible for providing equipment and resources for any maintenance work completed on the waste rock dumps or other locations around the mine.	Mine Manager
Managements of tailings, the supply of water to the processing plant and the management of water in the processing circuit.	Processing Manager
Planning and implementation of investigations into the waste rock dumps,	Environment Manager
Ongoing water monitoring	Environment Manager
Review and refine Rehabilitation Completion Criteria	Environment Manager
Management actions that are relevant to the management of AMD.	Environment Manager
Coordination of the design, assessment and approval of cover designs for waste rock and tailings as appropriate.	Environment Manager

4. Waste Rock and Tailings Classification and Volumes

Preliminary desktop and detailed geochemical assessments have shown that all waste rock and tailings mineral waste units, with the exception of DWH, are to be treated as potentially acid forming (PAF) for management purposes.

Estimated tonnages of waste rock and tailings at the Project are shown in Table 2.

Table 2: Life of Mine Ore and Mineral Waste Schedule as February 2019

Year	Ore mined	Ore stockpiled	Waste rock	Tailings	Existing Tailings Removal
1	-	-	1,004,400	-	-
2	385	385	156,997	-	187,500
3	220,666	27,062	162,062	193,998	187,500
4	241,116	18,183	138,418	249,996	-
5	284,357	52,544	47,317	249,996	-
6	135,579	-	-	190,113	-
Total	884,103	NA	1,509,194	884,103	375,000

4.1. Underground development / tailings production

Current mine schedules show underground development over the mine life totaling 21,769 m, ramping up and down; for an average of 454 m/month. Average tailings production over the production period is approximately 14,735 t/month.

As all waste rock would be managed by in-pit disposal and/or underground storage, and all tailings are reporting to the pit, no geochemical characterisation in real time is required for mineral waste handling and placement. Rather, the geochemical sampling would provide an inventory and historic record for closure management purposes.

4.2. Sampling and analytical procedure

Characterisation of waste rock involves taking a composite sample through the development area from a discrete location, or, can be a representative selection from recently stockpiled material. The tailings sample should be collected from freshly processed material to be deposited in the pit. Both the waste rock and tailings sample should be approximately 3 kg in weight.

All sampling activities are coordinated by the Mine Geologist. The numbering convention for waste rock should be simple, such as WR1, WR2…..WRn-1. A similar convention should be followed for samples from TSF2.

Visual

The Mine Geologist produces a geological log of each waste rock sample recording visual information. This log examines sampled material (HW, FW, DFW etc), approximate percent pyrite, arsenopyrite, other sulfide, oxidation state (O – oxide/weathered, T - transitional, F - fresh), alteration etc. This information can be used to critically analyse the geochemical data upon its return from the laboratory. An example geological log is provided in Figure 1.

Figure 1: Example of Geological Field Log

Waste Geology Logsheet

KEY

Lithology:	Greywacke	G	Alteration:	Sericite	Se	Weathering:	Oxide
	Shale	S		Chlorite	Ch		Transitional
	Quartz	Q		Haematite	He		Fresh
	Complex	C					
Strength:	Weak	1					
	Moderate	2					
	Strong	3					

Date	Hole ID	Lithology	Qtz %	Alteration	Py %	AsPy %	Weathering	Comments

Quantitative

Following visual inspection, a subset of the development waste and tailings samples would be forwarded to a NATA accredited laboratory to be analysed for:

- Acid base accounting; and
- Metals.

Recommended sampling and analysis frequency is provided below in Table 2. The sample numbers in Table 2 are based on an industry accepted formula provided in Equation 1 below (Price, 1997).

Equation 1: $n = 25 * \sqrt{x}$.

(Where x = Million tonnes (MT) of material per major lithological unit).

Therefore, and based on Equation 1, a rule of thumb to be representative is around 25 samples per million tonnes of material - per major lithology. As all waste rock will be stored together, as will all tailings, and each waste rock lithology has been geochemically assessed, the 'lithological' units for waste rock and tailings management purposes become simply 'waste rock' and 'tailings'.

Therefore, based on Equation 1, waste rock should be sampled and analysed approximately once every month and tailings should be sampled and analysed approximately once every 40 days. To be conservative, PG will sample and analyse both waste rock and tailings at a rate of one sample per month.

The sampling frequency would be reviewed upon mine schedule amendment as required.

Table 3: Sampling Frequency

Mineral Waste Unit	Approx. life of mine tonnes	Approx. sample number required	Approximate sampling frequency
Waste Rock	1,509,194	48	~1 per month
Tailings	884,103	48	~1 every 40 days

Samples should be forwarded to the NATA accredited and analysed for the suits shown in Table 4.

Table 4: Offsite laboratory analytical suite

Analysis	Samples required	Method
Slurry pH and EC	1 waste rock and 1 tailings sample per month	Soil / Water 1:5 (APHA 21st ed. 4500H+)
Total sulfur		LECO at 1350 deg C.
Sulfate sulfur		HCl digestion then ICP-AES
Sulfide sulfur		By calculation
Acid neutralising capacity (ANC)		USEPA 600/2-78-054 / Modified Sobek
Maximum potential acidity (MPA)		By calculation
Net acid production potential (NAPP)		By calculation
Oxidation pH and single addition net acid generation (NAG)		AMIRA (2002) / Miller (1997)

Analysis	Samples required	Method
Kinetic NAG test		AMIRA (2002)
35 element metals analysis on solids		35 elements by aqua regia acid digestion and ICP-AES.

All data should be used to validate the existing mineral waste geochemical classification and therefore inform the forward AMD strategy and plans at TGU for continuous improvement purposes. The data would also be used in closure planning and for legacy management.

5. Record Keeping, Reporting, Review and Audit

Records keeping under the AMD Management Plan are:

- laboratory geochemical analytical results
- Tails/Pit/TSF operating manual
- all geochemical monitoring reports
- research and development reports
- an emplaced mineral waste inventory (for waste rock and tailings) that should include the following information:
    - quantities and nature of mineral waste located in specific areas within the pit and/or underground
    - the nature of emplacement
    - quality control data as applicable
    - materials that may be re-used at a later date, such as topsoil, NAF, AC, etc.

Records shall be maintained in accordance with PG corporate policies and procedures, with all records maintained into perpetuity to inform future site risk management.

Geochemical data review should be undertaken in real time to monitor the effectiveness of the AMDMP, for adaptive management purposes, and for continuous improvement.

Reporting would be undertaken consistent with approval requirements, and would include:

- geochemical data on mineral waste: to be included in annual updates of the AMD Management Plan as an appendix to the Mining Management Plan under the NT *Mining Management Act*
- water monitoring data: to be included in a specific annual water report as required under the NT *Mining Management Act*.

The AMDMP is a dynamic document and therefore should be revised annually and appended to the updated Mining Management Plan (MMP) each year.

Auditing would be undertaken consistent with Primary Gold's internal quality assurance protocol.