MINE MANAGEMENT PLAN

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Project Name: Nolans Rare Earths

Authorisation Number: 1127-01

REVISION HISTORY

Date	Rev	Description	Prepared	Reviewed	Approved
31/07/2025	Rev 5.1	Issued for use	Y. Smythe McGuinness S. Environmental Scientist	D. Jordan Manager Environment	T. van der Walt CPO
16/04/2025	Rev 5	Issued for approval	Y. Smythe McGuinness S. Environmental Scientist	D. Jordan Manager Environment	T. van der Walt CPO
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06/11/2024	Rev 3.3.1	Issued for approval	Y. Smythe McGuinness S. Environmental Scientist	D. Jordan Manager Environment	S. Macnaughton COO
04/10/2024	Rev 3.3	Issued for approval	P. Hewitt S. Project Manager	D. Jordan Manager Environment	S. Macnaughton COO
04/09/2024	Rev 3.2	Issued for approval	S. Binnie NPI Project Manager	D. Jordan Manager Environment	S. Macnaughton COO
30/04/2024	Rev 3.1	Issued for approval	Y. Smythe McGuinness S. Environmental Scientist	T. Perry Head of Sustainability and Environment	S. Macnaughton COO
08/04/2024	Rev 3	Issued for approval	M. Robinson, Manager Environment	T. Perry Head of Sustainability	D. Cuzzubbo CEO
31/03/2023	Rev 2.1	Issued for use	M. Robinson, ESG Manager	M. Robinson, ESG Manager	S. Watkins, GM Projects
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31/07/2022	Rev 1	Issued for approval	M. Robinson ESG Manager	M. Robinson, ESG Manager	S. Watkins, GM Projects
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MINING MANAGEMENT PLAN CHECKLIST

A checklist of the requirements of the Mining Management Plan (MMP) (this report) has been outlined below. Where a requirement has not been completed, a comment and reason has been outlined.

Y/N	Page	Requirement	Department's Comment
Y	13	Has the plan been endorsed by a senior representative of the company?	
Y	20	**Introduction:** Have Operator details been included?	
Y	20	Is the company structure described?	
Y	23	Are title details included?	
Y	24, 14	Is there a project summary and description improvements?	
Y	38	**Site Conditions:** Have all the physical environment conditions for the site and surrounds been identified?	
Y	44	Have the current land uses and users and stakeholders been identified?	
Y	44	Have Community Affairs been described?	
Y Y	47 57	**Statutory and Non-Statutory Requirements:** Has all legislation relevant to the operation and associated permits and approvals been identified? Have all non-statutory obligations been identified and included?	
Y	58	Have Aboriginal and heritage sites been identified?	
Y	60	**Operational Activities:** Have all operational activities relating to mining, processing, exploration and any related activities for the site been addressed in the MMP?	
Y Y Y	41, 113, APPENDIX L	**Waste Rock Characterisation:** Have results of waste rock characterisation been included and discussed? Has a waste characterisation report been included? Does the MMP include a waste rock management plan?	
Y	21, 133	**Environmental Management:** Has the Environmental Management structure and responsibilities been outlined?	

Y/N	Page	Requirement	Department's Comment
Y	133	Has the Environmental Policy been included?	
Y	133	Has a register of environmental commitments been included?	
Y	142	Has a summary of all recommendations from the Environmental Impact Assessment been included and addressed if the project has been formally assessed?	
Y	147	Has training and induction been addressed?	
Y	147, APPENDIX I	Is there an Environmental Emergency and response plan?	
Y	148	Have all environmental aspects and potential impacts been identified?	
	148, APPENDIX V	Has a risk assessment been carried out?	
Y	149, Appendices	Have Environmental Management Plans (EMPs) for identified risks been developed and included?	
Y	149, Appendices	**EMPs:** Do all EMPs include: objectives and targets management and mitigation strategies monitoring and measurement discussion and analysis of results non-conformances and corrective actions?	
Y	153, EIS Chapter 7	**Water Management:** Has a comprehensive description of surface water conditions been included?	
Y	154, EIS Supplement – Appendix 10	Has a comprehensive groundwater model been described?	
Y	154	Have information or knowledge gaps been identified and described for water management?	
Y	154	Are there comprehensive details (including scopes of work) on actions proposed to be taken to respond to any identified information or knowledge gaps?	
Y	155, APPENDIX V	Have hazards been identified that could result from activities related to the operation and rank the associated risks of impacts to both surface and groundwater?	

Y/N	Page	Requirement	Department's Comment
Y	155, APPENDIX R, APPENDIX V	Are all strategies and actions that will be undertaken to manage any risks identified included?	
Y	156, APPENDIX R	Has the water monitoring program been detailed?	
N/A		Has all monitoring data been included?	
N/A		Has an interpretation of data by a suitably qualified person been included?	
N/A		Has a discussion of trends over time been detailed?	
Y	156	Have details of remedial/corrective strategies and scopes of work been included?	
Y	156	Have proposed actions been detailed?	
Y	157	**Incident Reporting:** Has a table of all incidents recorded on site been included and discussed?	
Y	158, APPENDIX S	**Closure Planning:** Has a Life of Plan – Unplanned Closure plan been included? Are all disturbances described? Are remediation activities that would be required in the event of unplanned closure described? Are activities required to achieve end land use objectives, described?	
Y	164,164 APPENDIX CC	Does the MMP include a detailed costing of closure activities for the life of plan? Have all past disturbances and those proposed for the next reporting period been identified and included?	
Y	Multiple Pages – See Index of Figures Above	**Maps and Plans:** Maps and plans have scale, scale bar, legend and north point? Datums used are MGA94 or GDA94 (expressed in decimal degrees) with elevations based on AHD?	

MINE MANAGEMENT PLAN
Mining Operations
Mining Management Plan

- Operator Name: Arafura Nolans Project Pty Ltd
- Project Name: Nolans Rare Earths Project
- Authorisation Number: 1127-01
- Date: 31/07/2025
- Document Distribution List: NT Government (DEPWS Mining Division)

The MMP must be endorsed by a senior representative of the company who has the appropriate level of delegation.

I Tommie van der Walt (CPO), declare that to the best of my knowledge the information contained in this mining management plan is true and correct and commit to undertake the works detailed in this plan in accordance with all the relevant Local, Northern Territory and Commonwealth Government legislation.



SIGNATURE: .....

DATE: 31/07/2025

Amendments

Section	Amendment
1.1 Operator Details	Updated key contact.
1.1.1 Organisational Structure and Responsibility	Updated Figure 1—1 Current Overall Management Structure.
1.2 Title Details	Added new Project tenure including: • AAs 33279 – 33281 (access and haul roads) • ML 33107 (explosives magazine) • Removed tenure not subject to this MMP (Extractive MPs)
1.3.1.1 Key Project Information	Figure 1—5 to Figure 1—15 updated with current Project layout and information including: • Realignment of access roads for safety and to avoid a Sacred Site • Movement of the explosives magazine to avoid potential flooding • Updated mining tenure.
1.3.2 Project Summary and Improvements	Added recent Project improvements and updates.
2.1.3 Geology, Resources and Reserves	This section was moved from the Mining Activities section into the Site Conditions section.
2.1.4.1 Fauna Surveys of Additional Tenure	Added information collected from fauna surveys conducted on the new tenure areas.
2.2 Socio-Economic Environment	Added reference to ongoing risk management system.
2.2.2 Identified Stakeholders and Consultation	Updated key parties' details.
3.1 Statutory Requirements	Updated status of current Project approvals. Added an environmental impact self-assessment of the new tenure areas. Updated with recent legislative and Departmental changes.
3.1.1 NT EPA Assessment	Updated Table 3-2 Project Licence / Approval / Permits with current status of approvals.
3.1.1.1 Environmental Impact Self-Assessment of Additional Tenure – Explosives Magazine, Site Access and Gravel Pits	Added this section to detail the recent self-assessment undertaken for the new tenure areas.
3.3 Sacred, Archaeological and Heritage Sites	Updated status of current heritage approvals.

Section	Amendment
4.0 Operational Activities	Updated with new staging of Project activities (Stages 1-12). Clarification that all proposed works are described within this section to improve clarity, and not within the previous *Appendix CC – Annexure A* as per the previous MMP (Rev 2.1). Updated with works undertaken to date. Restructured to reflect the current staged development of the Project, however there are no material changes to the proposed works.
4.1 Performance Against Previous Mine Management Plan	Inserted Table 4—1 which tracks works undertaken to date against the previous MMP. Removed the Nolans implementation schedule. The Project timeline is dependent on financing activities. Moved sections relating to RSF, Infrastructure Area, and Processing performance into this section (previously in Sections 4.3.11, 4.4.9, and 4.8 of the previous MMP Rev 2.1).
4.2 Stage 1 – Early Construction Works	Provides a succinct overview of the Stage 1 works, which were undertaken on site in 2023.
4.3 Main Construction Works	Describes the general approach taken to the planning of works into Stages 2-12.
4.4 Stage 2 – 4.13 Stage 12	Restructured the previous operational activity sections to reflect the staging of works in to Stages 2 - 12. Description of the linkage to security calculations to provide clarity where required. Updated to provide more detail and better describe the works in some sections.
4.4.1 Process Plant Pad / Hardstands **4.4.2 Process Plant Ponds** **4.4.3 Establishment of Temporary Facilities** **4.4.5 Mine Infrastructure Area Pad** **4.4.6 Explosives Storage Area Hardstand**	These are new sections added to provide further detail of what is planned in Stage 2 works.
4.4.4.1 Site Access Road and Village Road	Updated to clarify the initial road design will be unsealed except for an initial 100 m of the SAR. Updates also provided to the status and management of archaeological items and sites along the road alignment.
4.4.7 Communications	Updated with current communications infrastructure planning.

Section	Amendment
4.4.8 Waste Management **4.4.8.1 Waste Disposal Planning**	This section has been moved from Section 4.5.6 of the previously approved MMP (Rev 2.1). It has been updated to include the details of matured waste management planning, of which implementation will commence during Stage 2 works. Including use of the planned landfill facility for putrescible and non-contaminated wastes; as well as the disposal options for contaminated waste streams not suitable for landfill within the RSF, WRD, or offsite.
4.4.8.2 Landfill	At the time of writing the previous MMP, waste management planning had not yet been developed. The previous MMP described various waste management options for different waste streams including the option of *a compliant on-site landfill* (Section 4.5.6.2) with further details for the siting and design of a landfill provided in the previous Waste Management Plan (Rev 1) at APPENDIX D, however, did not detail its size, exact location, etc. Since that time waste management planning has been progressed, and this Section now describes the further planning for the construction and use of the landfill facility adjacent to the RSF during Stage 2 works. This landfill facility is planned for the disposal of putrescible and non-contaminated waste streams. The Waste Management Plan (APPENDIX D) has also been updated to include these details. This area has been included in the updated security calculations for Stage 2.
4.4.8.3 Bioremediation Pad	This Section includes the details of the planned bioremediation facility, to be constructed within the existing Village spray field area during Stage 2 works. Similar to the landfill area, the previous MMP described the use of *a site hydrocarbon bioremediation facility* (Section 4.6), however did not provide details. This Section now describes the planning and details for the construction and use of a bioremediation pad for the treatment of hydrocarbon contaminated soils. The Waste Management Plan (APPENDIX D) has also been updated to include these details. This area is located within the footprint of the Village spray field and hence has already been included and paid for in the security calculations for Stage 1.
4.5.2 Accommodation Village	Updated the maximum occupancy to reflect current planning and details the works undertaken to date.

Section	Amendment
4.6 Stage 4 – Hydromet Plant Construction **4.7 Stage 5 – Beneficiation Plant Construction** **Stage 6 – Sulphuric Acid Plant Construction** **Stage 7 – Non-process Infrastructure**	Added an overall description of each stage of works.
4.9.3.1.1 Construction	Added this section to describe construction of the fuel storage and distribution infrastructure.
4.11 Residue Storage Facility	Description of staged planning and scope included in security calculation. Clarification of terminology related to the planned RSF cells, and how they relate to the planned stages of works.
4.11.2.2 RSF Design Strategy	Updated for clarity and current design footprint area. Updated Figure 4—18 with current Project layout. Updated Figure 4—1 with current RSF design.
4.12.2 Mine Area Surface Water Management	Content previously included in the Civil Work and Mining Activities sections. Now included in Stage 10. Figure 4—5 Mining Area Surface Water Management (Stage 1 of mining design) was added to show the drainage structures considered within the Stage 10 works and included in the security calculation. Figure 4—6 Mining Area Surface Water Management updated (final mining design) was previously included, and has been updated to the latest version. Reference to updated Kerosene Camp Creek Diversion and Mine Surface Water Management Design, included in APPENDIX BB. Description of scope included in security calculation.
4.12.2.4 Kerosene Camp Creek Diversion	This is a new section added to provide further detail of what is planned for the Kerosene Camp Creek diversion.
4.13.1 Mining Activities	Provides clarity on the scope of mining activities currently included in the security calculation.
4.13.1.1 Mine Scheduling	Updated with planned mining rates, added Figure 4—7 LOM Plan – Ore Production. Description of staging.
4.13.1.2.2 Ore and Mineralised Stockpiles	Updated wording to provide more detail and better describe.

Section	Amendment
4.13.1.2.6 Waste Rock Dumps	Updated predicted final waste rock quantity and footprint (reduced amount). Added detail regarding encapsulation of NORM waste and rehabilitation to final slopes. Described WRD staged planning. Added information regarding the construction of cells within the WRD to contain and encapsulate contaminated radioactive waste materials not suitable for landfill.
4.13.2.10.1 Ponds	Updated to describe the staging of pond construction.
4.9.3 Fuel Storage and Distribution	Updated to describe current planned fuel storage locations and volumes.
5.1 Environmental Management Structure	Added a description of the Environmental and Social Management System (ESMS) developed for the Project.
5.2 Environmental Policy	Updated with a link to Arafura's current Environment Policy which is publicly available on Arafura's website.
5.3.1 Commitments Contained in the MMP	Updated with progress in meeting commitments.
5.3.2 Recommendations Resulting from Formal Environmental Assessment	Updated completion status against commitments.
5.6.2 Risk Assessment	Added description of the Environmental and Social Risk Register Arafura maintains for the Project, as part of the Project ESMS.
6.1.2 Groundwater	Updated with recent EMP development.
6.2.1 Identification and Filling of Information/Knowledge Gaps	Combined these two sections into one to avoid repetition. Added recent progress.
6.2.2 Water Account	Added water account for the Project to date.
6.3.2 Actions and Strategies in Response to Identified Risks	Included description of Arafura's risk management system.
6.4.1 Monitoring Program, Data Review and Interpretation	Added recent EMP development.
8.2 Background for Costing of Closure Activities	Updated for the current Project staged planning, with disturbance area inventory added for the works undertaken to date, as well as the proposed Project disturbance as per the updated security calculation.
8.3 Security Estimate	Updated with current staging.
9 References	Updated references.

Section	Amendment
Appendices	Updated APPENDIX B – Biodiversity Management Plan (to align with the version now approved by the federal regulator). Updated APPENDIX D – Waste Management Plan (to reflect the progressed landfill management planning). Updated APPENDIX K – Radiation Protection and Radioactive Waste Management Plan (to align with the version now approved by the federal regulator). Updated APPENDIX M – Groundwater Sampling and Data Collection Procedure (for currency with methods used on site). Updated APPENDIX P – Kerosene Camp Creek Management Plan (to align with the version now approved by the NT Water Regulator). Updated APPENDIX BB – Kerosene Camp Creek Diversion and Mine Surface Water Management Design (updated to current design). Updated APPENDIX CC – Security Calculation (updated for this MMP Rev 5.1). Added APPENDIX DD - Threatened Species Assessment of Gravel, Magazine and Access Tenure (assessment of new tenure areas included in this MMP). Added APPENDIX EE – Environmental Impact Self-Assessment, Explosives Magazine and Gravel Pits (assessment of new tenure areas included in this MMP).
Throughout document	Updated external links where required. Edits to improve accuracy and currency of wording to reflect current Project planning and progress, and the status of current Project approvals and EMPs. Updated to reflect planned staging of works. Updated references to governmental department/regulatory authorities for currency.

1.0 INTRODUCTION

1.1 Operator Details

The project operator and contact details are:

- Name of operator or company: Arafura Nolans Project Pty Ltd
- ABN: 88 118 158 900
- Key contacts: Tommie van der Walt, Chief Projects Officer
- Registered office: Level 6, 432 Murray St, Perth WA 6000, PO Box 5773 St Georges Terrace Perth WA 6831, T: +61 8 6370 2800, E: arafura@arultd.com, E: nolansproject@arultd.com
- Darwin office: Unit 34, 119 Reichardt Rd Winnellie NT 0820, PO Box 37220 Winnellie NT 0821

Arafura Nolans Project Pty Ltd and Arafura Rare Earths Limited (collectively referred to as the Company, or Arafura) are considered together within this document as the owner and operator of the Nolans Rare Earths Project (Nolans, or the Project). Arafura is an Australian mineral exploration and development company focusing on Neodymium and Praseodymium (NdPr) rare earths. It is headquartered in Perth, Western Australia and was listed on the Australian Stock Exchange (ARU) in 2003. The Company's flagship project is this Project, the Nolans Rare Earths Project, located in Australia's Northern Territory.

1.1.1 Organisational Structure and Responsibility

The current overall management structure relevant to this MMP is presented in Figure 1—1. These personnel will be further defined as Arafura moves towards operational readiness. The proposed organisation structures are presented as site, HSEC and for mining in Figure 1—2, Figure 1—3 and Figure 1—4 respectively. Changes to the proposed management and organisational structure will be reported at the end of each reportable period. While these structures may change in the run-up to operations, the current management and organisational structure is shown below.

