Auckland Tauranga Wellington Christchurch

PATTLE DELAMORE PARTNERS LTD

Scope for Baseline Environmental Monitoring Program – Exploration Permit # 51985 at Puhipuhi, Northland

Evolution Mining NZ Pty Ltd

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Scope prepared for

Evolution Mining NZ Pty Ltd.

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1.0 Introduction

Pattle Delamore Partners Limited (PDP) has prepared this Project Scope to provide baseline data prior to any exploration drilling or exploration drilling-related environmental disturbance at Puhipuhi, Northland.

2.0 Program Scope

In reviewing Evolution Mining's project scope, it was clear that the scope is significantly wider than that which would be normal for baseline environmental monitoring of an exploration project in New Zealand.

PDP propose the following scope to deliver the environmental services requested for the Hydrology/Hydrogeology and Baseline Environmental Monitoring Program at Puhipuhi, Northland.

A glossary can be found on page 10 to aid with the understanding of technical terms used.

2.1 Program 1 - Groundwater Sampling

Evolution Mining has indicated that existing privately-owned and operated boreholes and springs may be available to be sampled in the Puhipuhi area. Results from monitoring of bores and springs will be incorporated in the hydrological and hydrogeological model that is developed in Program 3.

2.1.1 Groundwater Monitoring Scope

PDP propose to undertake the following:

- Obtain current available bore records and water take consent information from Northland Regional Council's (NRC) database.
- Liaise with the nominated local contractor to retrieve basic bore information for bores where access permission is granted. This would likely include; bore use information, photos of the bore(s) headworks, current pump set up (if pump present), identification of sample valve/entry port.
- Once the information has been collated by the local contractor, liaise further with selected bore owners (or through the local contractor if more appropriate) to ensure bores are suitable for monitoring, as well as arranging a convenient time to complete monitoring.
- PDP will complete monitoring of selected wells and springs and sample dispatch to PDP nominated laboratories (IANZ accredited).

- Sample collection methods will be aligned with industry best practice and relevant standards (namely AS/NZS 5667.1:1998, US EPA 2010[1]).
- The physical and chemical assessments will comprise the following:

  Field Parameters:

  - Bore condition comments + photograph, GPS mark of location
  - Standing water level
  - pH, electrical conductivity (EC), temperature, turbidity, ferrous iron, visual and olfactory assessments.

  Laboratory Parameters:

  - pH, electrical conductivity (EC)
  - Major dissolved ions: magnesium, potassium, sodium, calcium, chlorine, sulphate, alkalinity
  - Dissolved Nutrients: nitrate, nitrite, ammoniacal-nitrogen
  - Dissolved & Total metals: arsenic, boron, cadium, chromium, cobalt, copper, iron, mercury, lead, manganese, nickel, thallium and zinc
  - E.Coli
  - Faecal coliforms
  - Stygofauna (5 x samples).

2.2 Program 2 - Surface Water Sampling, Stream Sediment, Aquatic Organisms

2.2.1 Scope

Evolution Mining has requested:

I. Surface water sampling within and at the exploration tenement boundaries to determine a baseline of metals and parameters that could be used to determine changes to the surface water if drilling was to commence and possibly to determine if there are specific areas within the tenement boundaries that are the source of any metals in the stream system, if metals are present. This information is to be used for the hydrology modelling (Program 3) where appropriate (particularly stream flow).

[1] US EPA (United States Environmental Protection Agency), 2010. Low Stress (Low Flow) Purging and Sampling Procedures for the Collection of Ground-Water Samples from Monitoring Wells (EQASOP-GW-001), Boston, MA: United States Environmental Protection Agency Region 1.

II. Surface water and sediment sampling, flow gauging, and fauna tissue analysis within and beyond the tenement boundary replicating the locations of previous sampling, to determine if there have been any changes to the system over time and again provide background data for the future. Sediment sampling of streams has also been requested to improve understanding of downstream dispersion/solubility/speciation of mercury, to determine whether Mercury in sediment was sourced from historic mining or from erosion of Mercury-bearing rock and soils, and to determine bioavailability of mercury in order to provide information about the potential uptake of Mercury to potential food sources tested by tissue analysis.

