MINE SITE GROUNDWATER SAMPLING PROCEDURE

Document No: ARMS-0000-H-PRO-N-0001 Rev 1

Project Name: Nolans Rare Earths

REVISION HISTORY

Date	Description	Prepared	Reviewed	Approved	3rd Party Approval
July 2022	Rev 1 Submit to DITT	Michael Robinson, ESG Manager	Michael Robinson, ESG Manager	Stewart Watkins, GM Projects	NA
23/07/2021	Rev 0	Michael Robinson, ESG Manager	Brian Fowler, GM NT & Sustainability	Stewart Watkins, GM Projects	NA

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1.0 INTRODUCTION

1.1 Background

The Nolans Rare Earths Project (the Project) is located approximately 135 km north north-west of Alice Springs, in the Northern Territory. The Project targets the Nolans Bore mineral deposit for rare earth elements. Activities will focus on construction, mining, processing, rehabilitation and decommissioning of an open-cut, rare earth mine, and its associated infrastructure.

1.2 Purpose

The Water Management Plan (WMP) for the Nolans Project (Project) provides a framework for the management of summary of sampling requirements at the site. The WMP has been designed to collect data throughout the construction and operations phase to assess the performance of water management onsite. In order to facilitate consistency in sampling, and comply with quality assurance and control methodologies, a series of sampling procedures have been established including:

- Surface Water Sampling Procedure;
- Mine Site Groundwater Sampling Procedure (this procedure); and
- Sediment Sampling Procedure.

All referenced company policies, standards, registers, operational procedures, activity specific documents, forms and templates are stored and can be accessed from within the Arafura Resources Integrated Management System (ARMS).

1.3 Objectives

The primary objective of Groundwater Sampling Procedure is to obtain a representative water sample with minimal alteration in water chemistry. The collected sample should represent the physical, chemical and biological characteristics of groundwater in the target unit as closely as possible.

The Groundwater Sampling Procedure locations will focus on the Mine Site and Processing Area, groundwater monitoring and assessment within the borefield is detailed in the WAMP.

1.4 Planning and Equipment

A number of factors must be considered during the field planning phase, prior to groundwater sampling. These include consideration of access road conditions, safety requirements, the depth of groundwater and well/bore construction (internal diameter and gravel pack). A summary of equipment and associated potential suppliers are provided in Table 1—1. All equipment in relation to groundwater sampling should be ordered a minimum of four weeks prior to sampling.

Table 1—1 Summary of Planning

Timing	Details	Supplier
At least 4 weeks prior to sampling	**Order** Lab Bottles Laboratory bottles Eskies and Cool Bricks	tbc
	Hire / Maintenance Check Low flow pump Water level gauge or interface probe	Eco Environmental 6/509-511 South Rd, Ashford SA 5031 08 8293 3355 adelaide@ecoenvironmental.com.au Thermo Fisher Scientific 5 Caribbean Dv, Scoresby Vic 3179 03 9757 4377 RentalsAU@thermofisher.com
	Purchase 0.45µm Stericup filters Stericup vacuum pump Low-flow tubing Nitrile gloves Decon N	Eco Environmental 6/509-511 South Rd, Ashford SA 5031 08 8293 3355 adelaide@ecoenvironmental.com.au Thermo Fisher Scientific 5 Caribbean Dv, Scoresby Vic 3179 03 9757 4377 RentalsAU@thermofisher.com
1 day prior to sampling	**Calibrate** Water quality meter	

2.0 GROUNDWATER SAMPLING PROCEDURE

2.1 Groundwater Sampling Events

The monitoring of groundwater at the Project is split into two types as detailed below:

Standing Water Level Gauging

Measurement of the standing water level relative to a surveyed point on the internal well casings. A groundwater gauging field sheet is provided in Appendix A.

Groundwater Sampling

Measurement of the standing water level, purging, recording water quality data and sampling. A groundwater purging sheet and Chain of Custody (CoC) sheet is provided in Appendix B and Appendix C, respectively.

2.2 Sampling Equipment

Surface water sampling requires the following:

- Groundwater sampling requires the following:
- Groundwater Gauging Sheet (Appendix A), Groundwater Purging Sheet (Appendix B) and Chain of Custody sheet (Appendix C);
- Water level gauge or interface probe;
- Water quality meter (calibrated);
- Low-flow sampling pump/equipment;
- Disposable low-flow sampling tubes;
- 0.45 µm water filters and suction pump;
- Eskies and cool bricks;
- Laboratory bottles;
- Nitrile gloves;
- Decontaminated plastic or stainless-steel bucket;
- Padlock keys and tools to remove well caps; and
- Permanent marker.