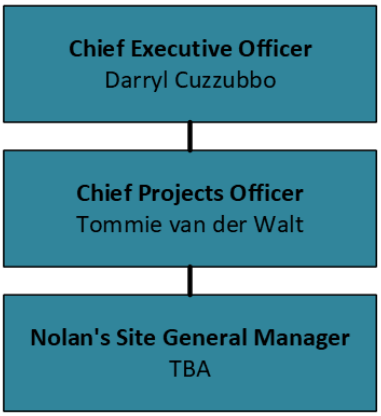


Figure 1—1 Current Overall Management Structure

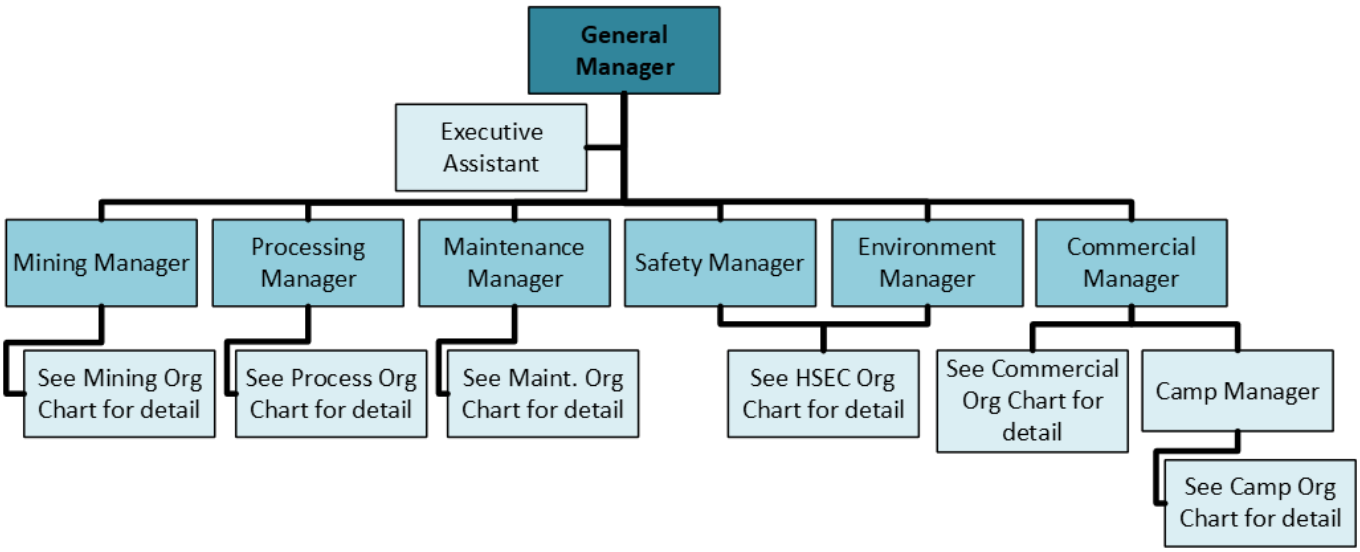


Figure 1—2 Proposed Site Management Structure

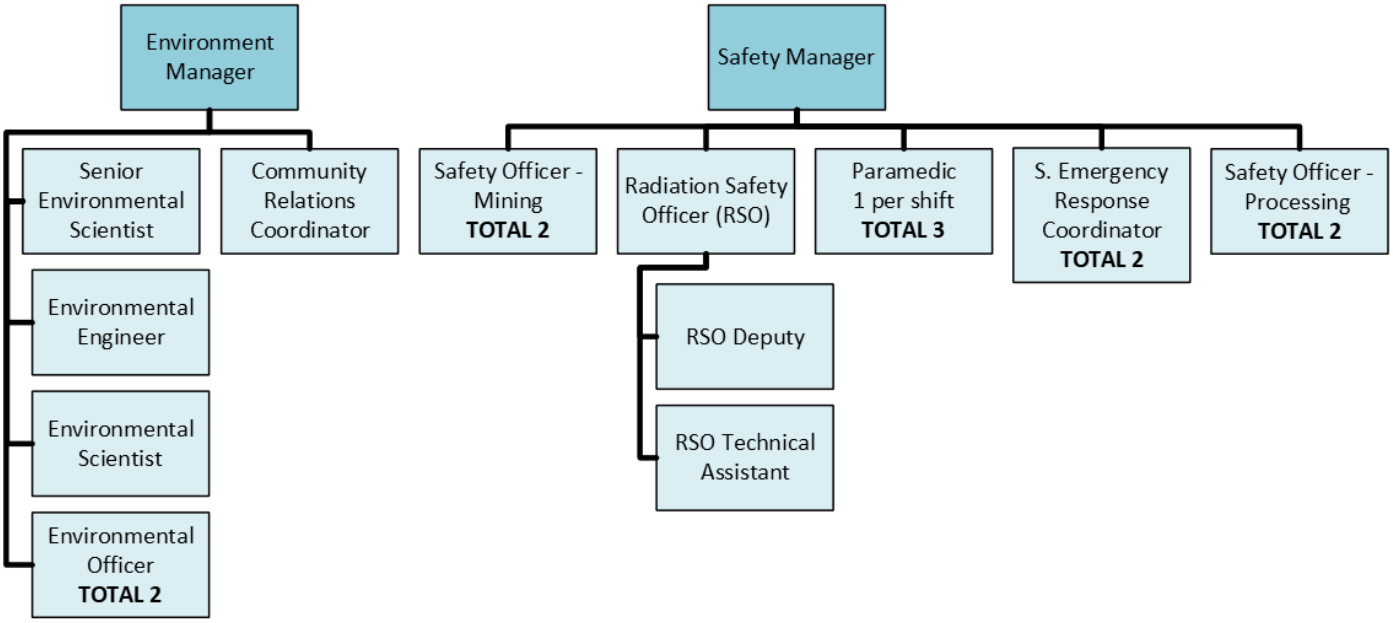


Figure 1—3 Proposed HSEC Organisation Chart

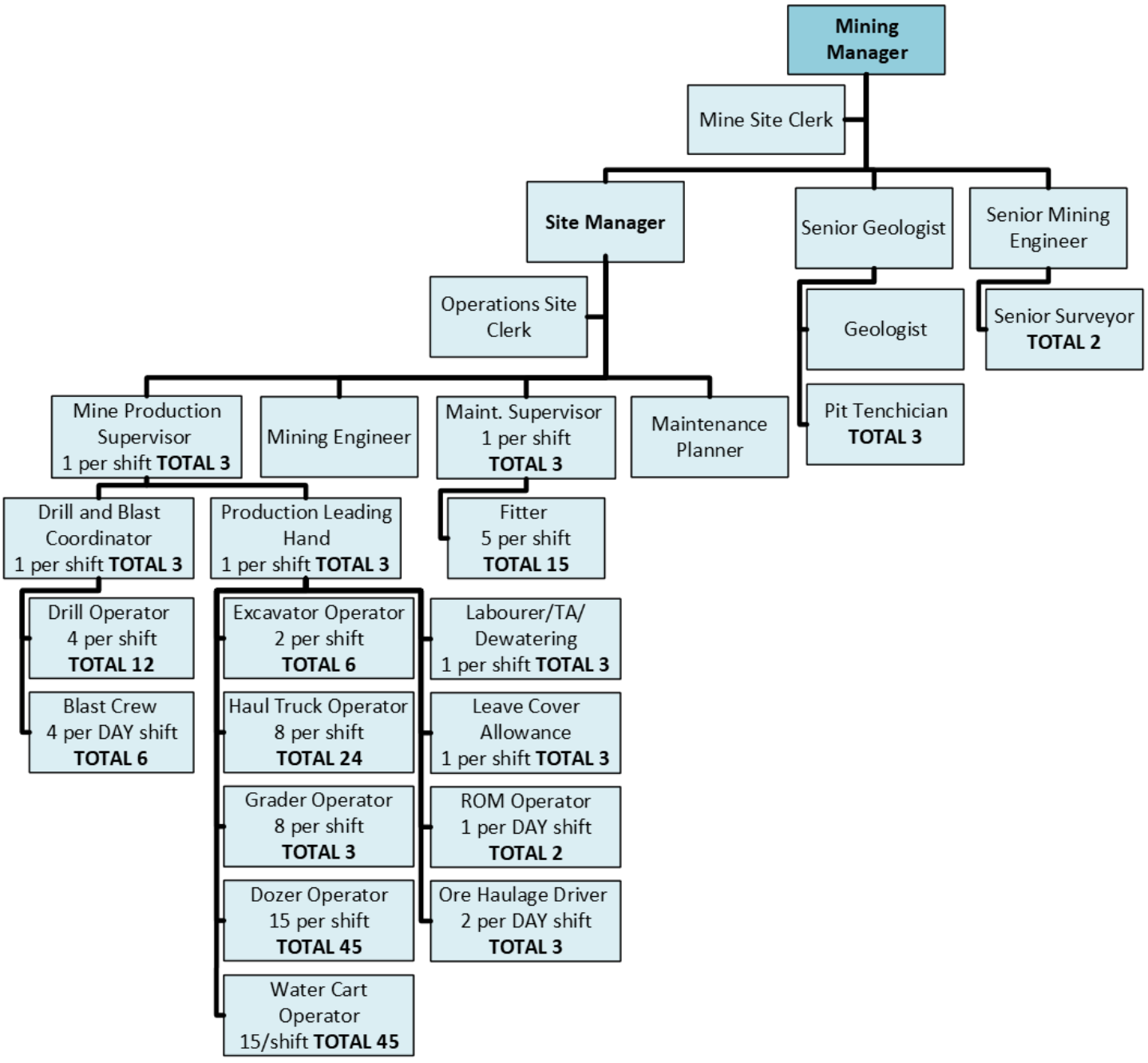


Figure 1—4 Proposed Mining Organisation Chart

1.2 Title Details

Table 1—1 provides a register of ownership for the mining interests associated with the Project including the title numbers, title holders, Project area, grant date, and expiry date.

Table 1—1 Registration of Ownership

Title Number	Title Holder	Project area	Grant Date	Expiry Date
AA 33279	Arafura Nolans Project Pty Ltd	Access and Haul Road	16/11/2022	15/11/2045
AA 33280	Arafura Nolans Project Pty Ltd	Access and Haul Road	16/11/2022	20/07/2045
AA 33281	Arafura Nolans Project Pty Ltd	Access Road and Water Pipeline	16/11/2022	20/07/2045
ML 26659	Arafura Nolans Project Pty Ltd	Primary Mineral Lease	21/07/2020	20/07/2045
ML 30702	Arafura Nolans Project Pty Ltd	Camp	21/07/2020	20/07/2045
ML 30703	Arafura Nolans Project Pty Ltd	RSF	21/07/2020	20/07/2045
ML 30704	Arafura Nolans Project Pty Ltd	Processing Plant	21/07/2020	20/07/2045
ML 32411	Arafura Nolans Project Pty Ltd	Borefield	29/01/2021	20/07/2045
ML 32412	Arafura Nolans Project Pty Ltd	Borefield	29/01/2021	20/07/2045
ML 32413	Arafura Nolans Project Pty Ltd	Borefield	29/01/2021	20/07/2045
ML 32414	Arafura Nolans Project Pty Ltd	Borefield	29/01/2021	20/07/2045
ML 32415	Arafura Nolans Project Pty Ltd	Borefield	29/01/2021	20/07/2045
ML 32416	Arafura Nolans Project Pty Ltd	Creek Diversion	29/01/2021	20/07/2045
ML 33107	Arafura Nolans Project Pty Ltd	Explosives Magazine	08/01/2023	20/07/2045
EL 31957	Arafura Rare Earths Ltd	Monitoring Bores	15/02/2019	14/02/2027
EL 31284	Arafura Rare Earths Ltd	Monitoring Bores	15/12/2016	14/12/2026
EL 31224	Arafura Rare Earths Ltd	Monitoring Bores	12/10/2016	11/10/2026
EL 29509	Arafura Rare Earths Ltd	Monitoring Bores	02/01/2013	01/01/2027
EL 28498	Arafura Rare Earths Ltd	Monitoring Bores	12/08/2011	11/08/2027
EL 28473	Arafura Rare Earths Ltd	Monitoring Bores	05/10/2011	04/10/2025

Extractive Mineral Permits (Extractive MPs) 33078-33085 are included within the separate Mining Authorisation 1083-01. The management of these gravel pits is described under the Nolans Construction Material Mine Management Plan, approved under the current Variation of Authorisation 1083-01 granted 5 May 2023. These activities are therefore not included within the scope of this MMP.

A description of the Access Authority (AA) areas granted in 2022 is provided in Table 1—2 below.

Table 1—2 Access Authorities

Access Authority	Area
AA 33279	Site access road (SAR) from Stuart Highway to the accommodation village (ML 30702) and to the process plant (ML 30704).
AA 33280	Mine access road (MAR) between the mine area (ML 26659) and the process plant (ML 30704).
AA 33281	Borefield access track and water pipeline between the production borefield (ML 32411, ML 32412, ML 32413, ML 32414 and ML32415) to the residue storage facility (ML 30703).

1.3 Project description

1.3.1 Location

Arafura is developing the Nolans Rare Earths Project (Nolans, or the Project) which is a rare earth mine located approximately 135 kilometres (km) north-northwest of Alice Springs in the Northern Territory (NT). The Project is situated approximately 10 km west of Aileron Roadhouse. The main access to the Project site is from the Stuart Highway, 5 km south of Aileron roadhouse. The majority of the Project site is situated on the Aileron Perpetual Pastoral Lease (PPL 1097), with the exception of the western part of the planned borefield area, which is situated on the Napperby Perpetual Pastoral Lease (PPL 1178), and the very northern portion of the Kerosene Creek diversion (ML 32416) which is located on the Pine Hill Perpetual Pastoral Lease (PPL 1030).

The Project site comprises five main areas linked by access roads and pipelines:

1. Mine Site
2. Explosives Magazine
3. Processing Site
4. Accommodation Village
5. Borefield.

1.3.1.1 Key Project Information

Key Project information and settings are presented on the following figures:

Figure 1—5 Regional Plan of Project Area
Figure 1—6 Site Plan of Main Project Infrastructure
Figure 1—7 Production Borefield Layout
Figure 1—8 Land Tenure Across Project Area

Additional Project features as described in the following sections are summarised in the following figures:

Figure 1—9 Areas of Environmental Importance Surrounding Project Area

Figure 1—10 Cultural Heritage Areas Designated by AAPA (C2024/012) and CLC (C2024-172)

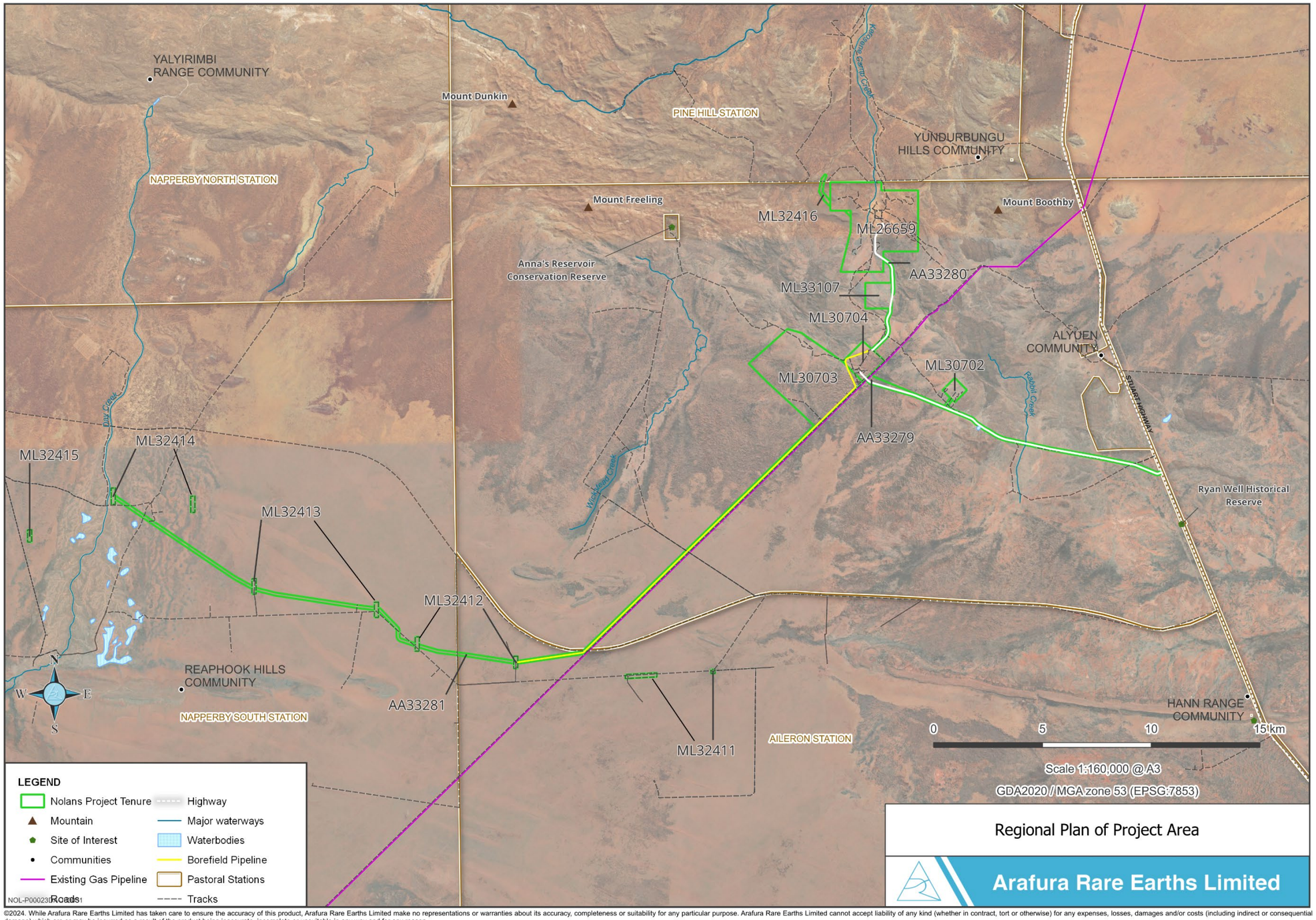
Figure 1—11 Mine Site Groundwater Monitoring Bores

Figure 1—12 Processing Site Groundwater Monitoring Bores

Figure 1—13 Groundwater Monitoring Bores

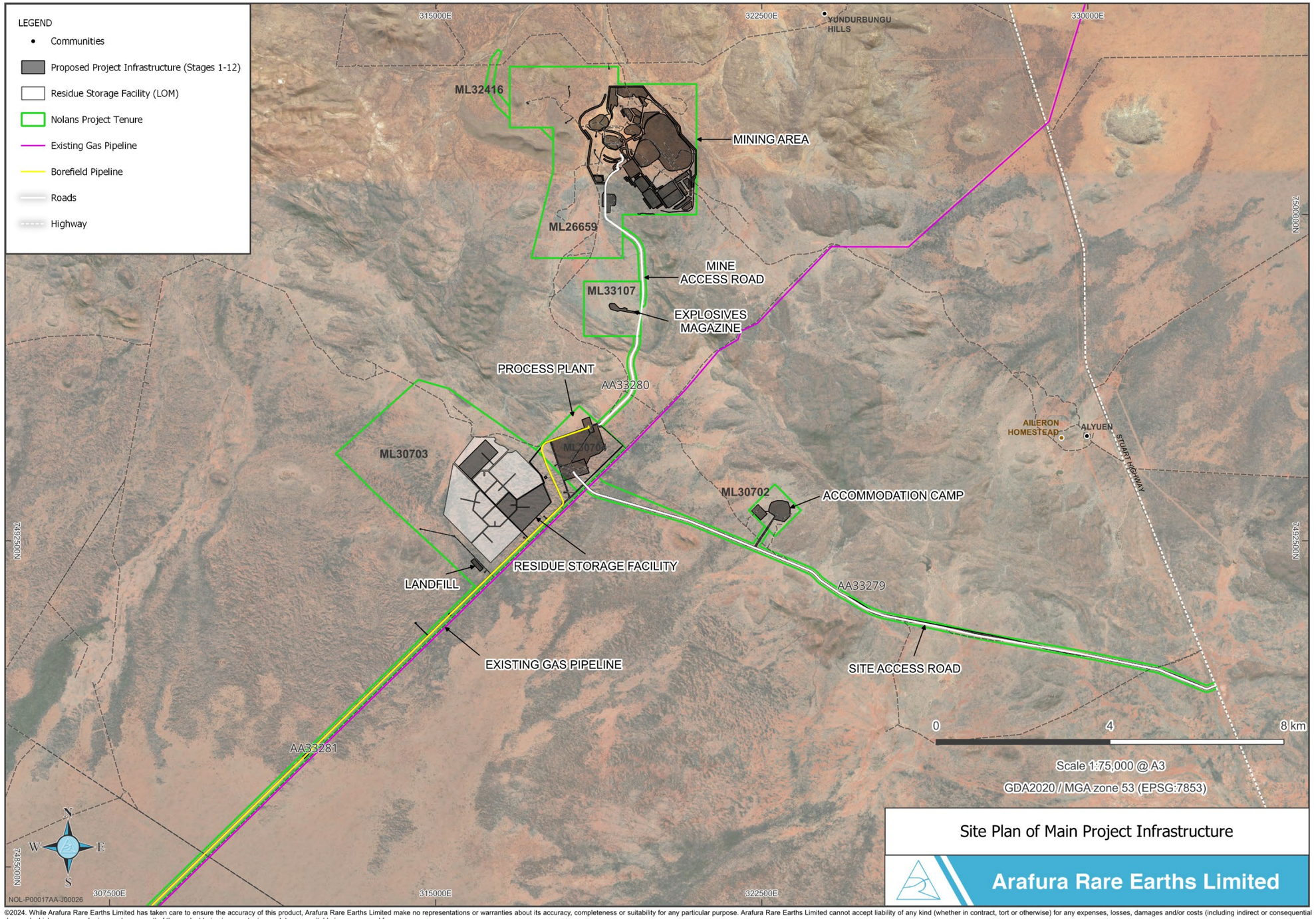
Figure 1—14 Vegetation Communities Across Project Tenure

Figure 1—15 Threatened and Near Threatened Fauna Observations in Proximity to Project Area.