PDP propose to undertake the following:

- Field preparation, including ordering field equipment and consumables/supplies and reviewing existing reports/data.
- Surface water and stream sediment sampling within and downstream of tenement boundary. PDP propose to collect water quality and sediment samples from **20 locations**, which includes most sites studied in the 1973 study by F.E. Hoggins and R. R. Brooks[2] and eight sites sampled by Northland Regional Council in 2013 and four additional sampling locations on the Papanui and Whenuaroa streams (see Figure 1).
- Stream flow gauging will be conducted at each surface water monitoring location.
- Fauna tissue and flora analysis for mercury downstream of the tenement boundary using acid-volatile sulphide (AVS)/selective extraction of metals (SEM). Fish (eels), freshwater molluscs, amphibians and watercress will be collected from up to **eight** locations and estuarine shellfish will be collected from **two** locations.
- Stream macroinvertebrate survey.
- Habitat assessment and desktop survey of potential barriers to fish passage.
- PDP will complete monitoring and sample dispatch to PDP nominated laboratories (IANZ accredited).

[2] Hoggins, F. E. & R.R Brooks (1973) Natural dispersion of mercury from Puhipuhi, Northland, New Zealand. New Zealand Journal of Marine and Freshwater Research, 7:1-2, 125-132.

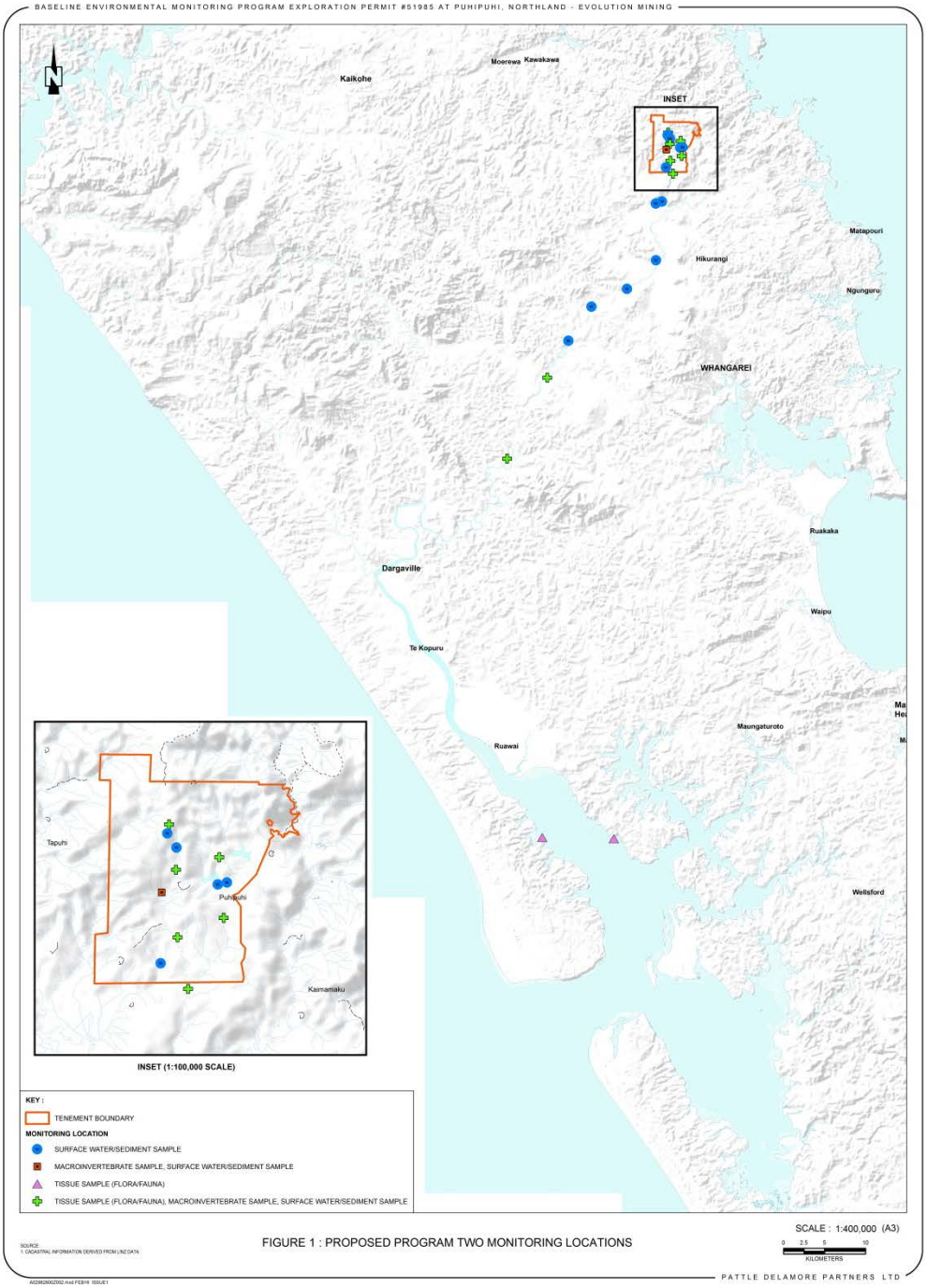

Figure 1: Proposed Program Two Monitoring Locations

- The physical and chemical assessments will comprise the following:

  Field Parameters:

  - Photograph, GPS mark of location
  - pH, electrical conductivity (EC), temperature, turbidity, dissolved oxygen (DO), ferrous iron, visual and olfactory assessments.

  Water Sample Laboratory Parameters:

  - pH, electrical conductivity (EC)
  - Hardness
  - Major dissolved ions: Major dissolved ions: magnesium, potassium, sodium, calcium, chlorine, sulphate, alkalinity