2.3 Sampling Locations

The sampling events and frequencies at each groundwater well is provided in Table 2—1 and presented on Figure 2-1 and Figure 2-2. The groundwater well locations are provided in Table 2—1 are indicative and will be further defined throughout the LOM as various facilities are constructed and/or expanded. Baseline / operation results will be reviewed through the MMP process to determine if further focused localised groundwater monitoring and investigation is required.

Table 2—1 Preliminary Groundwater Monitoring Locations – Stage 1

Note - Table to be revised in line with completed detailed designs. Locations and sample frequencies to be revised accordingly through LOM.

Site ID	Coordinates		Type	Description	Monitoring Schedule			
					Baseline		Operation	
	Easting	Northing			SWL	Laboratory	SWL	Laboratory
MB104 A / B	[redacted]	[redacted]	Boundary	Boundary / downgradient (upgradient during mining) Northern boundary, adjacent to Sediment Control and Kerosene Camp Creek.	Automatic Logger	Biannual Sampling	Automatic Logger	Quarterly
MB107 A / B	[redacted]	[redacted]	Point Source / Boundary	Eastern Boundary and East WRD	Monthly		Quarterly	
MB109 A / B	[redacted]	[redacted]	Point Source	ROM and western edge of East WRD.	Quarterly		Quarterly	
MB110 A / B	[redacted]	[redacted]	Point Source	ROM, West WRD and Southern Pit LOM extent.	Monthly		Automatic Logger	
MB111 A / B	[redacted]	[redacted]	Point Source	Southern edge of LOM Pit and Kerosene Camp and Stage 1 and 2 diversions.	Monthly		Automatic Logger	
MB112 A / B	[redacted]	[redacted]	Point Source	Western edge of Pit LOM, and southern edge of West WRD	Monthly		Automatic Logger	
MB113 A / B	[redacted]	[redacted]	Point Source	Western edge of West WRD and Topsoil Stockpiles.	Quarterly		Quarterly	
MB114 A / B	[redacted]	[redacted]	Point Source	Northern edge of West WRD.	Quarterly		Quarterly	
MB115 A / B	[redacted]	[redacted]	Point Source	Northern edge of LOM Pit, and upgradient / downgradient of Sediment control	Monthly		Automatic Logger	
MB116 A / B	[redacted]	[redacted]	Point Source	Northern edge of East WRD.	Quarterly		Automatic Logger	

Processing Site								
MB203 A/B	[redacted]	[redacted]	Point Source	~50 m North East / East RSF	Monthly	Quarterly	Quarterly	Quarterly
MB204 A/B	[redacted]	[redacted]	Point Source / Boundary	Eastern boundary of mining lease and south east of RSF	Automatic Logger		Automatic Logger	Quarterly
MB205 A/B	[redacted]	[redacted]	Point Source	~50 m South RSF	Quarterly		Automatic Logger	Quarterly
MB206 A/B	[redacted]	[redacted]	Point Source	~50 m South west RSF	Monthly		Automatic Logger	Quarterly
MB209 A/B	[redacted]	[redacted]	Boundary	Background bore ~800 m south of RSF, adjacent to Landfill.	Monthly		Quarterly	Biannually (quarterly once Landfill is in operation)
MB210 A/B	[redacted]	[redacted]	Boundary	Background bore, south western boundary of mining lease, adjacent to Landfill.	Monthly		Quarterly	Biannually (quarterly once Landfill is in operation)
MB211 A/B	[redacted]	[redacted]	Boundary	Background bore southern.	Monthly		Quarterly	Biannually
MB213 A/B	[redacted]	[redacted]	Point Source / Boundary	~ 150 m North west of processing plant	Monthly		Quarterly	Quarterly
MB214 A/B	[redacted]	[redacted]	Point Source / Boundary	~50 m North east of processing plant	Monthly		Quarterly	Quarterly
MB215 A/B	[redacted]	[redacted]	Point Source / Boundary	~ 100 m South east of processing plant, adjacent to mine access road.	Monthly		Quarterly	Quarterly
Notes								