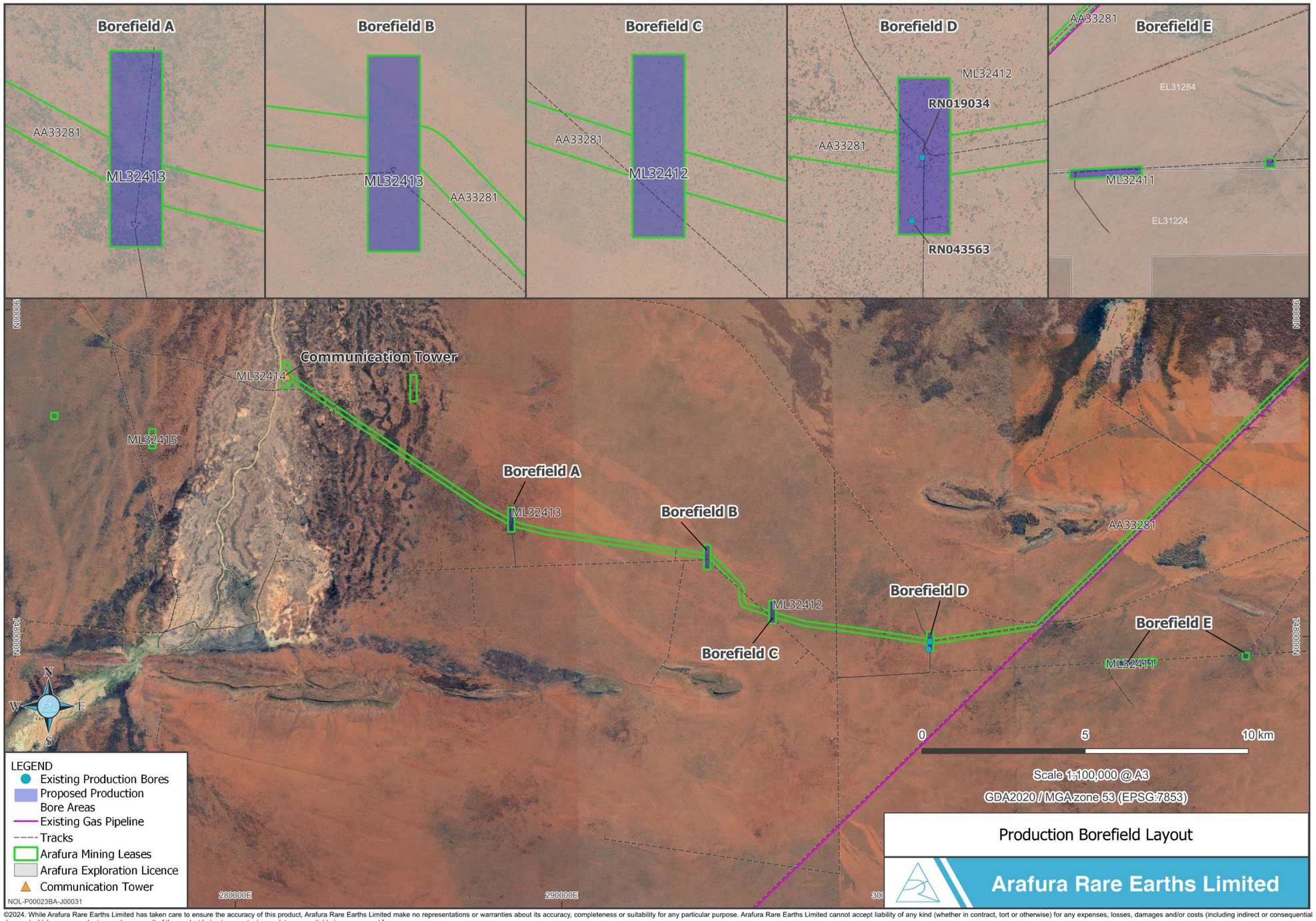
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Figure 1—5 Regional Plan of Project Area



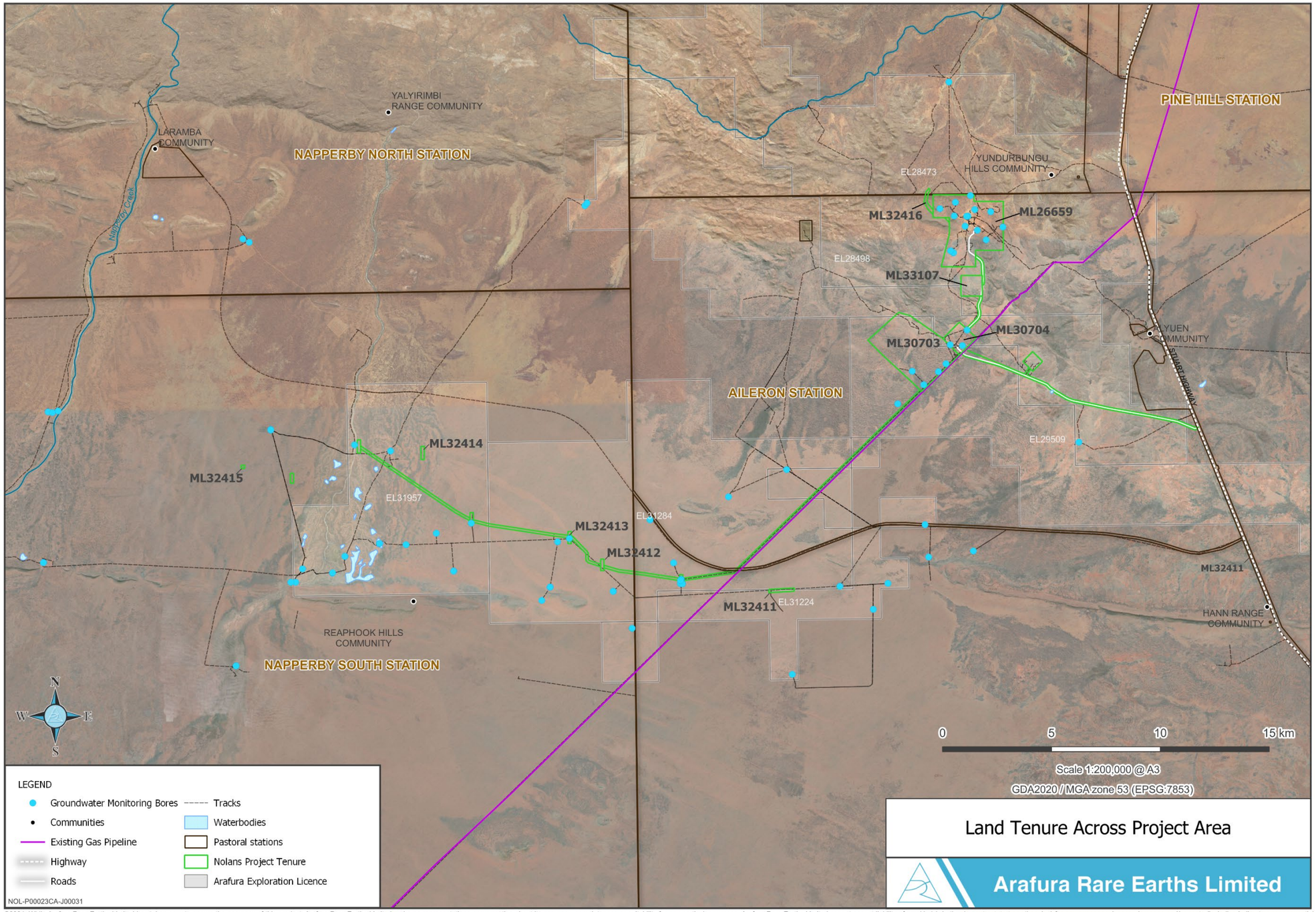
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Figure 1—6 Site Plan of Main Project Infrastructure



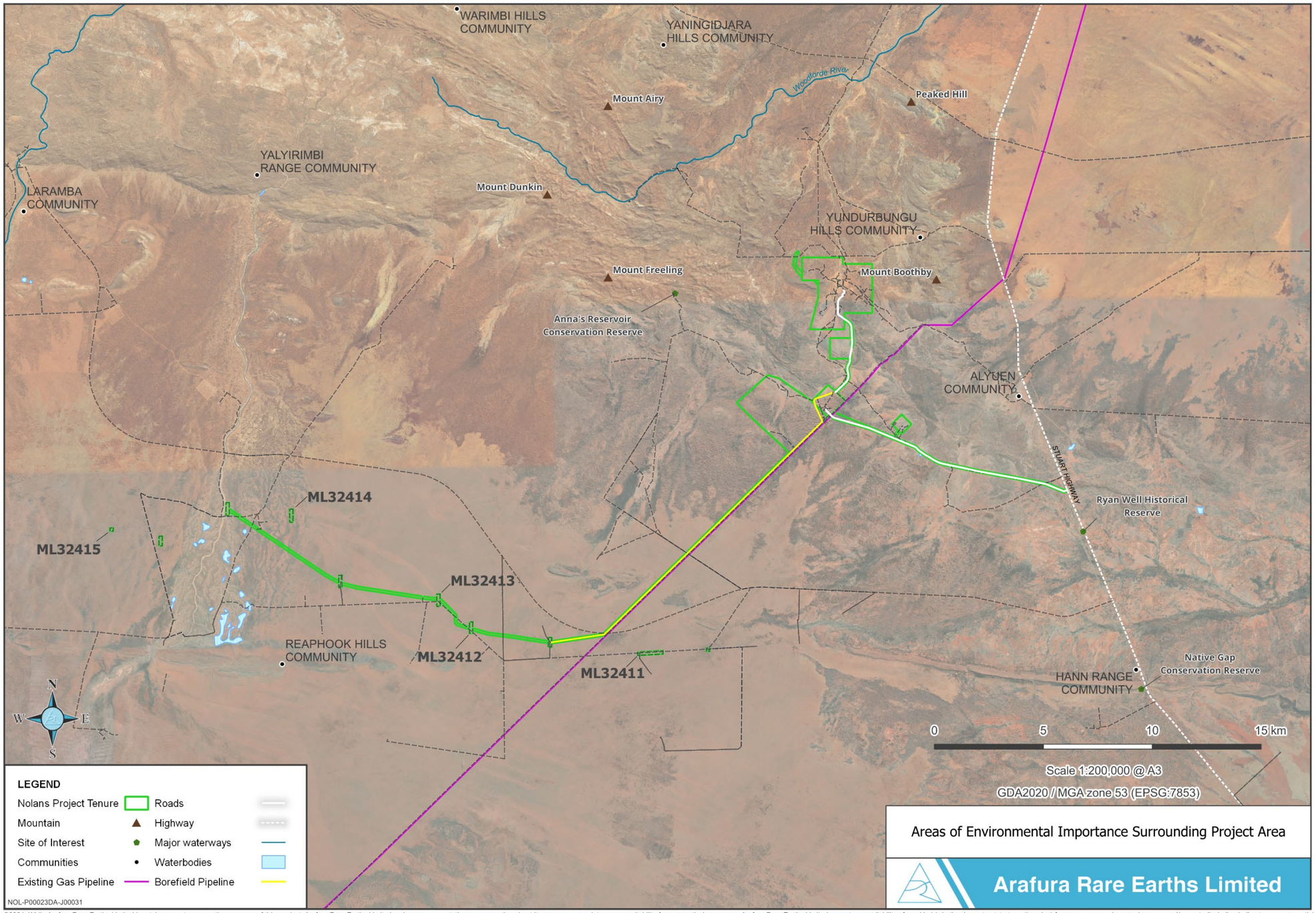
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Figure 1—7 Production Borefield Layout



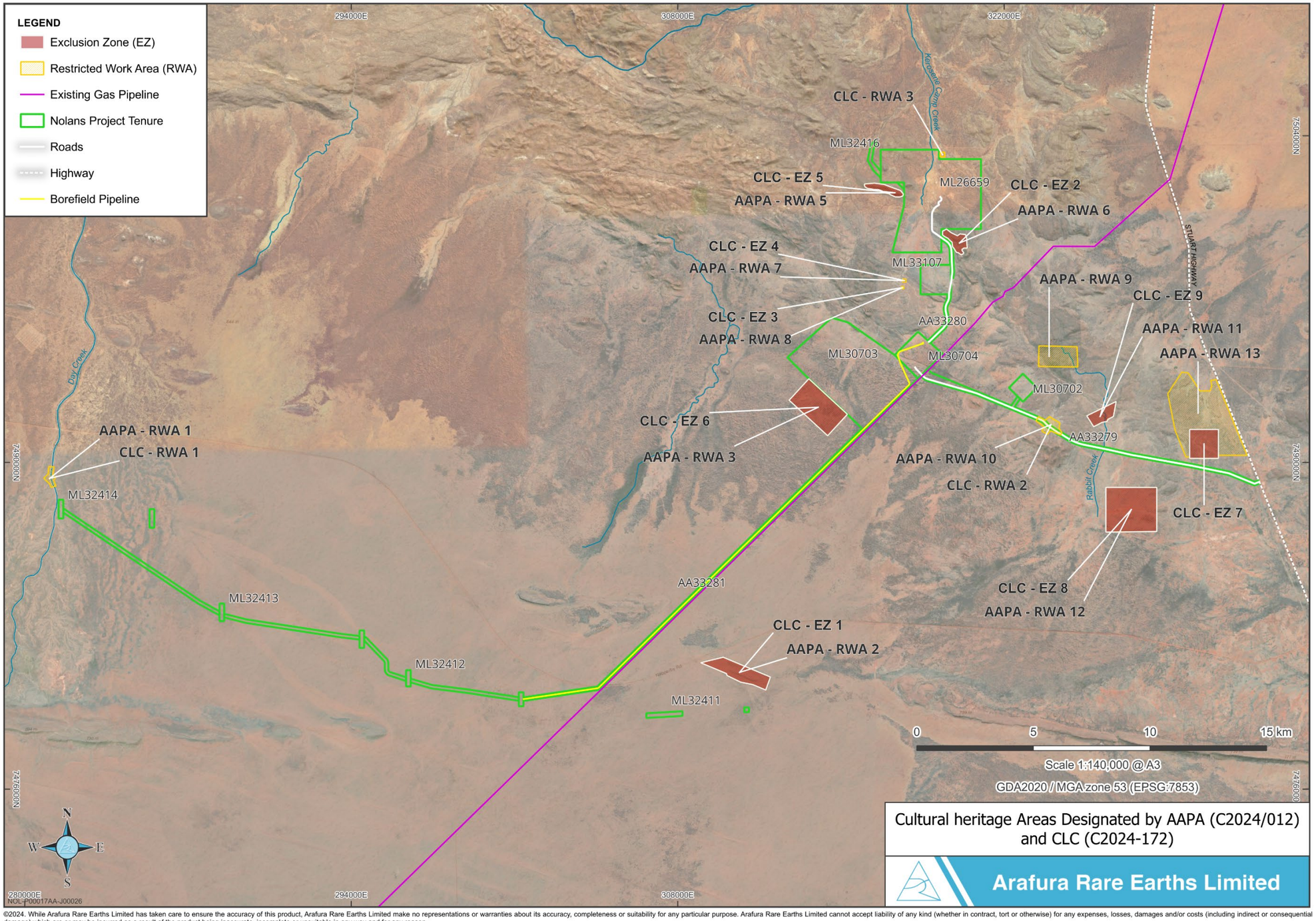
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Figure 1—8 Land Tenure Across Project Area



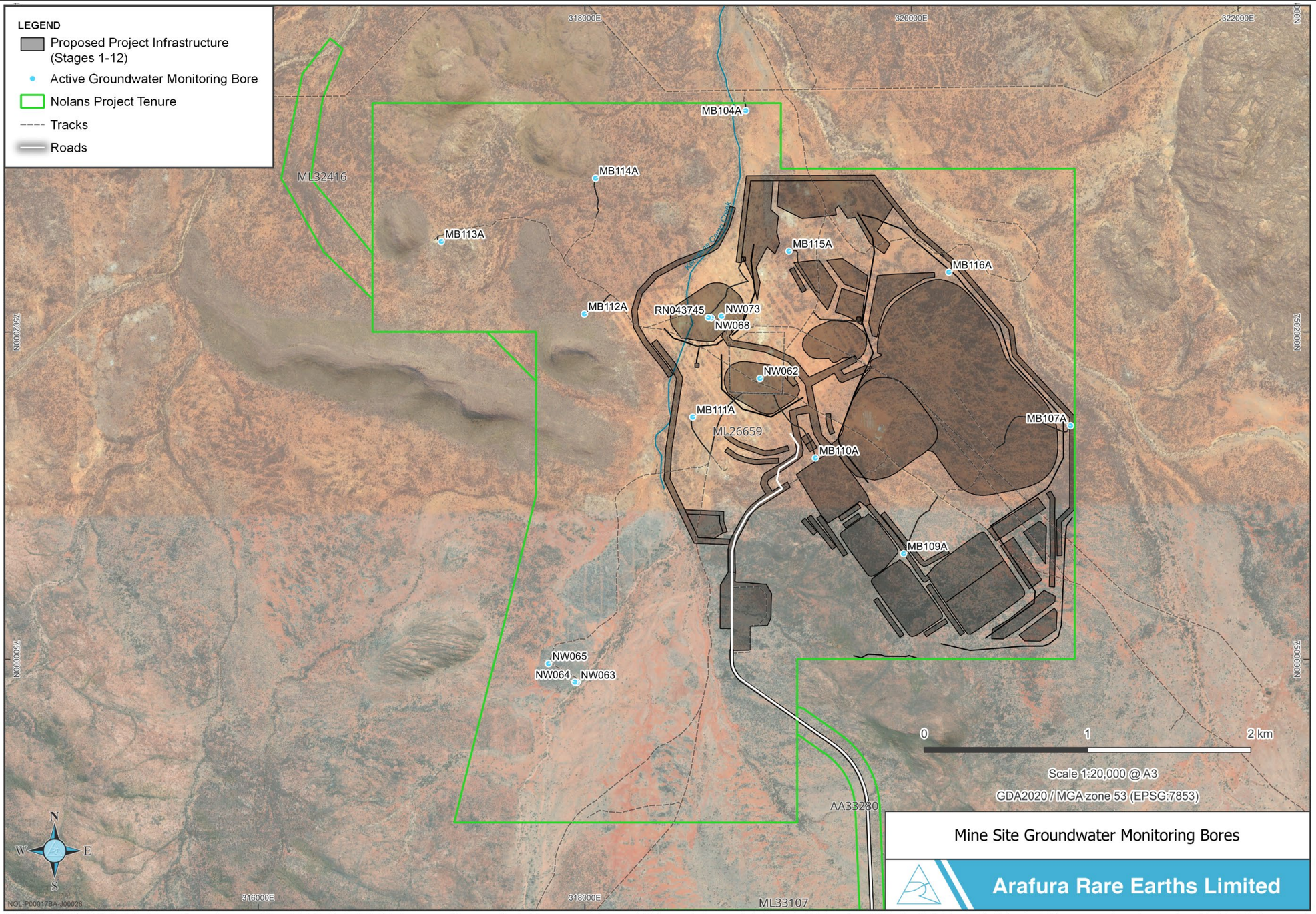
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Figure 1—9 Areas of Environmental Importance Surrounding Project Area



