V

Appendix V – Saline Impact Monitoring Plan

McArthur River Mining

A GLENCORE COMPANY

Action Plan for the Saline Vegetation Monitoring Plan

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Saline Vegetation Monitoring Plan Background

MRM is currently undertaking an investigation into the potential for impacts to vegetation as a result of saline seepage. The key elements of the investigation include:

- The existing Saline Impact Monitoring Program developed by EcOz in 2014.
- A review of the existing saline impact monitoring program undertaken by Eco Logical Australia Pty Ltd (ELA) in 2017.
- A remote sensing desktop assessment (and subsequent ground truthing) of sites potentially impacted by salinity that was undertaken by ELA in 2018.
- Development of a Saline Vegetation Monitoring Plan in consideration of the outcomes of the saline impact monitoring program review and remote sensing desktop assessment.

This Action Plan provides a summary of the progress made for each of the key elements to date as well as providing a summary of McArthur River Mining Pty Ltd's (MRM's) remaining commitments.

Further detail on each of these key elements is provided in the subsections below.

Existing Saline Impact Monitoring Program

To address a recommendation made by the Independent Monitor (IM) in the *MRM 2012-2013 Independent Monitor Report* (ERIAS, 2014), MRM commenced a new vegetation monitoring program in 2014 with the aim to detect impacts from saline seepage along Barney Creek and Surprise Creek.

This Saline Impact Monitoring Program is undertaken annually in the late dry season (e.g. September) and involves the following:

- Three sites located close to potential sources of saline seepage:
  - one on Surprise Creek near the South Perimeter Runoff Dam (SPROD);
  - one on Barney Creek near the SPROD; and
  - one near the ore processing mill on Barney Creek.
- Two control sites, one on Barney Creek and one on Surprise Creek, both upstream of the potentially impacted sites.

Each site is divided into three habitats:

- slope (of the channel);
- batter (at the top of the slope); and
- woodland (beyond the batter).

There are three monitoring plots at most Site / Habitat combinations that are 100 m^2 in area. The monitoring plots have dimensions of either 5 m X 20 m or 10 m X 10 m, depending on space constraints (the width of some of the slopes is less than 20 m).

At each monitoring site, the following information is currently collected:

- Vegetation characteristics, including:
  - Foliage cover.
  - Ground cover.
  - Vegetation species composition and structure.
- Disturbance characteristics, including:
  - Erosion.
  - Weeds.
  - Flooding.
  - Faunal disturbance.
  - Vegetation classifications.

The monitoring data is assessed for changes in foliage cover, ground cover and vegetation species composition and structure.

Saline Impact Monitoring Program Review

ELA was commissioned by MRM to undertake a review of the existing Saline Impact Monitoring Program. As part of their review, ELA considered the following criteria:

- technical best practice;
- cost effectiveness;
- practical and straightforward to implement;
- repeatable, timely, meaningful and relevant; and
- supported by the IM.

ELA made the following recommendations:

- Monitor vegetation following the wet season (in April/May) to capture the percentage of canopy cover and annual species, which have died off by the mid dry season.
- Undertake remote sensing of the site to highlight additional areas of interest.
- Replace random sampling in plots for canopy and ground cover with a transect approach. Monitor floristic biodiversity and structural diversity via a best practice surveying methodology.
- Incorporate control sites from revegetation monitoring.
- Incorporate a new monitoring site adjacent to the Tailings Storage Facility (within the Surprise Creek riparian corridor).

Remote Sensing Program

To facilitate the preparation of the updated Saline Vegetation Monitoring Plan, MRM has commissioned ELA to undertake a remote sensing assessment and subsequent ground truthing of potentially impacted sites. The aim of this assessment was to use remote sensing techniques to identify potential sites of point or diffuse seepage from mine-affected water at MRM that could be influencing salinity.

The objectives were to:

- use a series of Landsat and GeoEye imagery to identify potential seepage areas;
- identify areas for ground-based investigation where there may be increased risk of seepage or where further work could be required to develop a seepage management, monitoring and/or mitigation plan; and
- detail the adequacy of the technology used for the work.

Landsat 8 OLI TIRS C1 Level 1 imagery was acquired from the US Geological Survey Glovis website (http://glovis.usgs.gov). Historical rainfall data were analysed to determine generally dry periods and imagery from these periods was assessed as this was considered to provide the best opportunity to identify potential seepage areas in the environment. Images captured later in the dry season spread evenly over a six year period were checked for cloud cover and image quality. Those which appeared to be clear of cloud and haze were downloaded. Three Landsat images were selected for further processing and analysis, from the following dates:

- 28 July 2013;
- 19 August 2015; and
- 8 August 2017.

In addition to the Landsat sequence, MRM was able to provide a number of higher resolution datasets including:

- GeoEye-1 Multispectral Acquired (BGRN, 2m pixel) 16 September 2017;
- GeoEye-1 Panchromatic Acquired (0.5m pixel) 16 September 2017; and
- GeoEye-1 Pan-sharpened Multispectral Acquired (0.5m pixel) 16 September 2017.

Areas of seepage are likely to be expressed in remote sensing as:

- open water or moist soils against a background of a generally dry environment;
- anomalies in vegetation patterns, either unseasonal high or low areas of vegetation vigour (photosynthetically active biomass [PAB]) against the background patterns;
- salt and/or acid scalds areas expressed on the surface by bare soil, salt crystals, or stained soil; and
- water that is discoloured, usually red.

Visual mapping was undertaken to identify areas of potential seepage. The areas were tagged and labelled as Points of Interest (POI) for further investigation. POI were identified using a multi-stage process that involved assessing colour infra-red (CIR) and NDVI displays of the Landsat and GeoEye images. POI included areas that had:

- unusually high or low PAB relative to similar features in the surrounding landscape;
- wet or vegetated features that looked out of context or unusual;
- areas of high reflectance that did not correspond with mine infrastructure, roads or bare earth; and/or
- areas where the soil appeared to be stained.

In order to determine areas that require further investigation or where a seepage management, monitoring and/or mitigation plan would be needed, the POI were classified into three tiers of likelihood:

- Low – POI is unlikely to be mine-related;
- Medium - POI maybe partially mine-related or needs further investigation; and
- High – POI is likely to be a result of mine-seepage.

A total of 65 POI were identified through sequential assessment and mapping of the Landsat and GeoEye images. Of these, 10 were assessed as high likelihood, 18 medium likelihood and 37 low likelihood. These points of interest were resolved into nine Areas of Interest (AOI).

ELA recommended that the nine AOIs be included in further field and/or temporal investigations to determine the need for future monitoring and management options.

Saline Vegetation Monitoring Plan Commitments

MRM is currently preparing a revised Saline Impact Monitoring Program (renamed the Saline Vegetation Monitoring Plan) to address the recommendations made by ELA. This program will:

- Incorporate additional monitoring sites at the AOI identified by the remote sensing assessment (following ground truthing or further temporal investigations) and adjacent to the TSF (within the Surprise Creek riparian corridor).
- Include monitoring results from the Barney Creek control site currently included in the Revegetation Monitoring Program.
- Describe the updated monitoring methodology and timing as recommended by ELA.
- Be a component of the site wide Biodiversity Management Plan currently scheduled for development in 2018.

It is anticipated that the first round of monitoring for the Saline Vegetation Monitoring Plan would be undertaken in April/May 2018. Monitoring results would then be analysed and reported in the annual Operational Performance Report.