1. A / B denotes that a shallow and deep bore is proposed to be installed at the location. Not all sites allocated A and B bores will require nested or adjacent deep and shallow bores. Hydrogeological conditions should be assessed during drilling to determine this. Likewise, site specific conditions may negate the need to drill all of the aforementioned bores and should be reassessed based on local hydrogeological conditions.
2. Coordinates should be used as a guide, installation locations should be chosen to provide easy of access and reduce the risk of damage due to mining activity interaction.
3. Automatic loggers have been selected for locations which are in close proximity to surface water features and or provide the first perimeter of bores surrounding the pit. Manual monitoring can be superseded by automatic logging if practicable, at a frequency of 1 reading / day.
4. If concentrations are noted at boundary bores, additional down gradient bores should be installed as appropriate.
5. During operational period, the monitoring schedule should be reviewed annually to focus on any potential trends of groundwater impacts.

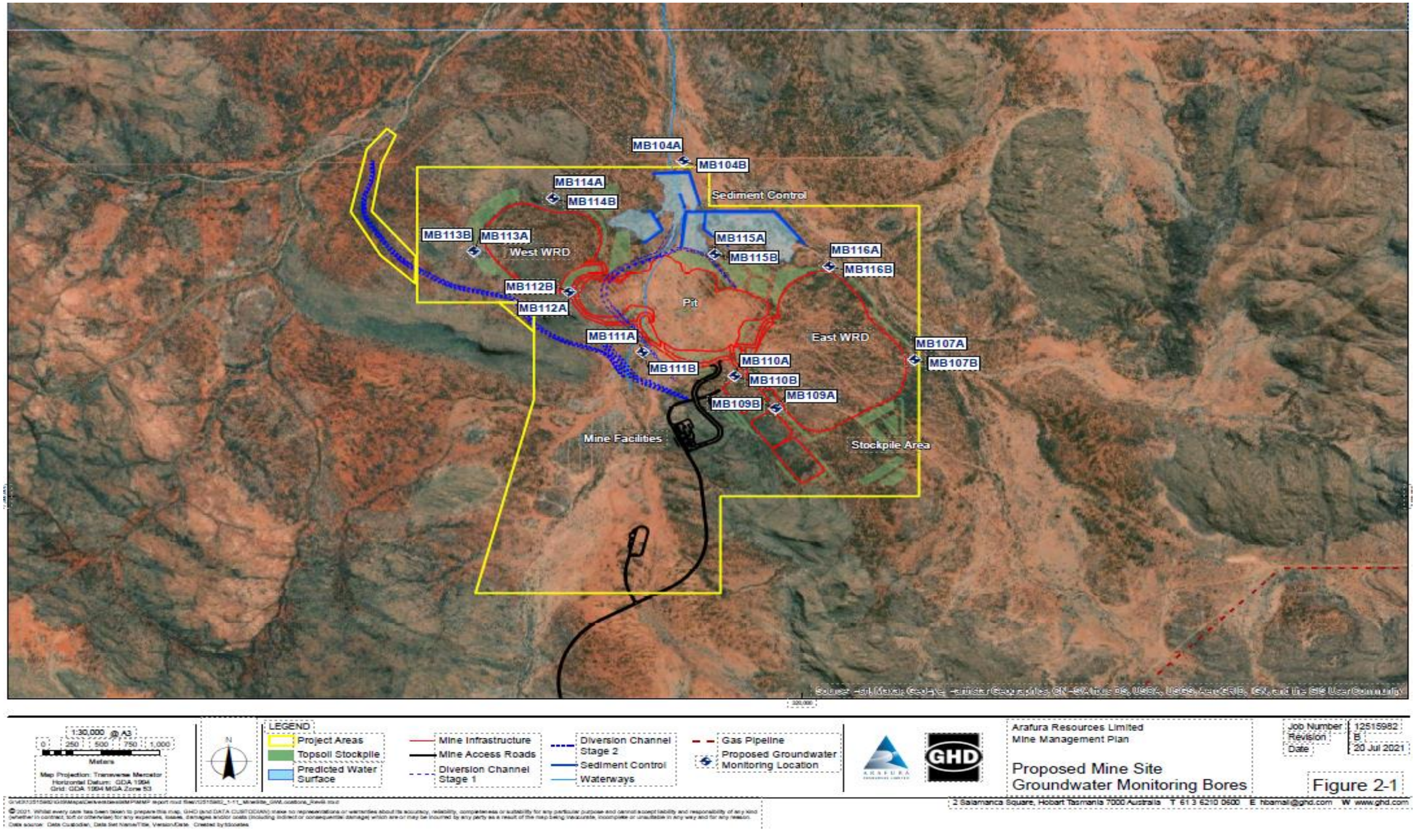

Figure 2-1 Potential Mine Site Groundwater Monitoring Bores

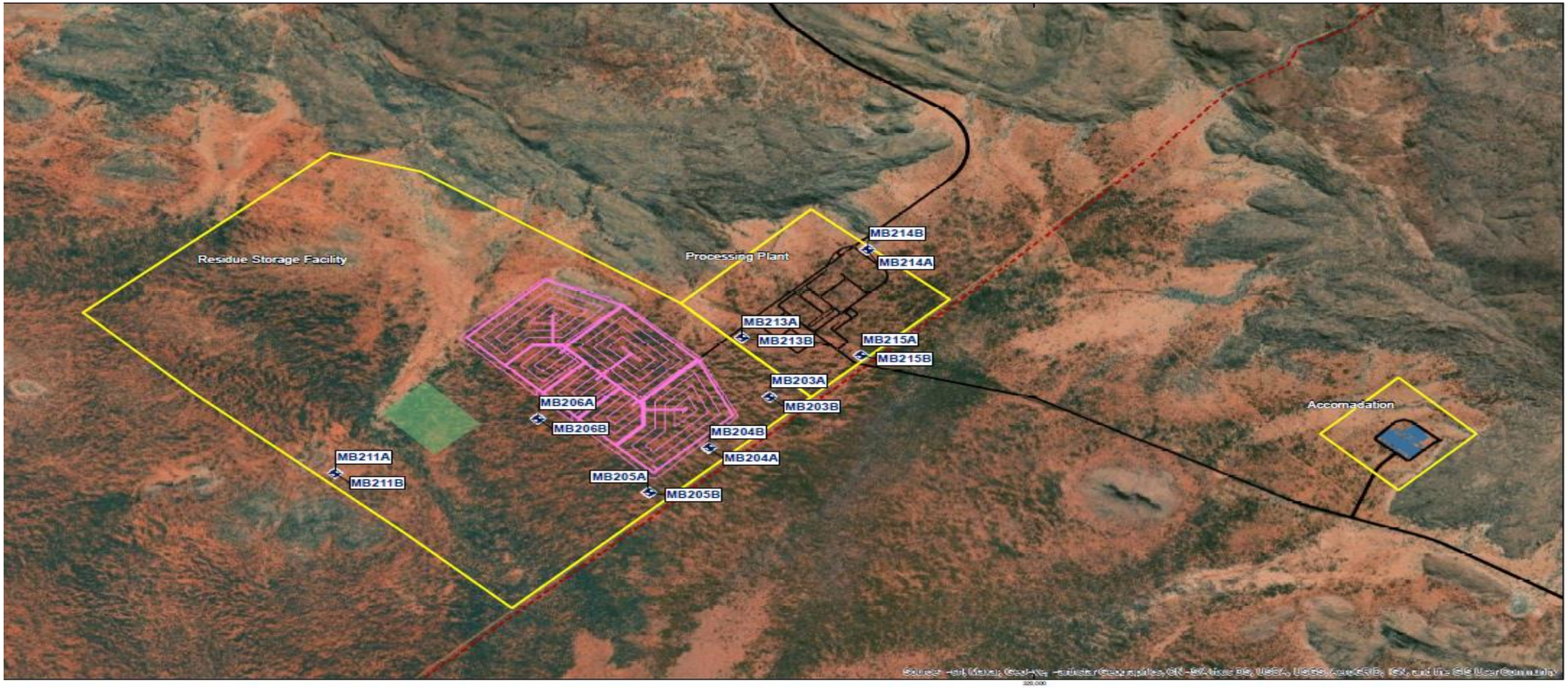

Figure 2-2 Potential Processing Site Groundwater Monitoring Bores

2.3.1 Groundwater Sample Assay Suite

Field measurements are to be collected using the water quality meter during the purging process. Following stabilisation of water quality parameters (see Section 3.2), laboratory samples are to be collected. The groundwater sampling assay suite is provided below:

- Standing water level
- Laboratory analysis and Field Parameter Collection:
  - Total Dissolved Solids, Total Suspended Solids, Total Hardness and Total Acidity and Alkalinity
  - Major ions ($CaCO_3$, CO_3, HCO_3, Ca, Mg, K, Na, Cl, SO_4, NO_3)
  - Metals total and dissolved (0.45 µm field filtered[1]): Al, As, B, Ba, Cd, Co, Cu, Fe, Li, Pb, P, Mn, Hg, Mo, Ni, Rb, Se, Sr, Ag, U, Th and Zn
  - Radionuclides (U-238, U-234, Th-230, Ra-226, Rn-222, Pb-210, Po-210, Th-232, Ra-228, Th-228). Radionuclides will be tested annually at selected representative bores only.

Note – The operational analyte suite will be determined following review of baseline data.

2.4 Sampling Frequency

Sampling frequency will be determined following installation of bores. Some will be quarterly, and others may be six-monthly or at another frequency. Based on significant drilling data the occurrence of groundwater around the Nolans deposit is very limited. An indicative frequency is provided in Table 2—1.

2.4.1 Environmental Incident Sampling

In the event that an incident occurs where a hazardous substance or chemical is discharged to the environment the HSEC Manager will determine if an investigation is warranted based on severity level of the incident, the requirements of the Hazardous Substance Management Plan and Emergency Response Plan.

[1] Samples for dissolved metals are field filtered using 0.45 µm Stericup filter.

3.0 GROUNDWATER SAMPLING PROCEDURE

3.1 Standing Water Level Gauging

Groundwater gauging is to be undertaken in accordance with the following:

- Complete groundwater gauging sheet for each sample location; and
- Gauging
  - Gauge water level relative to Top of Casing (TOC) using an electronic interface meter or dip tape. The well cap should be removed and the well allowed to stabilise before measurements are made. Where possible, depth measurements should be recorded to the nearest 1mm (i.e.0.001 m).
  - A groundwater gauging sheet is provided in Appendix A.

3.2 Groundwater Sampling Methodology

Groundwater sampling is to be conducted in accordance with the following:

- Complete groundwater gauging sheet for location;
- Gauging
  - Gauge water level relative to Top of Casing (TOC) using an electronic interface meter or dip tape. The well cap should be removed and the well allowed to stabilise before measurements are made. Where possible, depth measurements should be recorded to the nearest 1mm (i.e.0.001 m);
- Decontamination
  - Reusable sampling equipment such as the pump and cables should be decontaminated prior to and at the completion of sampling each sample location. Decontamination can be undertaken by submerging the pump and cables in a mixture of Decon N / Decon 90 and water;
- Pump Installation
  - Insert pump into well with care to avoid excessive disturbance and re-suspension of sediment within the well. The pump intake should be suspended inside the well screen so as to minimise the volume of stagnant groundwater required to be purged and intercept the inflowing groundwater from the target formation;
- Purging
  - Commence purging of well, the aim of this process is to remove 'stagnant' groundwater from the well so that groundwater is representative of the surrounding unit. Water quality parameters should be recorded at regular intervals (i.e. every 2 to 5 minutes or every 2 to 5 litres) on the groundwater gauging sheet (Appendix A).
  - Parameters are to stabilise prior to sampling, they are considered stabilised when three consecutive readings are within the following limits:
  - 10% for Dissolved Oxygen;

- ± 3% Electrical Conductivity;
- 0.05 pH units for pH;
- ± 0.2 °C for Temperature; and
- ± 10 mV Redox.

Contingency – No Parameter Stabilisation

If after prolonged purging the parameters do not stabilise to within the specified limits, the original well and gravel pack volume should be calculated and ensure at least 3 well volumes of groundwater has been purged.

Contingency – Pumped Dry

Low yielding wells that are purged dry should be left to recover. Following recovery of groundwater levels in the well, sampling can proceed on the assumption that the groundwater represents inflow from the unit screened by the well. In this instance, measurement of stabilisation parameters should record a minimum of three consecutive readings prior to sampling.

