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MOUNT LYELL REMEDIATION

Review of historical literature and data on the sources and quality of effluent from the Mount Lyell lease site

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A joint program between the Supervising Scientist and the Department of Environment and Land Management, Tasmania.

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ERRATUM

Page iv paragraph 3 - North Lyell Tunnel should read West Lyell Tunnel

Executive summary

This paper is the first in a series produced through the joint Federal/Tasmanian 'Mount Lyell Remediation Research and Demonstration Program'. The paper presents a summary of mining operations at Mount Lyell, characterises the environmental impacts and collates technical data from numerous sources which are to be used in other projects within the program. Data are derived from the previous mine operator, The Mount Lyell Mining and Railway Company Limited, the Hydro-Electric Commission, Department of Environment and Land Management Environmental Management Division and Copper Mines of Tasmania.

The Mount Lyell Mine is situated 2 km north of Queenstown, Western Tasmania, Australia. Queenstown is 270 km north-west of Hobart, the State capital and approximately 25 km inland from the west coast and the Southern Ocean. The Mount Lyell mining field is situated in a belt of rocks known as the 'Mount Read Volcanics' which extend approximately 60 km north and 25 km south of Queenstown. The Mount Read Volcanics comprise one of the richest mineral provinces of its type in the world.

The Mount Lyell mining leases 1M/95 and 2M/95 are situated in the headwaters of the Queen River which has its confluence with the King River approximately 15 km below the lease sites. The King River drains into the north-eastern end of Macquarie Harbour, a 276 km^2 harbour with a narrow mouth to the Southern Ocean.

Mining operations in the Mount Lyell region have produced over 1.3 million tonnes of copper, 750 tonnes of silver and 45 tonnes of gold since mining commenced in the early 1890s. This is equivalent to over four billion dollars worth of metal in 1995 terms. Environmental controls were non-existent for the majority of the period of mining and processing operations, and as a consequence there is a legacy of environmental degradation.

The nature of the mining methods (open-cut and underground), the number of mining operations and their infrastructure (over 40 at the turn of the century), mineral processing (pyritic smelting and conventional flotation and smelting), and riverine waste disposal of both liquid and solid wastes have resulted in severe environmental damage to not only the immediate mine area of approximately 13 km^2, but an adjacent area covering 50 km^2. Impacts to the physical landscape include the removal of 15 km^2 of vegetation and soil as a result of wood cutting and burning, substantial modification to the hydrology, and an increased erosion load in the Queen and King Rivers. Catchments downstream of the mine experienced degradation of natural river water quality, the creation of tailings levees along river banks, and a 2.5 km^2 tailings delta at the mouth of the King River where it discharges into Macquarie Harbour.

The high pyritic level of the waste rock dumps (>10%), the large exposed surface area from open-cut voids, extensive underground workings and associated caved areas, and the high rainfall of the region (2500–3000 mm) combine to produce extensive acidic leachate. The acid leachate, containing copper, zinc, aluminium, iron, manganese, and sulphate, is generated by the oxidation of exposed pyrite. Surface water flows leaving the lease are characterised by a pH of 2.5 to 3.5. It is expected that the mine area will continue to be a source of acidic leachate for many centuries unless remediation strategies are adopted to address the problem.

When mining operations by The Mount Lyell Mining and Railway Company Limited (MLMRCL) ceased on 15 December 1994, it was estimated, using median concentrations and flows, that copper loads alone in the effluent water leaving the mine site were in excess of 2000 kg/d. Maximum daily discharge rates may be up to ten times this level. Approximately

100 million tonnes of tailings have been disposed of to the Queen River. Beached tailings in the riverine system and the tailings delta in Maquarie Harbour continue to be a source of metal contamination to the aquatic system. For a single West Lyell waste rock dump monitored by Australian Nuclear Science and Technology Organisation (ANSTO) it is predicted acid generation may continue at reducing rates for greater than 600 years. Measurements have shown that approximately 130 tonnes of copper and 1300 tonnes of sulphate per year leach from this dump alone.

The monitoring dataset from Mount Lyell is highly variable. A good record of stream flow data exists for Hydro-Electric Commission (HEC) sites in the eastern hydrological catchment. Flow determinations for the lease site are estimates with the exception of a few monitored streams which have a short record of monitoring. Due to the high variability in water flow on the lease site, a long period of record is required to accurately define flow characteristics. The HEC has demonstrated a good relationship between catchment areas and median flows. Median flow values have generally been used to calculate mass loads by Environmental Geochemistry International (EGI), the HEC, and consultants Gutteridge Haskins and Davey (GH&D). Total flows calculated from median flow values may underestimate the actual flow by up to 500% where flow distributions are skewed as is the case on the Mount Lyell lease site. It has been shown that up to 80% of the total flow may occur in 20% of the discharge time as a result of catchment, rainfall, and runoff characteristics. This has important implications for the use of median flows to calculate mass pollutant loads. For environmental assessment, good quality information is required to develop time duration analysis of concentrations and loads, and the current dataset is inadequate for this application. As a result, reliance is placed on median flow values which are less than ideal.

Water quality data are highly variable with few trends being evident. An exception is MLMRCL station 6, North Lyell Tunnel, which demonstrates a gradual decrease in sulphate, iron, and copper mass loadings in the past five years. This is believed to represent a decrease in the rate of oxidation of sulphides as they are oxidised and leached.

Strong correlations exist between conductivity, sulphate and copper for waters derived from a single source. Conductivity may provide a useful indicator of copper loads in point source streams on the lease site. The correlation tends to break down when effluent sources are mixed.

Both the HEC and GH&D data suggest an inverse relationship between water quality parameters and flow suggesting concentrations may be diluted by rainfall.

For streams with low suspended solids and high acidity, total and dissolved metals are very similar. However, this was not the case for tailings contaminated waters where the abundance of adsorption sites on tailings particles resulted in a reduction in the dissolved metal content relative to total metal loads.

For surface catchments there is an obvious relationship between the catchment characteristics related to mining activities and pollutant loads. Catchments containing waste rock dumps and adits are highly contaminated. The major source is the Conveyor Tunnel in the Haulage Creek catchment which contributes up to 60% of total metal loads to the Queen River. The West Lyell waste rock dumps in this catchment are the second largest source of pollutants.

In order that environmental remediation strategies are effectively targeted for the maximum possible benefit, it is critically important that good quality monitoring data are collected. The provision of accurate environmental monitoring data will improve future site management decisions and enable cost-effective remediation strategies to be determined.

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