  - Dissolved Nutrients: nitrate, nitrite, ammoniacal-nitrogen
  - Dissolved & Total metals: arsenic, boron, cadium, chromium, cobalt, copper, iron, ferrous iron, mercury, lead, manganese, nickel, thallium and zinc.

  Sediment Laboratory Parameters:

  - Total recoverable metals: arsenic, boron, cadium, chromium, cobalt, copper, iron, ferrous iron, mercury, lead, manganese, nickel, thorium and zinc
  - Methyl mercury
  - Acid volatile sulphide – simultaneously extractable metals.

2.3 Program 3 - Hydrology & Hydrogeology

Creation of a robust conceptual hydrological/hydrogeological site model is paramount to understanding potential risks associated with water quality.

2.3.1 Hydrology / Hydrogeology Assessment Scope and Methodology

A desktop study, incorporating all relevant available information – including existing historical data and data collected from Program 1 and Program 2 – will be used to develop a site conceptual model. The model will include assessment and characterisation of the hydrological and hydrogeological system within Evolution Mining's permit area.

2.4 Program 4 - EM Strategy for Exploration Drilling

PDP staff have been responsible for the planning, consenting, stakeholder management and execution of a number of exploration drilling campaigns.

Consequently we appreciate the importance of the identification and management of both real and perceived risks associated with exploration drilling.

The key features of an Environmental Management Strategy are the following:

- Identification of the key environmental risks;
- Establishment of baseline environmental conditions;
- Formulation of management plans to:
  - Eliminate
  - Isolate, or
  - Minimise

  the risks and respond to any environmental incidents;
- Monitoring to assess the effectiveness of the management plans; and
- Revise management plans as required to maximise their effectiveness.