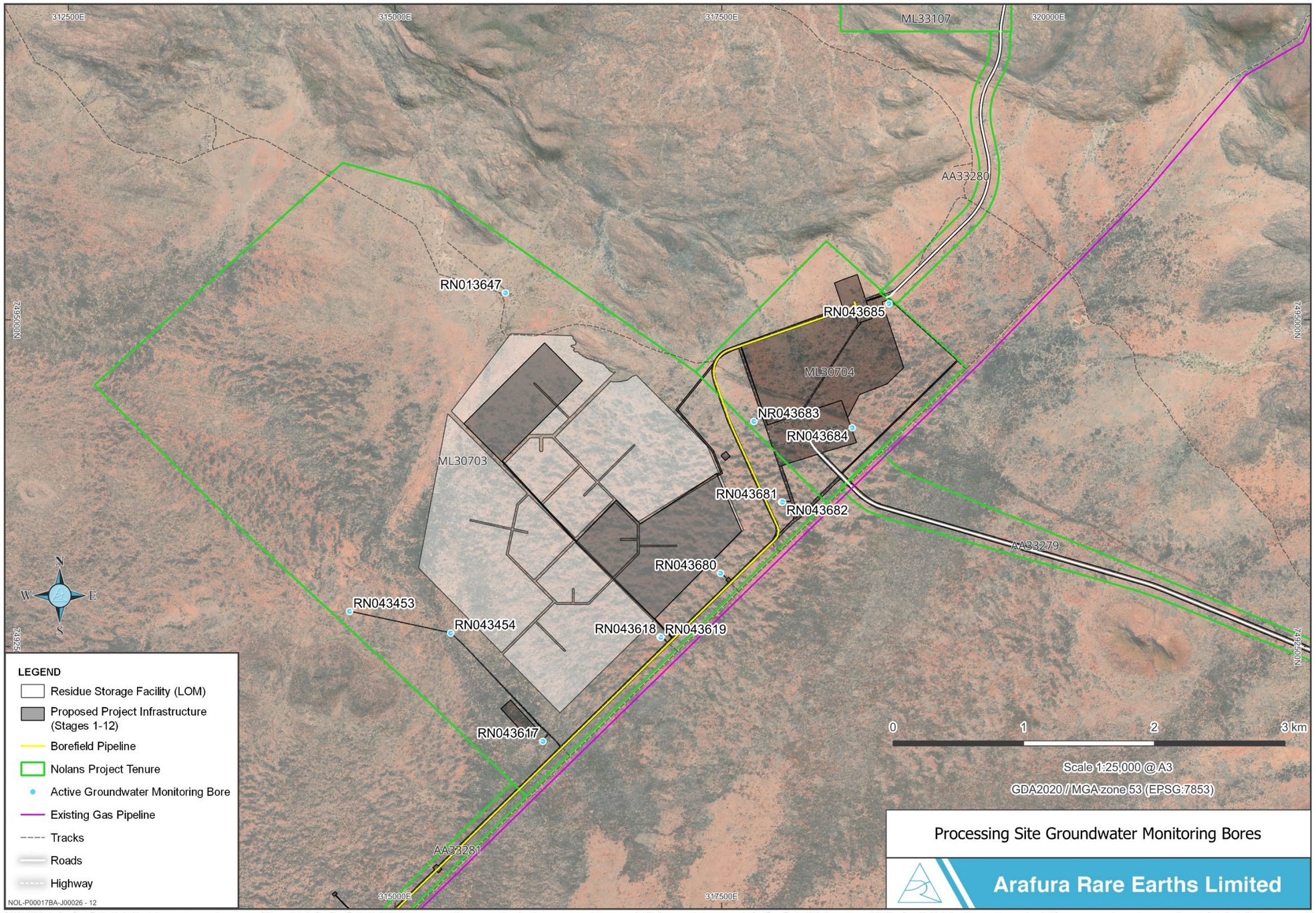
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Figure 1—10 Cultural Heritage Areas Designated by AAPA (C2024/012) and CLC (C2024-172)



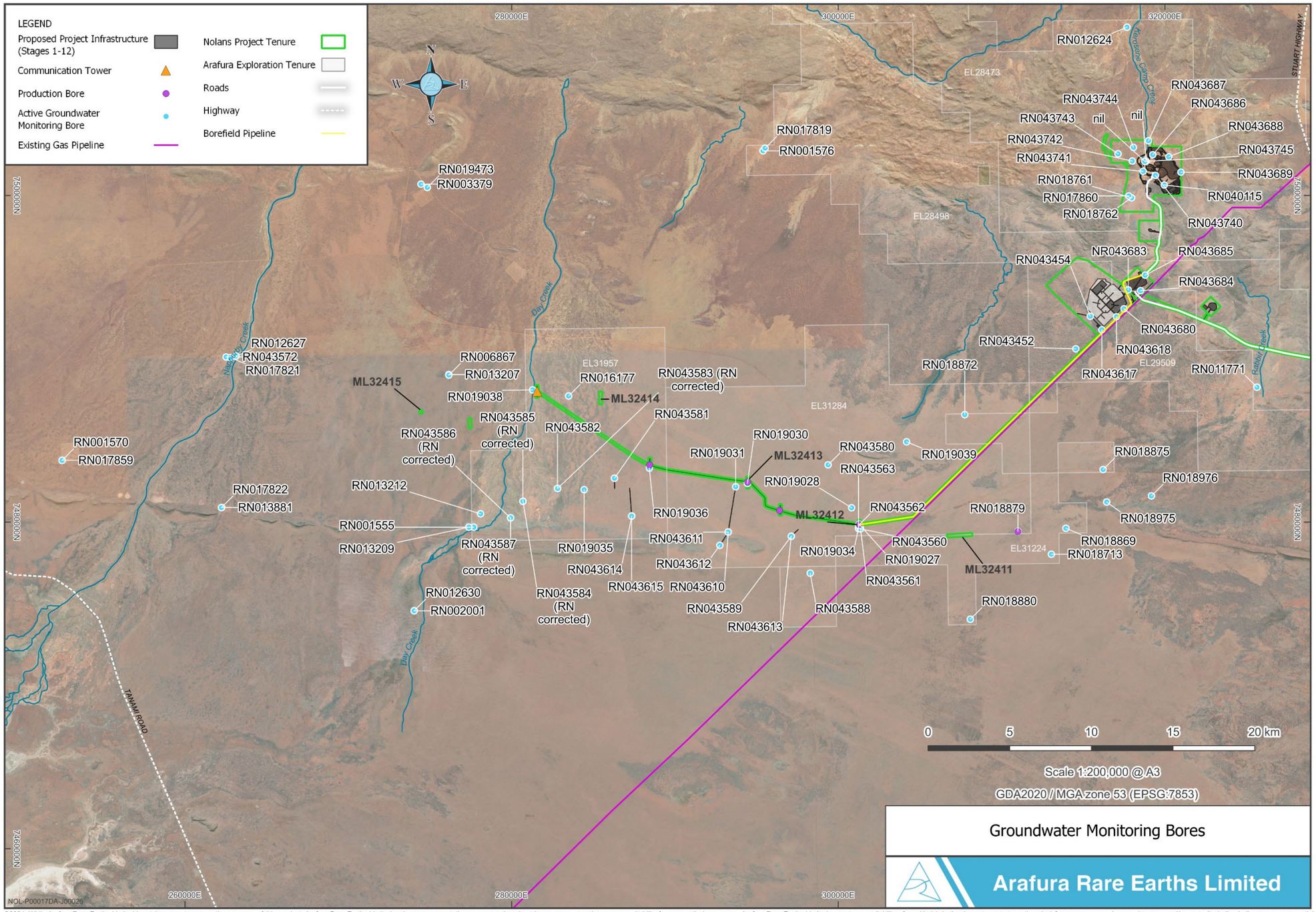
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Figure 1—11 Mine Site Groundwater Monitoring Bores



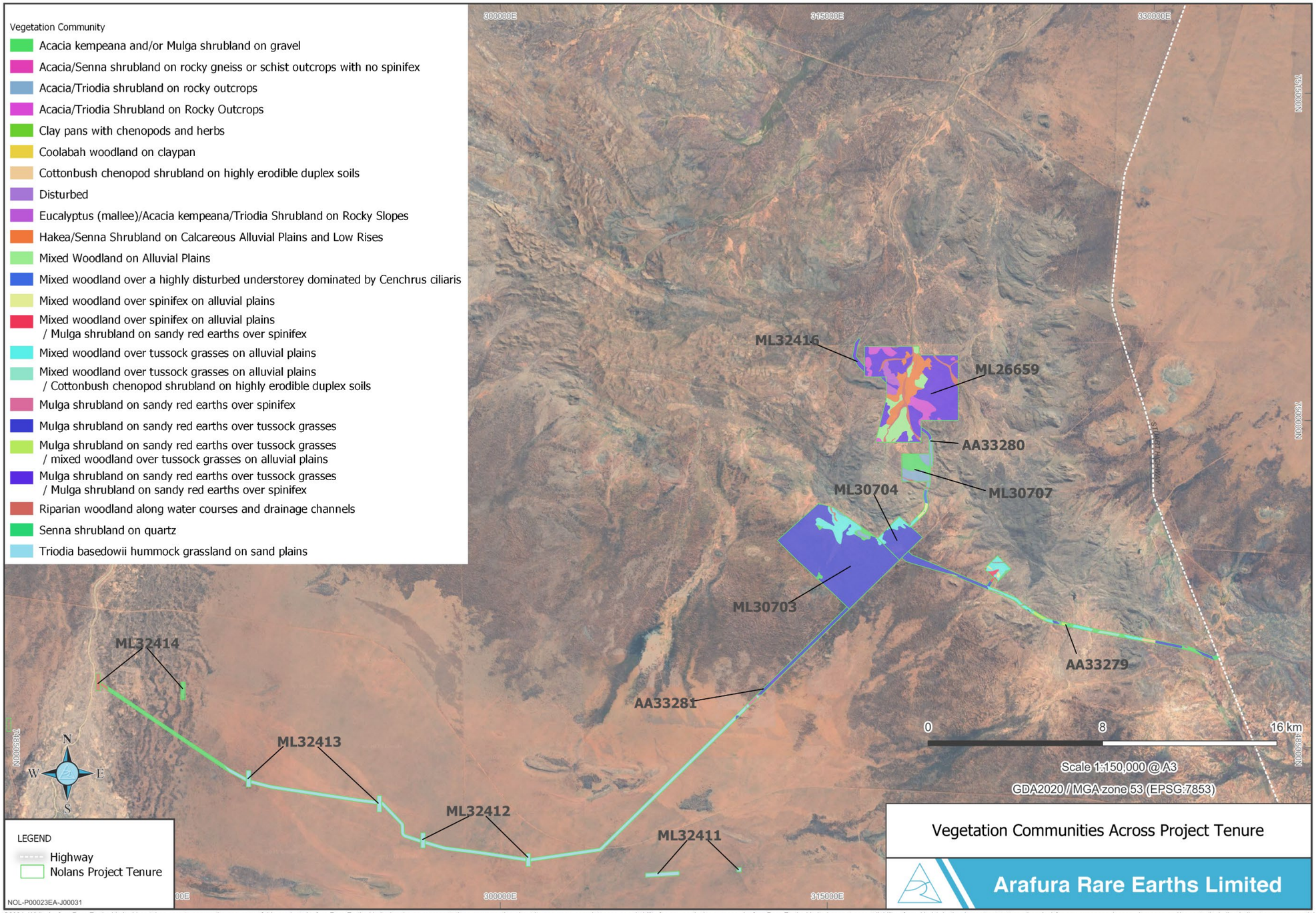
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Figure 1—12 Processing Site Groundwater Monitoring Bores



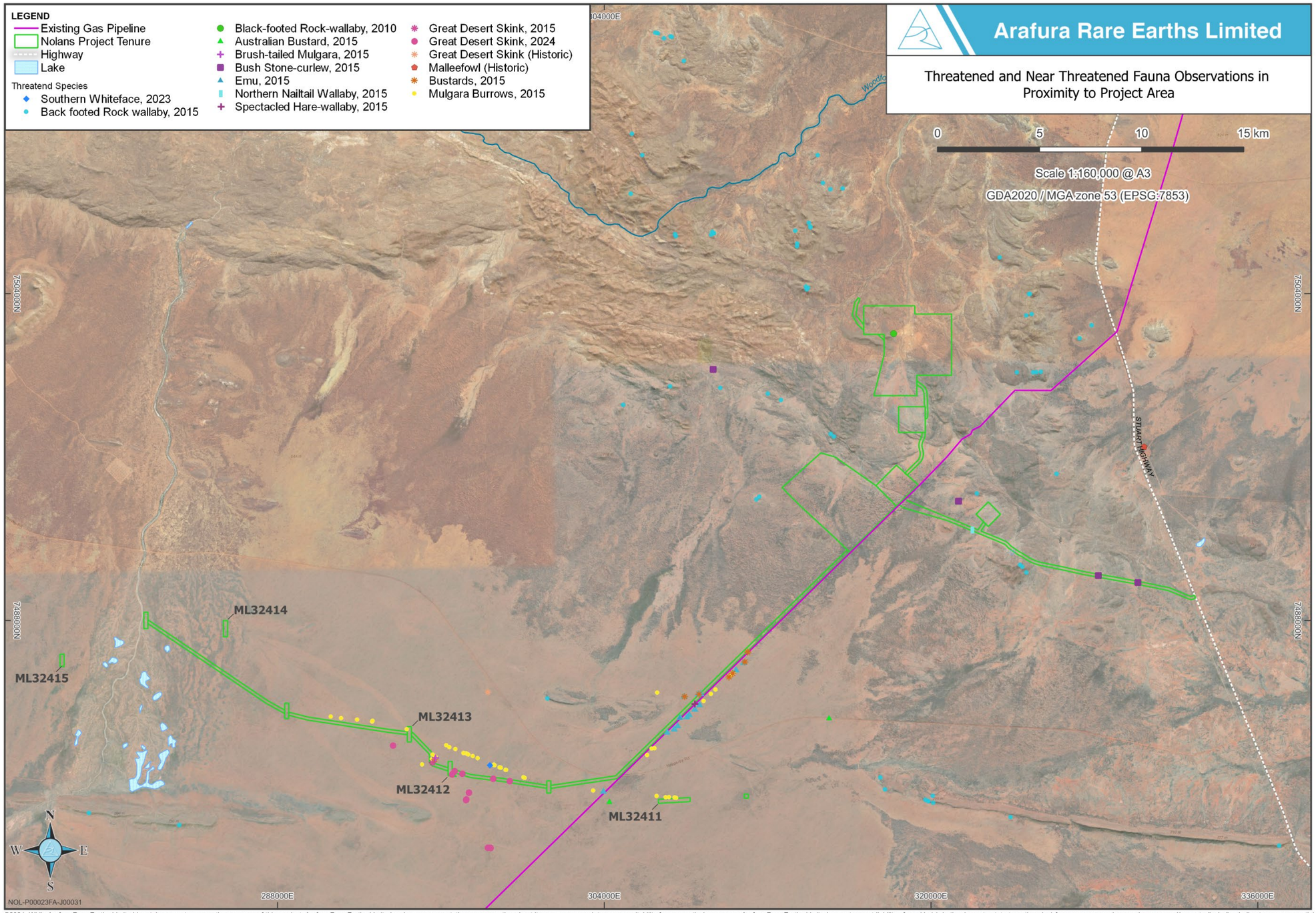
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Figure 1—13 Groundwater Monitoring Bores



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Figure 1—14 Vegetation Communities Across Project Tenure



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Figure 1—15 Threatened and Near Threatened Fauna Observations in Proximity to Project Area

1.3.2 Project Summary and Improvements

Following is a summary of the main milestones for the Project development to date:

- 2001 Exploration drilling.
- 2006 Cultural heritage and baseline environmental studies.
- 2012 Southern Basins groundwater exploration.
- 2015 Resource model upgraded to life of mine (LOM) 56Mt.
- 2016 Draft Environmental Impact Statement (EIS).
- 2017 Supplementary EIS.
- 2017 NT EPA Assessment Report 84.
- 2018 Definitive Feasibility Study.
- 2018 EPBC Approval for the Project subject to 14 conditions.
- 2019 NT EPA approval of the Section 14A variation.
- 2020 Native Title Agreement executed by the Project's native title holders (through their prescribed body corporates), the Central Land Council (CLC) and Arafura.
- 2020 and 2021 Primary mineral leases (MLs) for the Project granted.
- 2022 Access Authorities (AAs) granted for site access roads and water pipeline.
- 2022 and 2023 Licences to Take Groundwater granted.
- 2019 - 2023 CLC Sacred Sites Clearance Certificates for the Project areas granted.
- 2023 Mineral Lease (ML 33107) granted for the Explosives Magazine area.
- 2023 Extractive Mineral Permits (Extractive MPs) granted for gravel extraction pits.
- 2023 Groundwater monitoring bores installed.
- 2023 Early works construction completed.
- 2024 AAPA Certificate for the Project area granted.
- 2025 Permit to Interfere with a Waterway granted for Kerosene Camp Creek Stage 1 diversion.

No mining has occurred at the Project site to date. Early construction works were undertaken in 2023 as detailed in Section 4.1 of this document.

This variation to the MMP has been prepared to include the newly granted Access Authority areas and ML 33107 Explosives Magazine area, to reflect changes in Project layout and update with further detailed planning, and to include Project activities and progress to date.

2.0 SITE CONDITIONS

2.1 Physical Environment

The physical environment of the Project setting has been assessed as part of the following bodies of work:

- GHD, 2016, Nolans Project, Environmental Impact Statement (EIS), Arafura Resource Ltd, February 2016.
- GHD, 2017, Nolans Project, Environmental Impact Statement (EIS) – Supplementary Report, October 2017.
- GHD, 2019, Arafura Resources Ltd, Nolans Project Section 14A Notification, June 2019.

2.1.1 Climate

The study area climate consists of low rainfall and high summer maximum temperatures (average of 37°C) and low minimum winter temperatures (average 6°C), typical of the central Australian arid zone. Temperatures follow the expected seasonal pattern of cycling between warmer temperatures in the summer (peaking in December-January) and cooler temperatures (lowest in July) in the winter. Relative humidity is higher in summer and winter, whilst spring has the lowest humidity. Rainfall follows a seasonal trend of a wet season in the summer to early autumn months, and dry conditions for the rest of the year.

2.1.1.1 Precipitation

A detailed description of the precipitation patterns across the site is outlined in EIS Volume 2, Appendix K – Ground Water Report, Section 2.2 Study Area Climate: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_K_web.pdf)

Of note, the design climatic conditions used for sizing the residue storage facility (RSF) infrastructure is summarised in Table 2—1 which also presents the annual exceedance probability (AEP) and probable maximum precipitation (PMP) data for the Project area (KP, 2018). Likewise, the short duration storm rainfall depths are provided in Table 2—2.

Table 2—1 Design climate conditions (EA Amendment 14- KP RSF Design)

Item	Value (mm)
Annual Rainfall	
1 in 100 yr AEP Dry	30
1 in 100 yr AEP Wet	847
Design Storm Depth	
1 in 100 yr AEP 24 hr storm	196
1 in 100 yr AEP 72 hr storm	298
PMP 24 hr storm	670
PMP 72 hour storm	1,090
Annual Penmen Lake Evaporation	1,982

Short duration storm depth for a range of Average Reoccurrence Interval (ARI) were estimated using the Australian Government Bureau of Meteorology IFD Tool, as well as the methods as discussed in the Australia Rainfall and Runoff Guidelines (KP, 2018).

Table 2—2 Short Duration Storm - Rainfall Depth (EA Amendment 14 - KP RSF Design)

Storm Duration			Precipitation Depth (Mm) For AEP Storm Frequency (%)							
Min	Hour	Day	50%	20%	10%	5%	2%	1	0.5%	0.1%
5			7	11	13	16	19	22	25	33
10			11	17	20	24	30	34	38	51
15			14	21	26	30	37	42	48	64
30	0.5		19	29	35	42	52	59	67	89
60	1		24	37	46	55	68	78	89	118
180	3		34	51	63	76	93	108	123	163
	6		41	61	75	90	111	129	147	195
	12	0.5	50	74	92	109	135	156	178	236
	24	1	62	93	114	135	169	196	230	313
	48	2	76	116	144	172	218	255	300	413
	72	3	84	131	164	198	252	298	347	481
	168	7	95	153	196	242	308	362	427	592

The PMP rainfall depth for the site for a 24-hour event is estimated at 670 mm and for a 72-hour event at 1,090 mm, based on the Generalised Tropical Storm Method Revised Inland Zone as defined by the Australian Government Bureau of Meteorology (KP, 2018).

2.1.1.2 Evaporation

Evaporation is greatest during months of higher mean rainfall, with the highest average evaporation occurring in December and January at 375 mm per month. Rates of evaporation are significantly lower from May to August, coinciding with lower mean rainfall and temperatures. The annual average evaporation is 3,000 mm, approximately 850% greater than the annual average rainfall of 316.7 mm.

2.1.1.3 Wind

The prevailing wind direction is from the south-east with an average wind speed of 2.77 m/s, (~10 km/hr) remaining fairly constant throughout the year. There are also a small proportion of winds from the north-east. In terms of poor dust conditions, the incidence of light winds is important for poor dispersion while the strongest winds create the most wind erosion. This suggests sensitive receptors west and north-west of the site would be the most vulnerable.

