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# Memorandum

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| **Project number** | G1743 |
| **To** | Clay Gordon / Phil Scott |
| **Company** | Primary Gold / Preston Consulting |
| **From** | Daniel Barclay |
| **Date** | 15 September 2015 |
| **RE** | **Proposed Work Plan for Contaminant Transport Modelling** |

The Terms of Reference (ToR) for the Toms Gully Project (the project) requires provision of a "*conceptual site model describing potential sources, pathways, receptors, and fate of any contaminated waters, and products, from the Project, and Project components*." The ToR carries on to say that "*the minimum data required to support the model should include, but not be limited to:*

- *hydrogeological characterisation, and flow modelling where appropriate; and*
- *contaminant transport modelling of current and future seepage plumes*."

For the purposes of impact assessment and post closure modelling, 2D numerical modelling (SEEP/W) was carried out to predict the long-term water level in the Toms Gully Pit. Three dimensional (3D) groundwater flow modelling for the purposes of environmental impact assessment has not been carried out for the project on a scale appropriate to contaminant transport, and as a result, contaminant transport modelling has not been undertaken either. For the following reasons, a 3D impact assessment groundwater flow model with sufficient spatial coverage was not developed:

- Successful development and undertaking of the project would hydrogeologically see no tangible change to the existing post closure conditions that would occur in a 'do nothing' scenario. Also, the dewatered heads in the vicinity of the pit and underground during operations reduce the likelihood and magnitude of contaminant migration from on-site sources.
- There is insufficient reliable data (temporally and spatially) to support or justify the requirement for a detailed impact assessment groundwater flow model.
- There is sufficient conceptual understanding of the groundwater system to justify not undertaking an impact assessment groundwater flow model.
- The project design has purposely limited the creation of new contaminant sources and will minimise the risk of tailings as a contaminant sources during operations and at closure.

As recommended within the groundwater impact assessment for the project, Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) have nominated a bore census and comprehensive assessment of the groundwater monitoring network be carried out to confirm the location, status and integrity of the current groundwater monitoring network. Dependent upon the outcomes of the network assessment, AGE have nominated the construction of a number of monitoring bores to improve the capability of the monitoring network to monitor groundwater levels, drawdown and groundwater quality at the site.

As part of on-going improvement at the site, groundwater levels and quality are to be monitored during initial dewatering and operations with the intent of developing a regional groundwater flow model. The regional groundwater flow model would be based upon the feasibility study dewatering model with the model domain physically expanded to include Mt Bundy Creek, Coulter Creek and significant groundwater users within the region. The regional model would use the latest geological data from site. The regional groundwater model would also be developed to simulate seepage from surface infrastructure such as waste rock dumps (WRD), tailings storage facilities (TSF) and the water storage dam (WSD).

The regional flow model would be calibrated against the initial dewatering period to ensure the stresses on the groundwater system (i.e. dewatering of the open pit and existing underground) are accurately simulated and that observed groundwater levels closely match the model predictions. The regional flow model would then be used to predict the regional groundwater response to mining and in particular, post closure response. The post closure predictions would be compared against the feasibility dewatering model, spreadsheet water balance model and 2D SEEP/W model developed by AGE for the Environmental Impact Statement (EIS). Any differences between model predictions are to be documented and considered in terms of the model design and objectives.

As a pre-cursor to contaminant transport modelling, particle flow paths would be generated to assess the conservative behaviour of contaminants post-closure. This flow path assessment would determine whether contaminant transport modelling would be required and would depend upon the movement and capture of particles from the surface infrastructure. If the model predicts that the pit void post closure does not capture the contaminant particles, then it is recommended that contaminant transport modelling be carried out.

The contaminant transport modelling would predict the behaviour, migration and potential contamination plume(s) that would occur over time from the project. The contaminant transport modelling would use the current conceptual understanding of site conditions, contaminant sources, pathways and receptors as a basis for development. It would require detailed simulation of historic infrastructure to ensure the model predictions are as accurate as possible.

It is important to note that the post closure hydrogeological conditions from the project are not dissimilar to those conditions that would occur from the existing environment. The groundwater drawdown generated by the open pit will serve to capture contaminants from surface infrastructure, and the project improves the effectiveness of this contaminant capture mechanism. For the following reasons, it is reasonable to undertake and complete the further instrumentation, measurement and analysis required to develop a 3D groundwater flow and contaminant transport model during the operational period of the mine:

- the upfront time and cost involved to instrument and gather data in support of a 3D groundwater flow model;
- the improved technical accuracy of a 3D groundwater flow model to be developed from a purpose built data set;
- the reduced risk of off-site groundwater contaminant movement (from the WRDs and TSF) during operations;

- the adoption of best practice acid rock drainage (ARD) management for tailings and waste rock; and
- the need to better understand the existing WRDs (which are not being further used in the project) as contaminants sources.

In general, the additional data that is required to support the development of a 3D groundwater flow and contaminant transport model is as follows:

- accurate historical summary of site infrastructure and emplacement;
- coupled geochemical assessment of the WRD and TSF material properties;
- bore census and survey of existing groundwater monitoring bores;
- additional groundwater monitoring bores to provide adequate spatial coverage;
- detailed groundwater level monitoring (daily) across the site during the initial dewatering and operations;
- detailed discharge volumes from the pit and underground workings;
- determination of groundwater recharge flux from the WRD and TSF; and
- comprehensive water quality sampling for all bores;

It is understood that additional data capture has been proposed as part of the Water Management Plan. This data would support the development of a 3D groundwater flow and contaminant transport model.