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Memorandum

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Subject:	Supplemental Mitigation and Contingency Measures Considerations
Date:	July 22, 2019
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Project:	Independent Assessment of Amulsar Mine Impacts on Water Resources and Geology

This memorandum lists supplemental mitigation and contingent measures for mitigating impacts from mining activities on nearby major water resources.

1.0 Supplemental Mitigation and Contingent Measures

Generally, the design concepts used in the Amulsar ESIA/EIA for development of mitigation measures are reasonable and appropriate (e.g., low permeability liners, encapsulation, capping, drainage, and leachate treatment). However, several measures and plans are partial, not-sufficiently protective, and/or unreliable with a high degree of uncertainty, due to the deficient and questionable baseline characterization, data, models, design bases, and/or assessments (Refer to ELARD-TRC Report: Independent Assessment of Amulsar Mine Impacts on Water Resources, Geology, Biodiversity, and Air Quality and dated July 22, 2019).

Below is a list of supplemental mitigation and contingent measures that can be used to enhance the mitigation of potential impacts to groundwater and water resources from the mine. Specific design details and augmentation of these measures will be based on the updated characterization, modeling, and assessment.

- Use active treatment to supplement and/or replace the passive treatment systems (PTS) proposed for the mine. The selection and design of treatment processes and technologies should be based on adequately designed and implemented in advance bench-scale laboratory and field pilot treatability testing programs that represent the full range of operational and closure conditions, chemicals of concern, and contaminant sources. Robust plans and designs of the laboratory bench scale and field pilot testing programs should be developed and provided in advance.

- Improve the design criteria of the BRSF natural subgrade clayey subsoil liner as follows:
    - Increase the thickness of the liner from 30-cm to a minimum of 60-cm to 90-cm;
    - Specify the maximum hydraulic conductivity to be 10^{-6} to 10^{-7} cm/sec.
    - Use appropriate and specialized compaction equipment with the required compaction method and energy.
    - Adopt a robust and a comprehensive construction quality assurance/quality control (CQA/CQC) hydraulic testing program.
- Pump and drain the mine pits constantly during the operation phase into lined contact ponds to prevent the ARD generation and infiltration into groundwater.
- Add soil/rock with adequate pH neutralization and buffering capacity into the backfill of the BRSF and pits.
- Contingent measures for the mine pits as part of the closure phase. One or more of the following contingent measures can be implemented to control and mitigate ARD seepage and infiltration into groundwater:
    - Install contingent sumps with an adequate pumping system in the mine pits and direct the extracted leachate into the ARD treatment system to control potential ARD seepage and infiltration into groundwater.
    - Install contingent groundwater extraction wells around the perimeter and/or downgradient of the mine pits and the BRSF and direct the extracted groundwater into the ARD treatment system to control the potential ARD groundwater plumes.
    - Re-evaluate the capacity of the ARD treatment system and ponds to accommodate the contingent pumping from the pits.
- Install contingent groundwater extraction wells around the perimeter and/or downgradient of the HLF and contact water ponds and diversion system and direct the extracted groundwater into the treatment system(s) to control the potential groundwater plumes from these areas during operation and post closure phases.
- Contingent measure for the contact water pond and diversion system: The current design of the contact water ponds includes free-board for the 100-year, 24-hour storm consistent with IFC requirements. However, due to the high degree of uncertainties associated with climate change, the Project data and models, and seismic risks, it may be warranted as a contingent measure to increase the size and capacity of the contact water ponds and diversion systems against the 500-year, 24-hour storm event, as

recommended by Nevada Division of Environmental Protection (https://ndep.nv.gov/land/mining/closure/guidance-policies-and-applications).

- Place an engineered evapotranspiration (ET) cap over the Erato pit.
- Backfill and cap the Arshak pit to mitigate development and seepage of seasonal lake water.
- Design and implement a routine inspection and maintenance program for the caps of the pits, HLF, and BRSF as well as for the contact water ponds and diversion system.
- Implement a robust groundwater monitoring program around the mine structures during the operation and post closure phases to allow for a rapid response and implementation of necessary response actions and groundwater remediation measures.
- Implement a routine inspection and maintenance program for the chemical storage and handling areas and facilities and ensure that the containment systems and protocols are adequately functional and protective.
- Adequately control and promptly remediate any potential chemical releases and spills to the environment.

2.0 Additional Considerations

- The environmental risks to nearby water resources (groundwater, and major rivers and springs) should be manageable if the Lydian planned mitigation and closure measures and the above supplemental and contingent mitigation measures are adequately and verifiably planned, modeled, designed, implemented, operated, monitored, and maintained during the operation and post closure phases.
- ELARD-TRC's independent assessment has identified key data gaps and deficiencies in the baseline, modeling, and impact assessment. The development of appropriate mitigation plans and supplemental mitigation measures necessitate addressing the data gaps and updating the models and assessment accordingly. The characterization, assumptions and bases of the models should be improved and corrected. We believe that it is more prudent and appropriate to integrate the solute transport modeling into the regional groundwater flow model and use the 3-D numerical groundwater model FEFLOW to simulate the relevant solute transport scenarios and better represent the complex subsurface conditions and the various mine operations and potential contaminant sources. The transport scenarios should integrate the concurrent contaminant sources and should account for all the major contaminants of concern.
- The construction (not operation) of mine structures and facilities (e.g., buildings, ponds, conveyer, belt, liners, etc.) may be resumed in parallel (concurrently) while addressing

the data gaps and the updating of the assessment, characterization, modeling, and mitigation measures. The activities can be prioritized and sequenced based on the Armenian regulatory review and approval, the mine construction schedule and logistics, and the outcomes of updated baseline characterization and assessment.

- Appropriate full life-cycle cost estimates for the construction and long-term operation, monitoring, and maintenance (OM&M) of the mine mitigation (during the mine operation and closure phases) and closure systems and activities should be developed. These costs should extend to the full-life of the closure beyond the initial 5-year monitoring period and should include sufficient contingencies.