A detailed description of wind speed, seasonal changes and direction is outlined in the EIS Volume 4, Appendix Q – Air Report, Section 2.3 Wind Dispersion: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_Q_web.pdf)

2.1.1.4 Seismic activity

Historical earthquake data was obtained from the Geoscience Australia earthquake database for the extended area surrounding the Project. The data includes all recorded earthquakes (M3.0 and above) within the region from June 1968 to November 2013. The earthquake database indicates that 11 earthquakes have occurred within 200 km of the site with earthquake magnitude in the range of 3.0 to 4.8, including a M4.8 event that occurred within 38.0 km of the site on 3rd August 1968, 3 earthquakes in the Geoscience Australia database have occurred within 100 km of the site, including a M4.8 event 96.0 km from the site. A M6.7 earthquake occurred 315.6 km of the site on the Tennant Creek strike slip fault on 22nd January 1988.

2.1.2 Land Systems

Land systems are described in Landloch (2021a) within the Baseline Soil Assessment for the Project, provided in APPENDIX Y. The Landloch (2021a) work uses broad scale CSIRO land systems mapping. This land systems mapping describes and groups land with a recurring pattern of topography, soil, and vegetation.

2.1.2.1 Topsoil and Subsoil

Topsoil and subsoil are described by Landloch (2021a) within the Baseline Soil Assessment for the Project at APPENDIX Y. The Landloch (2021a) report describes intrusive field-based assessments which has grouped the sites into four soil profile classes (SPC) and delineated these classes into three soil mapping units.

The Landloch (2021a) study concluded that all of the soils assessed within the three study areas present are more similar than they are different. They are all free drained, loamy, non-saline, non-sodic, low fertility, friable earths. The main difference that is likely to have management implications was the depth to parent rock, and the associated presence/absence of rock fragments within the soil profile.

SPC C differed from all the other soils in that it was calcareous throughout. However, the alkalinity of this SPC is within limits suitable for many plants and is unlikely to be a significant limitation to the land capability.

The soils are relatively stable if undisturbed. However, due to their highly weathered, kaolinitic mineralogy, their weak structure, their loamy texture, and their low organic matter content, they are susceptible to being physically degraded. Over-trafficking when wet are likely to lead to compaction. The soil is also likely to become powdery and loose if over worked.

With appropriate management, the soils of the study areas present few plant growth limitations.

2.1.2.2 Topography and Geology

The topography of the mine site and borefield has been outlined in the following documents:

- The topography of the area is outlined in the Erosion and Sediment Control Management Plan Section 3.2 (APPENDIX F).
- The geology of the area is outlined in the DFS Section 2: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_DFS_Summary_Report_-_Final_for_website.pdf)

2.1.3 Geology, Resources and Reserves

The Nolans rare earths-phosphate-uranium-thorium (REE-P-U-Th) deposit is one of the largest and most intensively explored deposits of its kind in the world.

A detailed discussion of the regional and deposit geology, along with mineralisation, are discussed in Section 2 of the Definitive Feasibility Study (DFS): (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_DFS_Summary_Report_-_Final_for_website.pdf)

The deposit contains a JORC 2012-compliant Mineral Resources of 56 million tonnes at an average grade of 2.6% total rare earth oxides (TREO) and 11% phosphate (P_2O_5) that extends beyond 215 metres below the surface (see Table 2—3 below). Two-thirds of the contained rare earths are in high confidence Measured and Indicated resources.

Table 2—3 Mineral Resources for the Nolans Deposit as of 7 June 2017 (1% TREO Cut Off)

Resources	Tonnes (Million)	Rare Earths TREO %	Phosphate P_2O_2 %	NdPr Enrichment %
Measured	4.9	3.2	13	26.1
Indicated	30	2.7	12	26.4
Inferred	21	2.3	10	26.5
TOTAL	**56**	**2.6**	**11**	**26.4**

Note: Numbers may not compute due to rounding. "NdPr enrichment" is the proportion of TREO comprising Nd_2O_3 and Pr_6O_{11}.

The most abundant rare earth-bearing minerals at Nolans are apatite, monazite (both phosphate minerals) and allanite (a silicate mineral). These mineral species present a highly desirable rare earth mix at Nolans, with 26.4% of the mix represented by NdPr oxides. The mineralised material also contains radioactive minerals of uranium and thorium, along with their decay chain daughters in equilibrium and is considered a naturally occurring radioactive material (NORM).

The host rocks are predominantly a mixture of gneisses and granites with the mineralogy of these rock units is typically dominated by quartz, feldspar and biotite. A portion of the host rocks are also NORM.

Both ore and host rocks are extremely low in sulphides. Waste rock characterisation is addressed in the EIS Volume 2, Appendix L – Acid, Metalliferous Drainage Report: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_L_web.pdf)

Ore reserves have been estimated for the Project compliant with the requirements of JORC code 2012. The ore reserves are based on the pit and mine designs along with the anticipated mining, process and administrative costs, forecast metallurgical performance and product revenue.

In addition to the ore reserves, the pit design also includes a portion of Inferred Mineral Resources which is included in the mining inventory in the Life of Mine (LOM) production schedule.

Table 2—4 below provides the current ore reserves estimate and the mining inventory for the Project.

Table 2—4 Ore Reserves (As of 16 March 2020) and Mining Inventory

Material	Mt	P_2O_5	TREO	NdPr in TREO
		(%)	(%)	(%)
Proved	5.0	12.7	3.0	26.2
Probable	24.6	12.3	2.7	26.5
Total Ore Reserve	**29.5**	**12.4**	**2.8**	**26.5**
Inferred	9.5	11.4	2.5	26.6
Total Mineral Inventory	**39.0**	**12.1**	**2.7**	**26.5**

Note: Numbers may not compute due to rounding. "NdPr enrichment" is the proportion of TREO comprising Nd_2O_3 and Pr_6O_{11}.

2.1.4 Flora and Fauna

The flora and fauna of the Project area is outlined in detail in the following documents:

- EIS Volume 1, Chapter 09 – Biodiversity: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Chapter_9_LOW_RES_web.pdf)
- EIS Volume 3, Appendix M – Biodiversity – Flora and Vegetation Report: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_M_web.pdf)
- EIS Volume 3, Appendix N – Biodiversity – Fauna and Threatened Species Report: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_N_web.pdf)

- EIS Supplement, Appendix 15 – Stygofauna Pilot Study (GHD, 2011): (https://www.arultd.com/wp-content/uploads/2023/01/Appendix-15_Stygofauna-Report_WEB.pdf)
- Aquatic Ecology Services, 2020 Nolans Bore Rare Earth Mine Southern Borefield Stygofauna Pilot Study

No Stygofauna were identified in any of the 7 bores investigated as part of the mine site assessment (GHD, 2011). Likewise, the field investigation which sampled 18 bores within the southern borefield and the margins area, concluded that stygofauna were not present in these shallow alluvial aquifers (Aquatic Ecology Services, 2020).

2.1.4.1 Fauna Surveys of Additional Tenure – Explosives Magazine, Site Access and Gravel Pits

In addition to the above fauna surveys, additional targeted fauna surveys were undertaken in 2024 for the below tenure that had not been previously surveyed (see APPENDIX DD). These tenements are referred to as the 'additional tenure'. These included:

- Explosives Magazine - ML 33107
- Site access road - AA 33279
- Mine access road - AA 33280
- Construction material gravel pits – Extractive MPs 33078-33084.

Extractive MPs 33078-33085 are included within the separate Mining Authorisation 1083-01, and the management of these gravel pits is described under the Nolans Construction Material Mine Management Plan approved under the current Variation of Authorisation 1083-01 granted 5 May 2023.

A threatened species assessment undertaken prior to the survey indicated that two threatened species have potential to occur within the additional tenure for the Nolans Project – the Central Australian Rock-wallaby and Southern Whiteface.

Fauna surveys conducted in February 2024 revealed the following:

- Central Australian Rock Wallaby - Targeted field surveys confirmed that the species does not currently inhabit the additional tenure areas, and that critical habitat is not present (due to absence of good quality den / shelter sites, absence or low abundance of important food plants, and generally high predator occurrence in the area).
- Southern Whiteface - Targeted field surveys did not record species presence, however, it has been recorded in the area (and is a highly mobile bird species). Potential habitat for roosting/nesting was not observed and is considered unlikely to occur within the proposed disturbance footprints due to absence of tree species that typically support tree hollows and crevices. The Project area could be used for foraging purposes; however habitat is of marginal quality due to cattle grazing and fire impacts, and there are ample areas outside of the Project area that also provide suitable foraging grounds. Minor disturbance to low quality foraging habitat will not impact the local occurrence or population of this species.

2.1.4.2 Vegetation

The vegetation of the Project area is outlined in detail in the following documents:

- EIS Volume 1, Chapter 09 – Biodiversity: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Chapter_9_LOW_RES_web.pdf
- EIS Supplement, Appendix 9 – Vegetation of Day Creek: (https://www.arultd.com/wp-content/uploads/2023/01/Appendix-09_Vegetation-of-Day-Creek_WEB.pdf)
- EIS Volume 3, Appendix M – Biodiversity – Flora and Vegetation Report: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_M_web.pdf)

2.2 Socio-Economic Environment

The background socio-economic environment of the surrounding communities is described in the EIS Volume 1, Chapter 15 – Socio-economics, providing the latest information gathered as part of the Project:
(https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Chapter_15_LOW_RES_web.pdf)

The risk and associated management measures to mitigate the potential to socio-economic risks is outlined in the EIS Volume 2, Appendix G – Risk Register Social:
(https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_G_web.pdf)
These risks are being captured and managed on an ongoing basis through the Environment and Social Risk Register.

The EIS Volume 6 also contains Appendix X_K – Social Impact Management Plan:
(https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_X_K_web.pdf)
This management plan will continue to be updated to remain current throughout the life of the Project.

2.2.1 Current Land Use

Traditional owners of the land on which Arafura will operate are Anmatjere people, with senior traditional owners living in the Alyuen, Ti Tree, Pmara Jutunta and Laramba communities and further afield in places such as Alice Springs. Aileron Pastoral Holdings Pty Ltd also hold background land tenure to the mine site, processing site, accommodation village and part of the borefield area under Aileron Perpetual Pastoral Lease (PPL 1097). The borefield also extends onto part of Napperby Station (PPL 1178). The predominant land use is cattle grazing.

2.2.2 Identified Stakeholders and Consultation

The EIS describes the consultation process and key themes raised during consultation in Volume 1, Chapter 6 – Consultation:
(https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Chapter_6_LOW_RES_web.pdf)

Additional information is presented in EIS Volume 2, Appendix H – Community Consultation Report:
(https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_H_web.pdf)

Stakeholder consultation issues will be registered using the template provided in APPENDIX U. The template records the following key pieces of information:

- Name and title of persons consulted, and issues discussed. The register will also aim to record any specific concerns raised during consultation, actions taken to address them and the current status of these matters.
- An outline of the ongoing arrangements and consultation process undertaken with the underlying landowners and managers, and other interested stakeholders, to ensure they are informed and that their concerns are considered.
- Issues raised, and other stakeholder consultation undertaken, will be recorded within Arafura's Stakeholder Engagement Management System, which is an online platform for recording and reporting stakeholder engagement. This is part of the broader Environmental and Social Management System developed. It will act as evidence of two-way communication with other relevant stakeholders and any key details of the agreed arrangements for maintaining the communication process throughout the life of the MMP.

Shown in Table 2—5 below is a snapshot of the key parties which are associated with the proposed activity are outlined below, these stakeholders will be reviewed upon the next revision of the MMP.

Table 2—5 Key Parties Associated with Proposed Activities

Key Parties	Titles
Lease Owner/Manager:	Perpetual Pastoral Lease Holders: • Aileron Station • Napperby Station • Pine Hill Station
Land Owner:	Northern Territory Government (NTG)
Land Claimants (Native Title)	Registered Native Title Bodies Corporate (RNTBC): • Kwaty Aboriginal Corporation RNTBC • Irretyepwenty Ywentent Pwert Aboriginal Corporation RNTBC • Alherramp Ilewerr Mamp Arrangkey Tywerl Aboriginal Corporation RNTBC.
Land Council representing the Traditional Owners for the country	Central Land Council
Neighbours and communities	Alyuen, Aileron, Laramba, Ti Tree, Parma Jututa
Tenement Manager	AMETS
Government Departments and Authorities	NT: • Aboriginal Areas Protection Authority (AAPA) • Department of Health (DoH) • Department of Housing, Local Government and Community Development (DHLGCD) • Department of Lands, Planning and

Key Parties	Titles
	Environment (DLPE) • Department of Logistics and Infrastructure (DLI) • Department of Mining and Energy (DME) • Department of Trade, Business and Asian Relations • NT Emergency Service • NT Environment Protection Authority (EPA) • NT Fire and Rescue Service • NT Police Force • NT Police, Fire and Emergency Services • Power and Water Corporation • NT WorkSafe Commonwealth: • Department of Climate Change, Energy, the Environment and Water (DCCEEW)
Tourism and recreation stakeholders	NA
Shareholders	TBC
Employees (internal)	All employees

2.2.3 Workforce Description and Demography

Arafura has completed a Territory Benefit Plan, APPENDIX W, which sets out how the Project will meet the following objectives:

- Boosting local workforce development and employment opportunities.
- Facilitating regional and Indigenous economic and community development.
- Encouraging local business participation and small to medium enterprise capability development.
- Enabling economic, industry and social infrastructure investment.

The Project is expected to employ the equivalent of up to 850 full time employees over the twenty-six months of the primary construction period. During this time, it is expected that Northern Territory personnel will be employed directly by Arafura and its contractors where possible.

During steady state operations, the Project will employ an average of 280 full time equivalent workers in each year over the 38 years of operation.

Arafura has a specific Local and Indigenous Engagement Strategy which outlines the approach and strategic priorities around both local and indigenous engagement into the Project. This strategy is provided as a reference in APPENDIX X.

3.0 STATUTORY AND NON-STATUTORY REQUIREMENTS

3.1 Statutory Requirements

The various components of the Project and how they will be managed and operated in accordance with commonwealth and state based statutory requirements are outlined in Table 3—1 Statutory Requirements. Environmental Management Plans (EMPs) have been developed in accordance with the relevant statutory requirements outlined in Table 3—1.

Table 3—1 Statutory Requirements

Legislation	Agency	EMP Reference	Comments
Commonwealth			
Aboriginal & Torres Strait Islander Heritage Protection Act 1984	Attorney-General's; Prime Minister and Cabinet	Cultural Heritage Management Plan (APPENDIX G)	Protects natural, historic and Indigenous heritage places that are of outstanding universal value, outstanding significance to the nation; or that are owned or controlled by the Australian Government. No sites or places within the Project area are currently listed on the registers of: • World Heritage List; • National Heritage List; or • Commonwealth Heritage List.
Aboriginal Land Rights (Northern Territory) Act 1976	Attorney-General's; Prime Minister and Cabinet	Cultural Heritage Management Plan (APPENDIX G)	Governs the grant and administration of Aboriginal land in the Northern Territory. The Land Rights Act empowers Land Councils to administer Aboriginal Land Trusts and provides that Land Councils are to consult traditional Aboriginal owners in relation to proposals that affect Aboriginal land. The Land Rights Act also mandates the protection of sacred sites. The Project area is within the administrative boundary of the CLC. However, the Project area is not located on Aboriginal freehold land. The CLC has recorded sacred sites in the Project area. A Native Title Agreement is signed and registered with National Native Title Tribunal, this has recently been updated, and registration is pending.
Environment Protection and Biodiversity Conservation Act 1999	Department of Climate Change, Energy, Environment and Water	Weed Management Plan (APPENDIX A) Biodiversity Management Plan (APPENDIX B)	Requires a person not to take an action that has or will have a significant impact on a Matter of National Environmental Significance (MNES) unless that action is approved. The Project was referred to the Commonwealth Department of the Environment and was determined that the action was a "controlled action" and required formal assessment and approval under the EPBC Act. Reasons included: ▪ the proposed action may affect listed threatened species and communities including the listed vulnerable Black-Footed Rock-Wallaby – MacDonnell Ranges Population, Greater Bilby and Great Desert Skink; and ▪ the proposed action is a nuclear action due to the presence of certain minerals. Approval for the Project was granted under the EPBC Act in May 2018. Management strategies must be implemented by the Proponent and oversighted and enforced by the relevant regulator throughout the life of the Project to deliver acceptable environmental outcomes.
Native Title Act 1993	Attorney-General's; Prime Minister and Cabinet	Cultural Heritage Management Plan (APPENDIX G)	Provides for the recognition and protection of Native Title. Establishes the National Native Title Tribunal, which administers rights and interests over lands and waters by Aboriginal people. There are three native title determinations covering the Project area: • DCD2013/001 – Lynch v Northern Territory of Australia [2013] FCA 636 – Napperby Perpetual Pastoral Lease - Alherramp Ilewerr Mamp Arrangkey Tywerl Aboriginal Corporation RNTBC ; • DC2017/001 – Ngwarray v Northern Territory of Australia [2017] FCA 337 – Aileron Pastoral Lease - Irretyepwenty Ywentent Pwert Aboriginal Corporation RNTBC; and • DC2017/002 – Penangk v Northern Territory of Australia [2017] FCA 336 - Aileron (Nolan's Bore) - Kwaty Aboriginal Corporation RNTBC (located on Pine Hill and Aileron Perpetual Pastoral Leases). In the Act, the grant of a mineral lease on an area where Native Title has been determined to exist (or is subject to a registered native title claim) is a future act and will trigger the 'right to negotiate' process. The granting of the Nolans MLs occurred in July 2020 and February 2021 triggered the 'right to negotiate'. The right to negotiate process requires good faith negotiations between the proponent, government party and Native Title party with a view to obtaining the agreement of the

Legislation	Agency	EMP Reference	Comments
			Native Title party to the doing of the future act subject to conditions. In some circumstances, as is the case with the Project, there may be more than one Native Title party. If agreement is reached, the negotiation parties will execute an agreement in accordance with the Native Title agreement (NTA) and the future act will be valid for the purposes of the NTA. A copy of such agreement is to be provided to the National Native Title Tribunal. The act also provides for Indigenous Land Use Agreements (ILUA) which are voluntary agreements between a native title group and others about the use of land and waters. These agreements allow people to negotiate flexible, pragmatic agreements to suit their particular circumstances. When registered, ILUAs bind all parties and all native title holders to the terms of the agreement. The NTA also mandates certain processes of notification, consultation and or consideration of comments in relation to other types of future acts. Notification is likely to be relevant to the Project in respect of infrastructure related mineral leases and access authorities. Arafura has undertaken negotiations and reached agreement with all native title parties, and a tripartite NTA and associated ILUA were executed by the native title holders (through their prescribed body corporates), the CLC, and Arafura in June 2020. The agreement has subsequently been renegotiated and updated to include the new Project areas and updates to project planning, as consistent with this MMP. The agreement variation was fully executed in January 2025, and is pending registration with the National Native Title Tribunal. The ILUA requires CLC Sacred Sites Clearance Certificates to be obtained for all Project areas to manage sacred sites. These have been obtained for all currently planned Project areas and activities consistent with this MMP.
National Environment Protection (Air Toxics) Measure	Department of Environment, Parks and Water Security	Air Quality and Dust Management Plan (APPENDIX C)	To facilitate management of air toxics in ambient air that will allow for the equivalent protection of human health and wellbeing by: ▪ Providing for the generation of comparable, reliable information on the levels of toxic air pollutants at sites where significant elevated concentration of one or more of these air toxics are likely to occur ▪ Establishing a consistent approach to the identification of such sites for use by jurisdictions. ▪ Establishing a consistent frame of reference ('monitoring investigation levels'-MILs) for use by jurisdictions in assessing the likely significance of levels of air toxics ▪ Adopting a nationally consistent approach to monitoring air toxics at a range of locations
National Environment Protection (Ambient Air Quality) Measure)	Department of Environment, Parks and Water Security	Air Quality and Dust Management Plan (APPENDIX C)	Establishes national ambient air quality standards and a national framework for the monitoring and reporting of six common air pollutants, including ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2).
National Greenhouse and Energy Reporting Act 2007	Clean Energy Regulator	Air Quality and Dust Management Plan (APPENDIX C)	Corporate entities, corporate groups or entities that have operational control of facilities are required to be registered and report emissions and energy use if such emissions or use exceeds statutory thresholds contained in the Act.
	National Environment Protection Council	Air Quality and Dust Management Plan (APPENDIX C)	The purpose of NEPC is to ensure that: ▪ Australians enjoy the benefit of equivalent protection from air, water or soil pollution and from noise wherever they live; and ▪ Business decisions are not distorted, and markets are not fragmented by variations in major environment protection initiatives between member governments. NEPC creates National Environment Protection Measures (NEPMs) on:

Legislation	Agency	EMP Reference	Comments
			▪ Ambient air quality; ▪ Ambient marine, estuarine and freshwater quality; ▪ The protection of amenity in relation to noise; ▪ General guidelines for the assessment of site contamination; ▪ Environmental impacts associated with hazardous wastes; ▪ The re-use and recycling of used materials; and ▪ Motor vehicle noise and emissions. The Air NEPM sets air quality standards that are legally binding on each level of government. Jurisdictions put strategies in place to reduce emissions and to achieve the standards set out. The standards relate to six criteria air pollutants: carbon monoxide, nitrogen dioxide, photochemical oxidants, sulfur dioxide, lead and particles. Ambient Air Quality NEPM standards have been adopted for the Project.
Northern Territory Specific			
Bushfires Management Act 2016	Department of Environment, Parks and Water Security	Biodiversity Management Plan (APPENDIX B)	Relates to the prevention and suppression of bushfires. The fundamental principle established by the Act is that the responsibility for bushfire management rests with the landholder. In the event the Project requires controlled burning the company shall seek a permit through Bushfires NT. If site is situated outside the emergency response area, fire management is required to prevent impacts on property, industry and environment.
Environmental Offences and Penalties Act 1998	NT Environmental Protection Agency	Biodiversity Management Plan (APPENDIX B) Kerosene Camp Creek Management Plan (APPENDIX P)	Establishes penalties for certain offences under prescribed Acts, and for related purposes. Applies to both individuals and corporate entities. If found in breach of any relevant act – penalties will apply.
Fire and Emergency Act 1996	Northern Territory Fire and Rescue Service (NTFRS)	Fire Management Plan (EIS Volume 5, Appendix X_G)	Provides for the requirement to cooperate with NT Fire and Rescue Services in responses to fires and other emergencies and investigations within designated emergency response areas. Also requires compliance with a law for the prevention of fire or the protection of the public from danger arising from fire.
Fire and Emergency Regulations 1996	Northern Territory Fire and Rescue Service (NTFRS)	Fire Management Plan (EIS Volume 5, Appendix X_G)	Regulations under the Fire and Emergency Act 1996 for firebreaks; accumulation of combustible material; stacked materials; flues; cutting, heating and welding equipment; oily waste, emergency and evacuation planning, accommodation parks and smoke alarms.
Dangerous Goods Act 1998	NT WorkSafe	Hazardous Materials Management Plan (APPENDIX E)	Applies to the movement and handling of explosives, fuel and gas. Arafura will obtain licences for storage or transportation of any dangerous goods.

Legislation	Agency	EMP Reference	Comments
Heritage Act 2011	Department of Industry, Tourism and Trade	Cultural Heritage Management Plan (APPENDIX G)	Provides a system for the identification, assessment, protection and conservation of the Northern Territory's natural and cultural heritage. If any archaeological places or objects are to be disturbed, work must cease until permission is sought to carry out work on the heritage place or object. An application must be made with the consent of the owner of the place or object. Includes blanket protection for Aboriginal and Macassan archaeological places and objects across the NT, and other places, classes of places, or objects which the Heritage Council considers to be of heritage significance, which are then listed in the Northern Territory Heritage Register and Archaeological Site Register There are three declared heritage places in the vicinity of the subject area. There are also a number of sites containing artifacts which may be impacted by planned Project activities which will require approval under the Heritage Act.
Mining Management Act 2001	Department of Industry, Tourism and Trade - Mines Division	Weed Management Plan (APPENDIX A) Biodiversity Management Plan (APPENDIX B) Hazardous Materials Management Plan (APPENDIX E)	*Up until 1 July 2024:* Regulates mining activities and the management of mining sites. The legislation is administered by the DITT. An operator of a mining site requires an authorisation under the Act. An application for an authorisation must include an MMP. The MMP must describe the mining activities proposed and management systems to protect the environment, health and safety, details of ownership, plans for the mine workings and infrastructure, and a plan and costing of closure activities. An operator who carries out mining activities under an authorisation must provide a security to the Minister to secure compliance with the Act and cover the costs and expenses of preventing, minimising or rectifying environmental harm caused by mining activities. Following 1 July 2024, the *Environment Protection Legislation Amendment Act 2023* comes into effect which establishes a new environmental licensing framework for managing environmental impacts of mining activities under the *Environment Protection Act 2019* (see below).
Northern Territory Aboriginal Sacred Sites Act 1989	Aboriginal Areas Protection Authority (AAPA)	Cultural Heritage Management Plan (APPENDIX G)	Protects sacred sites by establishing a procedure for the registration of sacred sites and establishing a procedure for the avoidance and/or protection of sacred sites in the development and use of land. Under the Act, an Authority Certificate can be issued by the Aboriginal Areas Protection Authority (AAPA) that provides legal indemnity against possible prosecution in relation to damage to sacred sites resulting from the works or uses covered by the certificate, so long as any conditions imposed are followed. AAPA administers authority certificates in consultation with the relevant custodians under the Act. AAPA certificates have been granted for the Project for all areas except the new tenure. An application is currently being assessed by AAPA to include the new tenure areas.
Environment Protection Act 2019	Department of Environment, Parks and Water Security	Biodiversity Management Plan (APPENDIX B) Kerosene Camp Creek Management Plan (APPENDIX P) Water Management Plan (APPENDIX R)	Establishes the Northern Territory Environment Protection Authority (NT EPA) as an independent regulatory authority with duties and functions under the *Waste Management and Pollution Control Act and the Environmental Assessment Act 1998*. Assessment by the NT EPA is required for projects with the potential to have a significant impact on the environment. This Project has been assessed by the NT EPA, with recommendations provided in an Assessment Report completed in December 2017, and variation completed in September 2019, as further detailed in Section 3.1.1 below. *From 1 July 2024:* An Environmental (Mining) Licence will be required for all new mining activities. This will be administered by DEPWS. This replaces the need for a Mining Authorisation previously required under the *Mining Management Act 2001*.
Planning Act 1999	Department of Infrastructure, Planning and	Kerosene Camp Creek Management Plan	Establishes a system to facilitate planning for the orderly use and development of land.

Legislation	Agency	EMP Reference	Comments
	Logistics	(APPENDIX P)	
Soil Conservation and Land Utilisation Act 1969	Department of Environment, Parks and Water Security	Biodiversity Management Plan (APPENDIX B) Air Quality and Dust Management Plan (APPENDIX C) Kerosene Camp Creek Management Plan (APPENDIX P)	Erosion & Sediment Control Plan and Mine Closure Plan to meet objectives of this Act. Prevent soil erosion and conserve and reclaim the soil. Site specific plans have been developed for the Project to meet these requirements and will be updated as the Project progresses (see APPENDIX F and APPENDIX S).
Territory Parks and Wildlife Conservation Act 1976	Department of Environment, Parks and Water Security	Weed Management Plan (APPENDIX A) Biodiversity Management Plan (APPENDIX B)	Protects Territory parks and reserves, animals and plants (including wildlife and protected wildlife). The Act prohibits the intentional killing of any terrestrial or marine vertebrate or the taking of and interference with protected species of wildlife (with the exception of fish). All threatened species are classed as protected wildlife. It includes "Principles of Management" which requires that a threatened species be managed in a manner that "maintains or increases their population or the extent of their distribution at or to a sustainable level". Threatened species are defined under the regulations as being species that are 'extinct", "critically endangered", "endangered" and "vulnerable". It also lists those species of plants and animals that are protected within the Northern Territory. Under the Act, permits will be required to take or interfere with protected plants or animals. This may apply if protected plants or animals are encountered during the Project's life.
Ti-Tree Water Allocation Plan 2019-2020 (Draft)	Department of Environment, Parks and Water Security	Kerosene Camp Creek Management Plan (APPENDIX P)	The water allocation plan, which applies to all surface water and groundwater within the Ti-Tree Water Control District (TTWCD). It establishes an adaptive management framework for the allocation of water resources and the regulation of licensed water use. Its purpose is to ensure water resources are managed in a way that recognises and maintains environmental and cultural values while allowing water to be sustainably used for productive consumptive beneficial uses
Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act 2010	Department of Infrastructure, Planning and Logistics	Hazardous Materials Management Plan (APPENDIX E)	Regulates the transport of dangerous goods on land in order to promote public safety and protect property and the environment. The movement and handling of chemicals outside of workplaces is governed by the Act The Act creates certain offences in relation to the movement of dangerous goods including: ▪ Failure to hold a dangerous goods driver's licence; ▪ Transporting goods too dangerous to be transported; and ▪ Failure to transport dangerous goods in a safe way. ▪ The Regulations also creates a number of specific offences, including: ▪ The sale or supply of dangerous goods in non-compliant packaging: ▪ Labelling dangerous goods incorrectly; and ▪ Failure to segregate dangerous goods from food or food packaging. This legislation applies to the Project as dangerous goods will be handled and transported during construction and operation of the Project.

Legislation	Agency	EMP Reference	Comments
Water Act 1992	Department of Environment, Parks and Water Security	Kerosene Camp Creek Management Plan (APPENDIX P) Water Management Plan (APPENDIX R)	Establishes the process for the investigation, allocation, use, control, protection, management, and administration of water resources. A recent amendment to the Water Act now requires mining activities to hold a licence to take surface or groundwater; and a permit to construct or alter works that interfere with a waterway; where they are applicable. Arafura was granted two Licences to take Groundwater: • L10010 granted 25/08/22 to dewater the Nolans orebody for mine access; and • L10013 granted 21/03/2023 to extract water from the Reaphook Paleovalley Aquifer to meet Project water requirements. Arafura has been granted a permit to interfere with a waterway (IWW: KCC-001) issued 26 March 2025. This is for works to divert Kerosene Camp Creek (KCC) within the planned mining area. Stage 1 of the diversion works were applied for and approved, which is for the scope of mining activities described in this MMP. A copy of the permit and permit decision has been provided to DEPWS Mining Division for reference. The updated Kerosene Camp Creek Management Plan approved under the permit is now included at APPENDIX P. Stage 2 of diversion works will be for mining stages beyond the scope of this MMP. The permit and this MMP will be updated before undertaking any Stage 2 works.
Waste Management and Pollution Control Act 1998	Department of Environment, Parks and Water Security	Hazardous Materials Management Plan (APPENDIX E)	Primary piece of environmental protection legislation in the Northern Territory. The Act: ▪ imposes general environmental duties; ▪ requires the licensing of certain activities; ▪ establishes offences relating to the environment; and ▪ contains material enforcement, penalty and extension of liability provisions. The Act does not apply to a contaminant or waste resulting from a mining activity (as that term is defined in the *Mining Management Act 2001*) that is confined within the land on which the mining activity is being carried out.
Weeds Management Act 2001	Department of Environment, Parks and Water Security	Weed Management Plan (APPENDIX A) Biodiversity Management Plan (APPENDIX B)	Aims to prevent the spread of weeds and to ensure that the management of weeds is an integral component of land management. The legislation requires that reasonable attempts be made to control or eradicate declared noxious weeds. Categories of noxious weeds include the following: • Schedule Class A/C Weeds: - These plants do not occur in the NT but pose a significant threat if they invade or if present, pose a serious threat. Reasonable effort must be made to eradicate these weeds; • Schedule Class B/C Weeds: -These weeds often occur widely in the NT. They are capable of spreading further and should be prevented from doing so. Continuing control measures are required to prevent their spread. Reasonable attempts must be made to contain the growth and prevent the movement of these plants; and • Schedule Class C Weeds: -This category includes plants that pose an unacceptable risk of spreading in the Territory or to other parts of Australia if they were to be sold or traded in the NT and are a serious threat to another State or Territory of Australia. All schedule Class A and B weeds are considered to be Class C weeds. The manager of the Project site will be responsible for the management of weeds in accordance with the Act. Weed monitoring and control activities will be implemented on site as outlined within the Project Weed Management Plan (APPENDIX A).

Legislation	Agency	EMP Reference	Comments
Work Health and Safety (National Uniform Legislation) Act 2011	NT WorkSafe	Air Quality and Dust Management Plan (APPENDIX C) Hazardous Materials Management Plan (APPENDIX E) Emergency Response Management Plan (APPENDIX I)	The Act and Regulations control health and safety in the workplace, and apply to the use, handling and storage of hazardous chemicals at a workplace. The Act also requires incident notification and compliance with health and safety duties. An operator of a proposed facility is required to notify NT WorkSafe of circumstances where Schedule 15 chemicals are likely to be present in a quantity that exceeds 10 per cent of their threshold quantity. The regulator will then make a Major Hazard Facility (MHF) determination. If a facility is determined to be an MHF, the operator is required to submit a 'Safety Case Outline' and later a 'Safety Case' which demonstrate the adequacy of the operator's safety management and control measures. Once satisfied, the regulator will issue an MHF Licence with conditions for the safe transport, handling, storage, and use of chemicals, as well as event response and notification. Arafura have consulted with NT WorkSafe and drafted an MHF Notification and 'Safety Case Outline', and is currently finalising engineering and process flow sheets against an MHF gap analysis. Once complete and the Final Investment Decision (FID) is made for the Project, Arafura will notify the regulator, and if determined to be an MHF, submit the 'Safety Case Outline' and commence the MHF approval process. If determined to be an MHF, an MHF Licence will be required prior to transport of the specified chemicals to site, and commissioning of the processing plant.

3.1.1 NT EPA Assessment

The NT EPA completed its environmental impact assessment of the Project in December 2017. Its findings are contained in an Assessment Report (that includes recommendations) as advice to the Northern Territory Ministers for Environment and Natural Resources, and Primary Industry and Resources, for consideration in environmental approval decisions to be made by the NTG.

The NT EPA's report was provided to the Australian Government's Department of the Environment and Energy (DoEE) to inform its assessment and approvals process under the EPBC Act (now administered by the Department of Climate Change, Energy, the Environment and Water, DCCEEW). The DoEE completed its assessment and granted an approval to Arafura in May 2018 subject to 14 conditions.

Subsequent changes to the planned configuration of the Project required the completion of a Section 14A variation under the Northern Territory's Environmental Assessment Administrative Procedures. This was submitted to the NT EPA in June and August 2019. The NT EPA assessed the variation and in a Statement of Reasons document released in September 2019 determined that no further action was required.

In addition, a summary of the licence, approvals and / or permits that have been granted as per the requirements of statutory legislation is outlined in Table 3—2. Granted MLs are listed in Table 1—1.

Table 3—2 Project Licence / Approval / Permits

Legislation	Licence / Approval / Permit Reference
Native Title Act 1993	There are three native title determinations covering the Project area: • **DCD2013/001** – Lynch v Northern Territory of Australia – Napperby Perpetual Pastoral Lease – Alherramp Ilewerr Mamp Arrangkey Tywerl Aboriginal Corporation RNTBC • **DCD2017/001** – Ngwarray v Northern Territory of Australia – Aileron Pastoral Lease – Irretyepwenty Ywentent Pwert Aboriginal Corporation RNTBC • **DCD2017/002** – Penangk v Northern Territory of Australia – Aileron (Nolan's Bore) – Kwaty Aboriginal Corporation RNTBC (located on Pine Hill and Aileron Perpetual Pastoral Leases). Arafura entered into an NTA/ILUA with the three RNTBCs and the CLC in June 2020, titled Nolans Project Native Title Agreement. The CLC granted Arafura a number of Sacred Sites Clearance Certificates for the Project area between 2019 – 2023 for various Project areas and scopes of works as follows: • C2019-105 (Nolans Project area) • C2021-107 (Extractive mineral exploration) • C2022-080 (site and mine access roads) • C202032 (groundwater monitoring bores) The NTA/ILUA and Project area CLC Sacred Sites Clearance Certificates were updated in 2024 to include the new tenure areas and current scope of

Legislation	Licence / Approval / Permit Reference
	planned works.
Aboriginal Sacred Sites Act 1989	AAPA Certificates issued in 2008 (C2008/205) and 2013 (C2013/205) for exploration works have expired. A new certificate was issued 2024 (C2024-12) for mining activities. An application to amend C2024-12 to include the new Project areas and reflect the updated NTA/ILUA and CLC Sacred Sites Clearance Certificates was made in 2024, and is under assessment by AAPA.
Mining Management Act 2001	Mining Authorisation 1127-1 for the Nolans Rare Earths Project (the subject of this MMP) was issued 10 November 2022, and Variation of this Authorisation was issued 14 April 2023 to include additional groundwater monitoring bores. Mining Authorisation A0192-02 (exploration) for the Nolans Bore Project (groundwater monitoring bores) was also previously granted. The scope of these works is included in a separate MMP. Mining Authorisation 1083-01 for the gravel extraction pits was granted, and Variation of Authorisation granted 05 May 2023. The scope of these works is included in a separate MMP.
Water Act 1992	Arafura has been granted two Licences to take Groundwater within the Project area. Each licence contains conditions relating to extraction limits and water monitoring, management, and reporting. L10010 was granted 25 August 2022 to dewater the Nolans orebody for mine access. L10013 was granted 21 March 2023 to extract water from the Reaphook Paleovalley Aquifer to meet Project water requirements. Arafura was granted a Permit to Interfere with a Waterway for the Kerosene Camp Creek stage 1 diversion on 26 March 2025.
Environment Protection Act 2019	The NT EPA completed its environmental impact assessment of the Project in December 2017. Its findings are contained in Assessment Report 84, which outlines a detailed environmental impact assessment of the Project, and includes 16 recommendations for management of the Project. These recommendations have been considered by DITT and DEECCW within the subsequent conditions of Mining Authorisation and EPBC approvals.
Environment Protection and Biodiversity Conservation Act 1999	Approval for the Project was granted under the EPBC Act in May 2018. With a variation issued 24 October 2024. The updated approval contains 54 Conditions of approval for ongoing management of potential impacts to threatened species, and from radioactivity, within the Project area.

3.1.1.1 Environmental Impact Self-Assessment of Additional Tenure – Explosives Magazine, Site Access and Gravel Pits

The locations of the explosives magazine, access authority areas for the current alignment of the Site Access Road (SAR) and Mine Access Road (MAR) areas, and gravel extraction activities (additional

tenure) were proposed in the EIS and these areas have been further defined as the Project has progressed through to its current configuration.

Arafura undertook a self-assessment (see APPENDIX EE) to determine whether impacts on environmental values specific to the additional tenure areas (in addition to those assessed for the Nolans Project by the EIS) are considered significant or not, and whether they require referral for assessment to the NT EPA and/or Commonwealth under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The assessment took into account the EIS recommendations, MMP and EPBC conditions of approval, a site-specific survey validating habitat assessments, and a protected species likelihood of occurrence assessment. The ecological site-specific survey of the additional tenure areas was undertaken by EcOz Environmental Services in February 2024 as part of this assessment (see Section 2.1.4.1 of this MMP and APPENDIX DD).

The assessment also took into account the following regulatory guidance:

- The NT EPA screening tool which assists proponents in determining whether a proposed action requires formal referral under the EP Act.
- EPBC guidance on self-assessments.

Definition of Significant Impact

The definition of a significant impact under the *Northern Territory Environment Protection Act 2019* (EP Act) defines a significant impact as: "A significant impact of an action is an impact of major consequence having regard to:

(a) the context and intensity of the impact; and

(b) the sensitivity, value and quality of the environment impacted on and the duration, magnitude and geographic extent of the impact".

The NT EPA guidance on referral of a proposal (NT EPA, 2021a) outlines how the NT EPA determines that environmental impact assessment of a proposal is not required. The NT EPA will consider the proposal in terms of its potential for significant environmental impacts. In its consideration, the NT EPA will examine:

- Context and intensity of the impact
- Duration, magnitude and geographic extent of the impact and
- Sensitivity, value and quality of the environment impacted on.