- Groundwater Sampling
  - A groundwater sample should be collected after the measured parameters have stabilised. Commonly the purging device is used to sample the groundwater. Sampling should be undertaken so as to minimise the entry of air into the sample – run the outflow from the sampling device down the side of the container, rather than allowing it to cascade into the container.
  - Once collected, groundwater samples should be labelled and stored in ice chilled cooler boxes. Samples should be kept out of the sun. Samples should be returned to the laboratory under Chain of Custody (COC) documentation as detailed in Section 3.3.
  - A total metals sample (not filtered) and a dissolved metals sample should be collected. The dissolved metals sample requires field filtration through a disposable 0.45 µm filter;
- Waste Disposal
  - Purged groundwater is to be pumped onto the ground and all used disposable sampling equipment should be stored for disposal at the process site including filters, tubing and bladders.
- Electronic Transfer
  - All purging results, duplicate locations and CoC are to be scanned and kept on file. The final purging results prior to sampling are to be entered into the groundwater database. Purging sheets should be stored online for reference.

3.3 Sample Dispatch

Groundwater samples have potential to deteriorate following collection. Samples are to be placed into onsite fridge pending dispatch to laboratory. At completion of the sampling round bottles are to be packed into eskys and ice bricks placed on top of samples and transferred to Alice Springs

haulage depot. Samplers are to contact the haulage companies and laboratory to inform of sample delivery and requirements to keep refrigerated.

The sampler is to inform the laboratory of sample postage and provide a completed Chain of Custody (CoC). A blank CoC is provided in Appendix C.

4.0 ABBREVIATIONS AND DEFINITIONS

4.1 Abbreviations

Abbreviation	Meaning
Arafura / ARU	Arafura Resources Limited
µg	Microgram
µS	Microsiemens
AHD	Australia Height Datum
ALARA	As Low as Reasonably Achievable
ANZECC	Australian and New Zealand Environment and Conservation Council
BaP	Benzo[a]pyrene
BFD	Blind Field Duplicate
BOM	Bureau of Meteorology
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes

APPENDIX A GROUNDWATER GAUGING SHEET (EXAMPLE)

GROUNDWATER GAUGING FIELD SHEET			
Date		Sampler	

GROUNDWATER LEVELS

Standing water level is measured from the top of internal casing (TOIC).

Groundwater Well	Easting	Northing	Top of Internal Casing (m AHD)	Standing Water Level (m BTOIC)	Standing Water Level (m AHD)	Comments (Water Flow, Color, Suspended Sediments)

Additional Comments

APPENDIX B GROUNDWATER PURGING AND SAMPLING FIELD SHEET EXAMPLE

GROUNDWATER PURGING AND SAMPLING FIELD SHEET	
PROJECT DETAILS	
Depth to Water Table Before Sampling (m TOC):	Borehole ID:
Depth to Bottom of Casing (m TOC):	Date
Depth to Water Table After Sampling (m TOC):	QA Collected:
Sampler:	Sample Method:

FIELD PARAMETERS (Min of five)										
Time	Volume (L)	D.O (%)	D.O (mg/L)	TDS (mg/L)	Turbidity (NTU)	E.C (us/cm)	pH	Eh (mV)	Temp (^{0}C)	Comments (water flow, color, suspended sediments)
Post Sample Parameters										

Number of Bottles	Comments:

APPENDIX C CHAIN OF CUSTODY EXAMPLE

CHAIN OF CUSTODY

ALS Laboratory: please tick

ALS Environmental

□ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
□BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
□GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
□MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
□MELBOURNE 2-4 Weisal Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
□MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
□NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
□NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
□PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
□SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
□TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
□WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT:	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT **(List due date):**	**FOR LABORATORY USE ONLY (Circle)**
OFFICE:		☐ Non Standard or urgent TAT **(List due date):**	Custody Seal Intact? Yes No N/A
PROJECT:	**ALS QUOTE NO.:**	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER:		COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: C
PROJECT MANAGER:	**CONTACT PH:**	OR: 1 2 3 4 5 6 7	Other comment:
SAMPLER:	**SAMPLER MOBILE:**	**RELINQUISHED BY:**	**RECEIVED BY:** / **RELINQUISHED BY:** / **RECEIVED BY:**
COC emailed to ALS? (YES / NO)	**EDD FORMAT (or default):**		
Email Reports to (will default to PM if no other addresses are listed):		DATE/TIME:	DATE/TIME: / DATE/TIME: / DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed):			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS									
														Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.