2.4.1 Environmental Management Strategy Scope

PDP propose to undertake the following:

- Review the outcomes of Program's 1-3;
- Identify key stakeholder requirements;
- Review the proposed exploration drilling plan to identify key areas of potential environmental impact (environmental aspects and impacts analysis)e.g. sediment, dust, drilling muds, cuttings, aquifer isolation;
- Identify the key management plans required to manage exploration drilling environmental risks (i.e. operational controls);
- Identify monitoring required to demonstrate the effectiveness of the management plans (i.e. validation processes); and
- Recommend a process to revise management plans as the exploration drilling and monitoring proceeds.

2.5 Program 5 - Noise Monitoring

If a decision is made to conduct exploration drilling, Evolution Mining wishes to gather baseline noise data.

The noise monitoring should include noise monitoring at the nearest sensitive receptor (e.g. dwelling). If drilling proceeds, monitoring should occur with and without the drill rig operating to enable to impact of drill rig operation above the background noise to be assessed.

PDP staff has had experience with the implementation of controls to mitigate the impact of exploration drilling related noise should this be required.

2.5.1 Noise Monitoring Scope

PDP propose to undertake the following:

- Identify up to three noise sensitive receptors in collaboration with Evolution Mining;
- Undertake noise monitoring at each of the identified receptors to assess the impact of any drilling operation;
- Recommend potential mitigation controls for exploration related noise.

2.6 Program 6 - Dust Monitoring

Evolution Mining wishes to gather baseline dust data.

Generally dust causes what is referred to as “dust nuisance” effects and impacts on amenity values such as the soiling of clean surfaces and other visual impacts[3]. Fine particles such as PM_{10} can have potential health effects due to their ability to be inhaled into the lungs.

We recommend that the dust monitoring program focuses on the acquisition of dust data via dust deposition gauges. Monitored dust levels can vary significantly due to variations in weather conditions and changes in the source of the dust emissions[4]. Dust monitoring therefore needs to occur with a fixed sampling schedule and over an extended period of time. There is a considerable risk with taking a “snapshot” of dust concentrations that the period sampled happens to be a period of low dust levels. If a later “snapshot” shows higher dust concentrations it could be claimed to be as a result of the effects of exploration or mining.

In the exploration tenement the major contributor to background dust emissions are likely to be dust from traffic on the unsealed Mine Road which runs through the centre of the tenement, and dust arising from farming activities such as the application of fertiliser, reseeding of paddocks and haymaking. Dust levels are also likely to be generally higher in summer due to typically drier conditions.

We suggest dust monitoring over a 9 month period to encapsulate the period of any exploration drilling and provide data before, during and after any exploration drilling program.

[3] See Good Practice Guide for Assessing and Managing the Environmental Effects of Dust emissions, p1

[4] See Good Practice Guide for Assessing and Managing the Environmental Effects of Dust emissions, p27

2.6.1 Dust Monitoring Scope

PDP propose to undertake the following:

- Identify dust sensitive receptors in collaboration with Evolution Mining;
- Install three (3) depositional dust gauges; and
- Arrange for a local company to undertake the regular exchange of depositional dust gauges every 30 days for a period of 9 months and courier to the laboratory for analysis.

2.7 Program 7 - Surface Water Monitoring Program Development

2.7.1 Scope

Design an on-going surface water monitoring program (based on the hydrological data and hydrological model) including monitoring procedures for the collection of baseline water quality data.

Train a local contractor to conduct the monitoring.

2.8 Program 8 - Physical Environment Survey

2.8.1 Soil Characterisation Scope

Characterise mercury through the soil profile, in order to improve understanding of the distribution and speciation of mercury within soil profile (principal A, B and C horizons and weathered bedrock where / if possible), and undertake a qualitative assessment of relative bio-accessibility of mercury in soil.

2.8.2 Terrestrial Ecology Survey Scope

The project Terrestrial Ecologists will conduct a survey to identify whether there are at risk terrestrial species or ecosystems within the tenement boundaries, in order to understand the potential impact of exploration related activities.

2.9 Program 9 – Environment Management Program

The Environmental Management Plan (EMP) will expand upon the outcome of Program 4 - Environmental Management Strategy and detail the environmental objectives and the management plans, monitoring and processes required in order to achieve them.