Environmental impact assessment is unlikely to be required where:

- The type of proposal is not considered hazardous in nature.
- Environmental impacts from activities associated with a proposal are readily understood.
- The potential impacts are limited in extent and duration.

- Environmental values and sensitivities are not present or are unlikely to be significantly impacted by proposed activities.
- Impact mitigation is readily available and proven to be effective in limiting significant impacts to the environment.
- Relevant stakeholders have been identified and engaged.

The additional tenure activities undertaken are not considered to align with the above Significant Impact criteria.

Commonwealth Government – Matters of National Environmental Significance Screening

Under the EPBC Act an action will require approval from the Commonwealth Minister if the action has, will have, or is likely to have, a significant impact on a Matter of National Environmental Significance (MNES). A search of the Commonwealth Protected Matters Search Tool (PMST) was undertaken for the additional tenure areas, as well as an assessment of the likelihood of threatened and migratory species to occur within these areas. The details of this assessment are presented in APPENDIX DD and APPENDIX EE. The MNES screening tool helps to assess what species should be included in target surveys, and these included the following:

- Southern Whiteface – There are proximate records, including those from baseline studies. Suitable habitat is present within the development area, and the broader region. The development area could be used for foraging purposes; however, habitat is of marginal quality due to cattle grazing and fire impacts, and there are ample areas outside of the development area that also provide suitable foraging grounds.
- Warru, Central Australian Rock-wallaby – Numerous records in the general area. Previous targeted surveys in 2015 and 2022 did not detect the species within the current development area (noting that not all areas were checked). Potential for suitable habitat within the current development area (i.e. rocky hills) (requires site assessment to confirm habitat suitability). The isolated nature of the rocky hills within the current development area may reduce habitat suitability due to increase predation pressure from surrounding plains (cat and fox are known to occur in the area).

No MNES were identified during the ecological survey of the of the additional tenure that was undertaken in February 2024.

The conclusion of the environmental impact self-assessment for the additional tenure, including the explosives magazine and site access road areas, and gravel pits, is that the disturbance is not significant (noting the cumulative disturbance of threatened species habitat does not exceed that already approved for the development, as described in the EPBC conditions of approval) and does not require further referral. The mitigation of environmental impacts can be managed through amendments of the Mine Management Plan and existing mitigation measures.

3.2 Non-Statutory Obligations

The management of the operations of the Project have been developed with general consultation of the non-statutory obligations and guidelines outlined in Section 9.2.

3.3 Sacred, Archaeological and Heritage Sites

The Project area is within the administrative boundary of the CLC. The CLC and the Aboriginal Areas Protection Authority have recorded sacred sites in the Project area, however the Project area is not located on Aboriginal freehold land (Figure 1—10). There are three native title determinations covering the parts of Project area which have all been determined:

- DCD2013/001 - Napperby Perpetual Pastoral Lease - Alherramp Ilewerr Mamp Arrangkey Tywerl Aboriginal Corporation.
- DCD2017/001 - Aileron Pastoral Lease - Irretyepwenty Ywentent Pwert (IPY) Aboriginal Corporation.
- DCD2017/002 - Aileron (Nolan's Bore) - Kwaty Aboriginal Corporation.

A Sacred Site Clearance Certificate C2024-172 was issued by the Central Land Council on 25 October 2024 which covers the entire Project site, and is up to date with current Project planning.

3.3.1 Sacred Sites

Within the Project area, a Restricted Works Area associated with a Sacred Site has been designated by AAPA within the previous alignment of the access road and service corridor between the Processing Site and the Mine Site. The planned haul road between the processing facilities and the mine has therefore been realigned to avoid this site, as per the new MAR alignment and Access Authority (AA 33280).

Adjacent to the Project area are two Restricted Works Areas associated with Sacred Sites. These areas will be carefully managed to avoid potential indirect impacts from Project activities.

- One RWA is located on the southwest boundary of the Processing Site. The area includes a hill and swamp.
- One RWA is located to the west of an access track between the Napperby road and Borefield area. The area includes a rocky ridge and sand dune.

Authority Certificates were issued by the Aboriginal Areas Protection Authority (AAPA) in 2008 and 2013, identifying conditions covering all works associated with mining and access to the mine site (C2008/205), and mineral exploration activities inclusive of water drilling, reconnaissance visits in 4WD vehicles, access with drilling rig and support vehicles and minor vegetation clearing at discrete locations (C2013/205). The conditions in C2013/205 specify that no work shall take place, or no damage shall occur within the above mentioned RWAs.

A new Authority Certificate from AAPA was issued in 2024 (C2024-12) covering the borefield and mining tenure. A second AAPA certificate for the explosives magazine ML and solar farm ML will be applied for in 2024, which will ensure that all Project areas are covered by AAPA certificates. Any conditions in future certificates relating to Restricted Works Areas are to be incorporated into the Cultural Heritage Management Plan (APPENDIX G).

3.3.2 Heritage and Archaeological Sites

Archaeological surveys previously undertaken for the EIS include:

- Archaeological & Heritage Management Solutions Pty Ltd 2015, Nolans Rare Earth Project, Nolans Bore, Northern Territory: Indigenous and Historic Cultural Heritage Assessment, GHD on behalf of Arafura Resources Limited.
- Earthsea Pty Ltd 2010, Archaeological Survey of the proposed Haul Road Corridor, Nolan's Bore Rare Earths Project, GHD for the Nolans Bore Environmental Impact Statement (EIS).
- Earthsea Pty Ltd 2012, Archaeological survey of parts of EL28473, Nolan's Bore 2011-2012, GHD and Arafura Resources Ltd.
- Gunn, R 2006, Nolans Bore Prospect Aileron, Central Australia: Archaeological Survey, Arafura Resources Ltd.

From the AAPA records, there are three declared heritage places in the vicinity of the subject area but none of these will be impacted by the Project.

4.0 OPERATIONAL ACTIVITIES

Project activities have been planned in twelve (12) stages:

- Stage 1 – Early Construction Works (works completed to date)
- Stage 2 – Bulk Earth Works, Temporary Facilities and Communications
- Stage 3 – Process Plant Concrete and Village
- Stage 4 – Hydromet Plant Construction
- Stage 5 – Beneficiation Plant Construction
- Stage 6 – Sulphuric Acid Plant Construction
- Stage 7 – Non-process Infrastructure
- Stage 8 – Power Supply and Distribution
- Stage 9 – Residue Storage Facility
- Stage 10 – Mine Complex and Surface Water Management
- Stage 11 – Mining Operations and Processing Activities (Mining Campaign 1)
- Stage 12 – Mining Operations and Processing Activities (Mining Campaign 2)

No further Project exploration activities are planned at this time.

The explanation of the planned staging of works was formerly detailed in *Appendix CC - Annexure A: Security Estimate Memo* of the previously approved Mine Management Plan (Rev 2.1). The description of the planned staging of works is now described within this section of the MMP for clarity, and to align with the updated Security Calculation included at Appendix CC.

Whilst the content in the below stages has been restructured to better align with the staged development of the Nolans Project, and updated to reflect the latest design available, there has been no material change to the planned infrastructure and processing facilities for the Project (processing, non-processing and mine) from the previously approved MMP. The key changes detailed in this MMP compared to the previously approved MMP (Rev 2.1) are:

- realignment of the MAR and SAR (realigned to improve safety at the junction between the MAR and the Stuart Highway; and realigned to avoid a sacred site exclusion zone west of the MAR); and
- relocation of the explosives magazine to avoid potential flooding, to the newly granted tenure (ML 33107) to allow for this.

4.1 Performance Against Previous Mine Management Plan

Site works as described within the previously approved MMP (Rev 2.1) were undertaken within the Project area, with the majority of these works undertaken between March and October 2023. These works were mainly described in the previous MMP under 'Enabling Works' and 'Early Works Construction'. Not all of the works previously described within those sections were undertaken. For a succinct overview of the works undertaken in Stage 1, refer to Section 4.2 below. For a cross-reference of 'performance' or works undertaken against the previous MMP, see Table 4—1 below.

Table 4—1 Performance of works undertaken against previous Mine Management Plan (Rev 2.1)

Section of previous MMP (Rev 2.1)	Previous description of works in MMP Rev 2.1	Works undertaken in 2023
Section 4.1.1 Enabling Works	In order to progress the necessary hydrogeological studies (phase two groundwater modelling in accordance with the WAMP) and bore construction designs for the groundwater production bores and overall borefield development, diamond-core drilling up to five (5) 'stratigraphic bores' will occur at each borefield location early during the enabling works program. This drilling program will provide hydrogeological data on the borefield stratigraphy to enable detailed production bore designs.	These works were completed under a separate MMP (Mining Authorisation 192-02) in November 2021.
	Groundwater Monitoring Bores will be installed as conditioned within the approved Northern Territory of Australia, Licence to Take Groundwater (Licence Number L10010 and L10013) and as detailed within the Arafura Water Management Plan (APPENDIX R) and Water Abstraction Management Plan. Intended locations of the Monitoring Bores are provided in Figure 1—11 and Figure 1—13 and have been selected to assess impacts on the Nolans Local Aquifer and Reaphook Borefield. The target locations will be drilled using a sonic rig (or similar) and require a 25m-by-25m drill pads and minor tracks for access. As with most drilling programs, the intended drill targets are indicative only and may be altered slightly depending on the success of water interception and/or accessibility by drill equipment. The final locations of the monitoring bores will be updated in future revisions of the MMP.	Groundwater and environmental monitoring bores were installed within and surrounding the Project site. As conditioned within the approved Northern Territory of Australia, Licence to Take Groundwater (Licence Numbers L10010 and L10013) and as detailed within the Arafura Water Management Plan (APPENDIX R); Water Abstraction Management Plan (approved by DCCEEW and under the water licence); and Waste Rock Management Plan (APPENDIX L). Groundwater Monitoring Bores locations were selected to assess impacts of Project water extraction on the Reaphook Palaeovalley Aquifer and Nolans Aquifer/Mine Site, as well as monitor for any potential contamination of groundwater from Project activities. The locations of the monitoring bores are

Section of previous MMP (Rev 2.1)	Previous description of works in MMP Rev 2.1	Works undertaken in 2023
		shown in Figure 1—11 (within the mine site area), Figure 1—12 (within the processing site area), and Figure 1—13 (within the borefield area). A total of 45 groundwater and environmental monitoring bores were installed. Monitoring bores were typically drilled within a 25 m by 25 m drill pad, with some pads having two (2) bores. Existing site roads and tracks were used where possible. In some cases, new access tracks were required, with a total of approximately 7 km length of new tracks installed, with a width of approximately 3 m.
	Rehabilitation of the access track between the Stuart Highway, the process plant site and the village site utilising the existing station tracks alignment wherever possible. This access shall provide access for all plant and equipment proposed under the early works development phase and removes any need for the Project to consider utilising other primary station/bore access tracks. Minor upgrading, if required, may also be undertaken to the Nolans track, which runs from Aileron to the Nolans Bore, and to the track from Nolans Bore to the process plant site.	Initial rehabilitation of the access track was undertaken, requiring the widening of the existing track to allow safe access and egress for plant and equipment movements. No upgrades to the Nolans track(s) as described above were required. Further site track upgrades are planned in Stage 2, as described in Section 4.4.4.1 below.
	Coupled with the above rehabilitation works, access to water is a strict requirement to support any construction scheduled under the enabling and early works programmes. This requires the upgrading of the existing Nolans Dewatering Test Bore (located in the proposed pit	The development of the Nolans bore for early works was not pursued due to several variables, and Arafura opted to import construction water from offsite.

Section of previous MMP (Rev 2.1)	Previous description of works in MMP Rev 2.1	Works undertaken in 2023
	outline) and potentially the drilling of an additional bore(s) (within the pit area) to provide capacity to sustain the proposed activities until the main water supply is developed.	
	Installation of a water system from the Nolans Bore(s) which will consist of a dam near the bores, pumping system and pipeline to deliver water to a dam near the village location. The water pipeline will largely follow the existing station track between the Nolans Bore area and the village area.	Refer to the above row for activity details, work scope deleted for this stage.
Section 4.1.2 Early Works Construction	Borefield D (i.e. the first borefield west of the gas pipeline) development: Increase site water supply to meet more demanding civil works and support construction personnel's daily water usage. This development involves drilling of two (2) additional production bores to supplement the existing bore, respective observation bores and other monitoring bores as outlined in the Water Management Plan (APPENDIX R).	Borefield D development occurred which included the drilling of two (2) additional production bores to supplement the existing bore, including three (3) deep well groundwater (observation) monitoring bores that are included under the groundwater monitoring bores noted above. One of these production bores was drilled in the V-unit aquifer and deemed not viable as a water production bore. The other production bore was drilled at Borefield D, as shown in Figure 1—7.
	Water pumping infrastructure at borefield D development: headworks for all three (3) productions bores at borefield D, centrally located collection tank and transfer pumps, large bore buried pipeline between borefield D and the process plant site temporary turkey's nest and a centrally located control and monitoring system, diesel generating set and diesel storage tank.	Headworks, made up of a mixture of temporary and permanent infrastructure, were fitted to the two (2) viable production bores as described above, with the third (non-viable) bore being capped and made safe. Temporary infrastructure (i.e. smaller transfer pumps and generator sets) will be used to meet the lower demands during construction works, before being increased to meet operational needs for the commencement of

Section of previous MMP (Rev 2.1)	Previous description of works in MMP Rev 2.1	Works undertaken in 2023
		Stages –11 and 12. Headworks included one (1) large diameter tank, two (2) smaller poly tanks and a fuel cell. The DN450 HDPE pipeline was installed belowground for approximately 24.5 km and approximately 0.5 km aboveground on approach to the constructed lined turkey's nest. A 5 km DN110 pipeline was laid aboveground between the turkey's nest and the Village to provide raw water to a hired-in reverse osmosis plant.
	Accommodation village bulk earthworks to ensure the pad construction is sequenced ready to receive accommodation units and central facilities.	The village pad construction was completed in its entirety.
	Establishment of a 'fly-camp' in-situ at the village location to supplement available beds at Aileron Roadhouse and allow for increased manning to accelerate the overall bulk earthworks campaign. The balance of the camp development shall follow with a sequenced, gradual handover of rooms to allow occupation and increased manning.	The 48-person 'fly-camp' was established at the village complete with small kitchen/diner. Subsequent establishment of a temporary 200-bed 'construction camp' within the village complex, complete with central facilities including kitchen, diner, wet mess, gymnasium, and other ancillary facilities, was completed. These building were not connected to site utilities. Another 200-beds are down-stacked onsite ready for installation. The fly-camp and construction camp buildings and facilities are temporary infrastructure and permanent installation in not provisioned. Gensets were all disconnected and removed,

Section of previous MMP (Rev 2.1)	Previous description of works in MMP Rev 2.1	Works undertaken in 2023
		and a number of small poly tanks were installed for water and wastewater balance. A temporary water (RO) treatment plant and permanent wastewater treatment plant (WWTP) and preparation of a spray field were installed within the village. Neither treatment plant has been connected or used to date. The WWTP represents the only permanent infrastructure installed to date within the accommodation village Mineral Lease (ML 30702). Consisting of one (1) large tank and multiple smaller poly tanks and concrete footings beneath the system totalling approximately 807.8 m2. The WWTP was previously forecasted as Stage 2 works within MMP Rev 2.1.
	Establishment of the quarry and borrow pits, at locations to be finalised with applications to be made for extractive mineral permits or extractive mineral leases and a separate MMP for these quarrying and borrow operations.	These works were not carried out during this stage and will be carried out as a matter of priority concurrently with the planned Stage 2 works for access to granular materials. These works are however now covered under a separate Mining Authorisation 1083-01 granted to Arafura 18 June 2021 and hence are not covered within the scope of this MMP.
	Site Access Road (SAR) bulk earthworks will commence once the main water supply and fly-camp are established with the SAR prepared to an appropriate engineered standard to allow the safe delivery of plant, equipment and other materials (i.e. accommodation units,	Construction commenced on the SAR, clearing of the construction right of way taking place first, followed by the development of the initial approximately 4.6 km from Stuart Hwy constructed to subgrade level for full width.

Section of previous MMP (Rev 2.1)	Previous description of works in MMP Rev 2.1	Works undertaken in 2023
	temporary offices, etc.) to site to suit the needs of Contractors mobilising early under the main construction programme.	
	Plant pad bulk earthworks will commence in parallel with the development of the SAR.	Construction of a turkey's nest of approximately 0.7 ha (designed to hold approximately 7,500 m^3 of water); development of a stormwater pond to provide material for the construction a laydown area of approximately 20.5 ha were completed within the processing plant area Mineral Lease (ML 30703).
	Installation of the microwave communications system to from Aileron to the Village which involved installation of towers and communications infrastructure at Aileron Roadhouse and on a hill close to the village. This will allow communications, including two-way radios, consistently across the site. The microwave communications network will later be expanded to the plant area, mine area, and borefields.	These works were not carried out during this stage. The installation of communications infrastructure is now planned in Stage 2.
Section 4.1.3 Construction – Section 4.1.3.5 Additional monitoring Bores	Environmental Monitoring Bores will be installed to fulfill commitments within Waste Rock Management Plan (APPENDIX L) and the groundwater and surface water sampling procedures (APPENDIX M and APPENDIX N). Intended locations of the Monitoring Bores are provided in Figure 1—12. The target locations will be drilled using a sonic rig (or similar) and require a 25m-by-25m drill pads and minor tracks for access. As with most drilling programs, the intended drill targets are indicative only and may be altered	The activities undertaken are as described above for Section 4.1.2 Early Works Construction.

Section of previous MMP (Rev 2.1)	Previous description of works in MMP Rev 2.1	Works undertaken in 2023
	slightly depending on the success of water interception and/or accessibility by drill equipment. The final locations of the monitoring bores will be updated in future revisions of the MMP.	

The description of works within this MMP have been updated compared to the previous MMP, to reflect the changes in Project planning and execution, and to include further detailed planning where it has been progressed. The works undertaken on site to date have been described within Stage 1 – Early Construction Works within Section 4.2 below. The scope of further works planned on site in subsequent stages are described in Stages 2 – 12 within Sections 4.1 – 4.13 below. The works described in Stages 2 – 12 had not yet commenced at the time of document preparation.

As works are progressed, performance against this MMP will be reported in further detail for key environmental aspects and Project facilities, as described for RSF, Infrastructure Area, and Processing performance below.

4.1.1 Future Reporting of RSF Performance

No residue storage activities have been undertaken at the Project site at the time of document preparation. In subsequent revisions of this MMP this section will provide an assessment of residue storage facility performance, including such factors as:

- Volumes of material in storage and updated planned volumes for the oncoming reporting period
- Water recovery rates
- Seepage recovery rates
- Any leakage detected
- Engineering upgrades and modifications to the design.

4.1.2 Future Reporting of Infrastructure Area Performance

No infrastructure activities other than early construction works have been undertaken at the Project site at the time of document preparation. In subsequent MMPs this section will provide an assessment of infrastructure performance, including such factors as:

- Water usage, by type (i.e., raw water, desalinated water, potable water)
- Energy Usage (power and natural gas)
- Engineering upgrades and modifications
- Detail any new infrastructure initiatives, developments or changes proposed for the oncoming reporting period.

4.1.3 Future Reporting of Processing Performance

No processing activities have been undertaken at the Project site at the time of document preparation. In subsequent MMPs this section will provide an assessment of processing performance, including such factors as:

- Mineral treatment (ore treated, feed grade, recovery, process plant performance).
- Product, volumes and quality.
- Processing circuit efficiency (water use).
- Energy requirements (power use).

- Production and major reagents or chemicals consumption.
- Engineering upgrades and modifications.
- Detail any new processing initiatives, developments or changes proposed for the oncoming reporting period.