2.9.1 EMP Scope

PDP propose to undertake the following:

- Update the Program 4 outcomes if required;
- Prepare required management plans;

- Update monitoring requirements to assess the performance of the Environmental Management Program; and
- Write a procedure for updating the various management plans in response to incidents, complaints received or monitoring results.

Presented by

SIGNATURE 

Steve Pearce

Glossary[5]

Acidic Having a pH of less than 7.

Alkaline Having a pH of greater than 7.

Ammonia Compound of nitrogen toxic to stream life at high concentrations).

Aquifer A layer of soil or rock which water can pass through or be retained in.

Base flow Low flow in a stream usually sourced from ground-water discharge.

Baseline study Data collected to document existing conditions.

Bioaccumulation The build-up of a chemical in body tissues.

Bioavailability How readily a chemical is taken up by living organisms either through the skin or via food.

Catchment The area of land from which rainfall drains into a single low point.

Detection limit The concentration below which a particular analytical method becomes difficult to determine with certainty.

Dissolved Separated into individual atoms or molecules and dispersed in a liquid like water.

Dissolved oxygen (DO) The amount of oxygen present in a water sample.

E.coli A specific type of bacteria.

Electrical conductivity The measure of the amount of electrical current a material can carry.

EPT richness index A measure of macroinvertebrate community health.

Estuary A coastal body of water, typically at the mouth of a river, which is open to the sea and allows fresh water from inland to mix with sea water.

Faecal coliform A specific type of bacteria.

Fauna The animal life inhabiting a particular area.

Flow gauging Measuring the flow of water in a river or stream.

Flora The plant life inhabiting a particular area or environment.

[5] Primary sources:
Government of British Columbia, Ministry of Environment, Glossary of Water Quality Terms http://www.env.gov.bc.ca/wat/wq/reference/glossary.html#index accessed 05/02/16, and;
Wai Care Manual Book 6 - Fact Sheets, Wai Care, 2003.

Geographic information system (GIS) Computer programs that link mapping information, such as roads, town boundaries, water bodies, with other relevant information about a particular location.

Groundwater Water that exists beneath the land surface.

Habitat The part of the physical environment where plants and animals live.

Heavy metals Elements that can contaminate water and sediment and cause damage to some forms of life in high concentrations.

Hydrology The science that deals with the water cycle in the environment-land, soil and atmosphere; properties, distribution and circulation of water.

Hydrogeology the branch of geology dealing with the waters below the earth's surface and with the geological aspects of surface waters.

IANZ International Accreditation New Zealand.

Invertebrate Animal without a backbone.

Ion A negatively or positively charged atom or molecule which has either an excess or shortage, respectively, of electrons.

Macroinvertebrate Invertebrates visible to the naked eye.

Nitrogen An element that is essential to all plants and animals.

Nutrient A substance, element or compound, necessary for the growth, development and reproduction of plants and animals, as a pollutant any element or compound, such as phosphorous or nitrogen that encourages abnormally high organic growth in ecosystem.

Parameter Any variable that can be measured, e.g. nitrate.

pH A measure of the acidity or alkalinity of a solution.

Quality assurance Evaluation of data collection and analysis techniques to ensure correct procedures were followed.

Riparian Areas of vegetation adjacent to rivers and streams.

Sediment Particles of sand, clay, silt, and plant or animal matter carried in water.

Sensitive receptor Locations where people gather or spend time (e.g. houses and schools) and may be exposed to an adverse effect (e.g. noise or dust)

Species diversity An ecological concept that incorporates both the number of species in a particular sampling area and the evenness with which individuals are distributed among the various species.

Species (taxa) richness The number of species (taxa) present in a defined area or sampling unit.

Stygofauna Aquatic organisms that live in groundwater.

Tributary A stream or river that flows into a larger stream or river.

Turbidity A measure of water clarity.

Wetlands Ecosystems whose soil is saturated for long periods seasonally or continuously, including marshes, swamps, and ephemeral ponds.