4.2 Stage 1 – Early Construction Works

The Stage 1 Early Construction Works were to get the Project site ready for the commencement of material construction works by ensuring that the main infrastructure and water supply were in place to support construction. The following activities were completed in Stage 1:

- Improvement of the site access road from the Stuart Highway into site (the road is currently a rough station track.)
- Modification of the intersection (temporary with the final intersection design installed later) of the site access road with the Stuart Highway to provide safe, and legal, entry and exit from the site.
- Develop the initial stages of the construction material borrow pits to provide suitable construction materials for earthworks. These works and associated closure estimates are covered under a separate MMP (Mining Authorisation 1083-01).
- Undertake the camp bulk earthworks, which includes vegetation clearing, topsoil removal (and stockpiling), backfilling and compacting for building footings.
- Installation of the fly camp for the construction contractors and first stages of the permanent construction camp.
- Install the site communications backbone (consisting of either an optical fibre cabled into the camp location or a microwave tower on a hill adjacent to the camp location).
- Install borefield D and the associated water pipeline to site, which consists of:
    - Construction of an access track from Napperby road to the borefield D location.
    - Drilling and fit out of two additional production bores at borefield D.
    - Drilling and fit out of a number of monitoring bores, and construction of the associated access tracks where required, around borefield D and various areas of interest for groundwater monitoring.
    - Installation of bore pumps, collection tank, transfer water pumps, generating set and associated equipment at borefield D.
    - Clearing of the access way between borefield D and the process plant site for installation of the main water pipeline.
    - Trenching, installation and burying of the main, approximately 500mm diameter, water pipeline from borefield D to the process plant site.
    - Construction of a temporary turkeys nest dam for construction water storage at the process plant site.
    - Installation of temporary pumps and diesel generators to draw water from the dam for construction and a pipeline from this dam to the camp.

- Process plant site bulk earthworks which included vegetation clearing, topsoil removal (and stockpiling), backfilling, development of compacted pads, development of surface water management structures and stormwater ponds.
- Commencement of the earthworks for the development of the site access road.

4.3 Main Construction Works

Following on from Stage 1 – Early Construction Works, Stages 2 – 10 consist of the main construction works, when the majority of infrastructure and facilities (both temporary and permanent) are planned to be constructed. This includes preparation of the first cell of the RSF for the first 7 – 9 years of operation (Stage 9) and development of the mine area surface water management structures including the Kerosene Camp Creek realignment for the first stages of mining operations (Stage 10).

The process plant will be predominantly constructed by a tier 1 construction contractor, with smaller discrete packages awarded to alternate parties based on the capability of the nominated contractor and suitability of the package to that contractor's capability.

The processing areas, as noted below, are to be constructed in a traditional method on an earthworks pad, concrete base, structural steel support structures, various mechanical equipment, tanks, EIC services and interconnecting piping. The subsequent measurement and recording of quantities for inclusion in the Security Estimate contained in APPENDIX CC of this document, have been generated from the overall plant layout drawing, plus extraction of quantities from numerous engineering deliverables. For those areas which are estimated on a square meterage, a proportional assessment for each of the various concrete elements and process plant areas has been applied as per their corresponding geographical footprint. Those items for which a quantity is applied, a count of each element has been adopted. In particular, the tanks have been grouped as small being less than 100 kl and large equal to or greater than 100 kl.

Stages 11 – 12 consist of the first two stages of mining operations (Mining Campaign 1 in Stage 11; and Mining Campaign 2 in Stage 12) and the associated Waste Rock Dump (WRD) and processing activities. Further details are provided below.

4.4 Stage 2 - Bulk Earthworks, Temporary Facilities and Communications

4.4.1 Process Plant Pad / Hardstands

The process plant pad consists of areas of compacted structural fill upon which various process structures will be constructed. Exposed areas will generally consist of compacted hardstands consisting of granular pavement materials. Heavily loaded areas (such as the reagents logistics area) will consist of compacted granular pavement materials with a durable geogrid (filled with a DGB20 or similar) as a trafficable pavement.

Drainage structures will consist of a combination of V-drain and table drains where suitable. Piped concrete culverts will be used where depths of formation allow to convey water at intersections whilst trafficable swales will be used where culverts are not practical.

4.4.2 Process Plant Ponds

Within the overall footprint of the process plant area are a series of earthen ponds lined with HDPE. These ponds will typically be formed partially above and below ground. The initial disturbance of these areas will occur within Stage 2 Earthworks, and further construction within the relevant subsequent Stages 2-6. Operation of these ponds will first occur within Stage 11; further details are provided within Section 4.13.2.10.1 below.

4.4.3 Establishment of Facilities

4.4.3.1 Construction Offices and Facilities

Numerous temporary construction facilities such as office blocks, crib rooms, ablutions and training rooms will be used to support the various stages of construction. These will be concentrated in a hub-style layout within the Processing Area ML. With installation of associated fuel cells required to fuel vehicles, plant, and equipment for this stage of works. One backup generator is planned at the administration area.

There are a total of 14 fuel tanks planned across the site for the scope of Stage 1 – 12 activities. The planned locations of these are described within the relevant works stage/areas described throughout Section 4.0 of this document; and are summarised in Section 4.9.3. The timing of installation will coincide with the commencement of works in these areas and/or fuel requirements within these areas as works progress. All 14 fuel tanks have been included within Stage 2 of the security calculations, to allow flexibility in the timing of installation and use.

4.4.3.2 Concrete Batch Plant

A temporary concrete batch plant will be erected and commissioning on the hardstand prepared under Stage 1 – Early Construction Works. This will include some small buildings, "mobile" batching plant, fine/coarse aggregate storage, cement silos amongst other small ancillary assets.

4.4.4 Access Roads and Tracks

Proposed road corridors have been selected to avoid sensitive vegetation and heritage sites. Roads will be designed and constructed using conventional techniques with due consideration for minimising changes to surface water flows, through construction of floodways and/or culverts and/or installation of side drains where necessary. Baseline biodiversity data and hydrology studies will be used during the road design to avoid impact to sensitive areas. Roads will be built to relevant Austroads guidelines, Australian Road Research Board (ARRB) Unsealed Roads Manual and NTG design standards.

4.4.4.1 Site Access Road and Village Road

The main SAR from the Stuart Highway to the processing site, cleared and stripped under Stage 1 – Early Construction Works, typically follows the alignment of the existing station tracks and will be constructed to a public road standard with a pavement width suitable for the safe passing and overtaking of heavy vehicles (i.e. road trains). The road has been designed as an all-weather road and the final design will have a two-coat bitumen sprayed seal surfacing for its entire length, with signage, road markings, etc. Initial road construction will be unsealed except for the first 100 m, and dust

suppression controls will be implemented as required. This is reflected in the current security calculations, which includes initial sealing of the SAR at the intersection with Stuart Highway for a length of 100 m. The security calculations will be updated prior to undertaking bitumen sealing of the remainder of the road.

There are a number of archaeological sites that have been identified along the planned road alignment. Consultation with Traditional Owners and approvals were obtained to remove some of these artifacts, and the road alignment was adjusted to avoid these areas as required. For those approved for removal, artifact removal and storage were undertaken in 2023. For those remaining in-situ, signage and fencing/controls have been installed, and will be maintained as appropriate and agreed with Traditional Owners over the life of the Project.

The 16 km SAR intersects with the Stuart Highway approximately 5 km south of the Aileron Roadhouse. This main intersection will conform with NTG requirements for intersections, including spacings and surface treatments, and design shall include provisions of auxiliary lanes to accommodate accelerating and decelerating truck traffic travelling on the Stuart Highway.

4.4.4.2 Mine Access Road

The MAR between the processing site and the mine site will provide general access for personnel and serve as the haul road for trucking ore to the process plant. Traffic volumes will be relatively low, which, coupled with an adequate design speed, will accommodate an unsealed road for this approximate 8.5 km alignment.

This road was redesigned and has now been positioned to avoid a registered sacred site on the western side of the road.

Increased dust suppression efforts and regular maintenance will be employed to ensure the mine access road always remains serviceable.

4.4.4.3 Process Plant Internal Roads

Internal roads throughout the process plant will be constructed to an appropriated engineered standard providing a narrow unsealed dual carriageway arrangement as compared to the main access roads. Traffic volumes will be limited; however, these roads will receive regular watering for dust suppression.

4.4.4.4 Other Project Accesses

Other Project roads, more prudently coined 'Access Tracks', including those to, and within the, borefield, the tailings pipeline corridor, will likely be of a lesser quality but all will be constructed to ensure user safety as a guiding principle, with natural drainage maintained where possible. All access tracks will be appropriately signed and will be unsealed but with routine dust suppression applied to ensure the surface remains intact.

4.4.5 Mine Infrastructure Area Pad

The Mine Infrastructure Area (MIA) pad consists of areas of compacted structural fill upon which various mining related infrastructure (e.g. workshops, refuelling and washdown facilities and office structures) will be constructed. One fuel storage tank is planned within this area. Exposed areas will generally consist of compacted hardstands consisting of granular pavement materials.

A sediment pond is located to the western perimeter of the MIA area and receives internal run off from non-bunded aeras such as roads, pads, hardstands and internal stormwater drainage. Internal drainage structures will consist of a combination of V-drain and table drains where suitable. Trafficable swales will be used internally to convey sheet flow within the MIA to drains.

4.4.6 Explosives Storage Area Hardstand

The ESA pad consists of areas of compacted structural fill upon which various explosives storage infrastructure (e.g. storage sheds, explosives mixing equipment, bulk explosives storage laydowns and magazine) will be constructed. Exposed areas will generally consist of compacted hardstands consisting of granular pavement materials.

Two sediment ponds are located to the northern perimeter of the MIA area and receive internal run off from non-bunded aeras such as roads, pads, hardstands and internal stormwater drainage.

Internal drainage structures will consist of a combination of V-drain and table drains where suitable. Trafficable swales will be used internally to convey sheet flow within the ESA to drainage structures.

4.4.7 Communications

Communications for the site will be via a microwave link to the existing Tilmouth tower (Telstra fibre access point) that connects into the existing Telstra optical fibre backbone back to Alice Springs. The microwave link and communications infrastructure across the site will consist of:

- An existing tower at Tilmouth with a connection to the Telstra fibre network back to Alice Springs. New microwave equipment shall be installed on the existing tower to provide a microwave link to the Nolan's main communications tower via the intermediate tower at borefield F (ML32414).
- A main communications tower at the accommodation village (ML30702) with a microwave link back to the Tilmouth tower via the borefield F tower. The main communications tower is connected to the site fibre network providing access to the internet for the entire site.
- An intermediate communications tower at borefield F (ML32414) will be installed to enable an appropriate line of sight from the existing Tilmouth tower to the Nolan's main communication tower.
- An additional intermediate communications tower will be installed at the mine infrastructure area (ML26659) to facilitate digital two-way radio coverage in the mine area.
- A digital two-way radio repeater system will also be installed at the main communications tower and the mine infrastructure tower to provide radio coverage around the site.

- A communications pole will be installed at each borefield as they become operational, to connect the borefield control system to the main communications tower, and from there to the plant control system.
- A fibre network will be installed throughout the site to provide communications between the main communications tower, the village, the site administration facilities, the process plant, the mine infrastructure area tower and the mine infrastructure area.
- All of the remote communications equipment will be run from solar power and all systems will be backed up with batteries to ensure constant communications availability.
- No mobile phone tower is currently planned to be installed. Mobile phones will be able to operate through connection to the Wi-Fi networks that will be established in the village and work areas.

4.4.8 Waste Management

4.4.8.1 Waste Disposal Planning

All waste materials generated on site will be collected, sorted and contained within receptacles appropriate to the waste type. Receptacles will be available within each work area for the types of waste generated.

Once sorted, each waste stream will be treated appropriate to the waste type – either disposed of within the appropriate onsite facility; or removed offsite for reuse, recycling or disposal. Waste will be managed in accordance with the waste hierarchy of control outlined in the National Waste Policy (Commonwealth 2018).

Each waste type will be generally managed as described below. Waste management planning is further detailed within the Waste Management Plan, included at APPENDIX D.

General Waste

General waste that is non-contaminated or controlled and non-recyclable will be collected from each work area and disposed of within the onsite landfill facility. For example, general construction and building waste; process plant waste and packaging, etc.

Putrescible Waste

Putrescible waste will be collected from the village and other work areas (e.g. building areas during construction; and the mine office and processing plant crib rooms during operations) and disposed of within the onsite landfill facility.

Sewerage will be treated within a wastewater treatment facility at the village site; and within septic tank systems at other work areas (processing plant and mine office). Sewerage will be treated and biologically digested within the system(s). Treated water from the wastewater treatment facility at the village site will be discharged through a spray field adjacent to the facility. Remaining consolidated treated solid wastes (biosolids) at the end of the treatment train will be collected on a routine basis and disposed of within the landfill facility.

Recyclable Waste

Preference will be given to the recycling of waste where a service provider is available within proximity to the Project. Where available, the types of waste able to be recycled will be collected by an appropriately licenced contractor for transport to the relevant recycling facility.

Controlled Waste

Controlled waste includes NT 'listed waste' such as asbestos and tyres; as well as 'special waste' types such as medical waste. Controlled wastes will be collected by an appropriately licenced contractor and disposed of offsite at a licenced facility in accordance with the relevant guidelines. Preference will be given to the recycling of tyres where a service provider is available within proximity to the Project.

Hazardous Waste

Hazardous wastes include both solid waste materials (e.g. materials contaminated with chemical residues) and liquid wastes (e.g. waste hydrocarbons). Hazardous materials will be collected in appropriate bins or storage tanks. Solid waste materials will either be disposed of onsite within the RSF (when operational); or collected by an appropriately licenced contractor and disposed of offsite. Preference will be given to returning materials (e.g. containers) to the manufacturer for reuse where possible. All other waste, including all liquid waste materials, will be disposed of at an offsite licenced facility in accordance with the relevant guidelines.

Hydrocarbon contaminated soils will be either disposed of in the RSF where the contamination is with process chemical; or remediated in the hydrocarbon bioremediation facility (located within the village spray field) before being disposed of in the WRDs.

Radioactive Waste

Waste materials containing NORM or contaminated with radioactivity (e.g. through contact with ore) will be disposed of within cells in the WRD facilities. Further detail is provided within Section 4.13.1.2.6 Waste Rock Dumps below.

4.4.8.2 Landfill

The location of the proposed landfill is shown in Figure 1—6 and Figure 1—12 above, adjacent to the RSF area and accessible from an existing monitoring bore access track. Siting and design of the landfill was developed in accordance with the NT EPA *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory* (NT EPA 2013). The location was chosen based on suitable ground conditions, with approximately 8 m of soil cover overlaying base rock and low risk of acid producing soils. It was placed away from regular work areas to avoid any potential issues arising from odours or flies. Being located adjacent to an existing access track limits disturbance, and proximity to the RSF is also convenient for rehabilitation tracking in future. There are also two existing groundwater monitoring bores located within proximity to the proposed landfill area, which will facilitate monitoring of groundwater for any potential contamination.

A 3 ha area has been allocated for use as the landfill. This is estimated to be sufficient for current waste volume estimates for the life of mine; with additional space allowed for access and removed soil storage. As well as space for a sorting and storage yard, for waste streams which are to be collected and taken offsite.

The active landfill area will be fenced with dingo-proof fencing to prevent access by dingoes and other native or pest fauna. The active landfill area will likely be phased, with a smaller section of the 3 ha area being fenced and used at any one time.

Within the landfill area, sequential trenches will be dug (approximately 6 m deep, but subject to detailed design and ground conditions). Soil material including topsoil will be stored in windrows

adjacent to the trenches. Separate trenches will be used for putrescible waste and general waste. Putrescible waste will be covered with a layer of soil immediately following disposal. Once trenches are filled with waste, they will be covered over with the stored soil and then topsoil for a total cover of approximately 2 m. Filled trenches will be progressively rehabilitated once filled.

Detailed design of the landfill facility will be undertaken prior to its construction. The design and operation of the landfill will be in accordance with the abovementioned NT EPA Guidelines (NT EPA 2013).

4.4.8.3 Bioremediation Facility

A bioremediation facility will be located within the existing spray field, which is adjacent to the village area. This will be used to treat soils contaminated with hydrocarbons across the site. Contaminated soils will be spread across the bioremediation pad and regularly irrigated with the treated water from the wastewater treatment plant. Co-location of the bioremediation pad within the spray field allows for water use efficiency, as treated fresh water will be disposed of from the wastewater treatment plant which is not being used for another purpose. This provides water savings by not requiring additional desalinated water for bioremediation, as saline water is unable to be used within the bioremediation process.

4.5 Stage 3 – Process Plant Concrete and Village

4.5.1 Process Plant Concrete Construction

These works encompass construction and all steel fixing and concrete works for the entire Hydrometallurgical (Hydromet) Processing Plant. Inclusive of Process Plant, Mill and Crushing Area, Beneficiation, and SAP.

4.5.2 Accommodation Village

The accommodation village is located approximately 5 km from the process plant, accessed along the main site access road. The accommodation village will be laid out to make use of the natural surface grade for drainage and earthworks and will be subject to a detailed site survey and geotechnical investigation.

For operations, the village will consist of up to 280 rooms operating (potentially) on a motelling arrangement. For construction, the camp will have an occupancy of up to 850 on a motelling arrangement.

Central facilities and permanent accommodation units will be purchased, while the additional accommodation units required during construction will be leased and demobilised with the start-up of full-time plant and mining operation. The village will be comprised predominantly of prefabricated transportable buildings (larger building being multi-modular style) for both the central facilities and the accommodation units. Site erected structural buildings for central facilities applications will only be used in the event prefabricated units are not practical.

As detailed within Stage 1 – Early Construction Works, an initial fly camp for the construction contractors and first stages of the permanent construction camp has been installed. Completion of the

accommodation village to accommodate the full construction and operations workforce will occur during this stage of works.

In addition to the accommodation provided at the village, approximately 30 accommodation units are available at the nearby Aileron Roadhouse (approximately 15 kilometres from the Project village) to provide contingency peak accommodation and were also used as a fly-camp to facilitate early works.

The buildings (central and accommodation) will use a range of noise and thermal insulation techniques to provide comfort and maximise energy efficiency. The central facility buildings will include the following:

- Kitchen dining building complete with freezer and cool room storages for food.
- Village administration building, office, medical and shop.
- Recreation building(s) that provide a range of functions including breakout rooms, training/inductions and gymnasiums.
- Two fuel tanks (one bulk tank and one day tank) for fuelling of village equipment, vehicles, and plant required at this stage of works.

4.5.2.1 Wastewater Collection and Treatment

4.5.2.1.1 Construction

The permanent wastewater treatment plant (WWTP) installed under Stage 1 – Early Construction Works at the village area will service the village and other temporary construction facilities.

Temporary facilities at the worksites, such as crib rooms and ablutions, will have holding tanks to collect the wastewater which will be emptied by a local contractor and either discharged into the village WWTP system or disposed of off-site.

4.5.2.1.2 Permanent Facilities

Permanent wastewater facilities will have all wastewater collected in the process plant site and village and pumped to the WWTP located at the village. The treated effluent will be disposed of in a spray field close to the village or utilised for irrigation of landscaping within the village (using buried seepage irrigation or other appropriate methods in accordance with appropriate regulations). Sludge will be removed by a local contractor and either disposed off-site or disposed on-site in the tip waste facility.

The permanent camp may also include a grey water collection system which will collect wastewater from suitable sources for direct irrigation of landscaping.

Wastewater at the mine infrastructure area will be pumped to a central holding tank which will be pumped out by a local contractor on a regular basis and discharged into the central village WWTP or taken for disposal off-site.

4.6 Stage 4 – Hydromet Plant Construction

The Hydromet Plant includes the majority of the shared infrastructure and services. The major equipment packages within the Hydromet Plant shall be procured by Arafura and free issued to the nominated construction Contractor.

The main process facility is a series of complex processing areas where mechanical equipment, including pumps, tanks and agitators, pressurised and non-pressurised vessels and filters are utilised for extraction and separation processes to treat the concentrate from the Beneficiation plant, producing NdPr and Samarium, Europium, Gadolinium/Heavy Rare Earths (SEG/HRE) oxides. All by products from processing are retained in the processing circuit until either reutilised in the process, distributed for sale, or transferred to the Residue/Tailings Storage Facilities via a closed-circuit system. The individual processing areas are interconnected through various mechanical, piping and conveyor systems to ensure effective handling of the materials.

4.6.1 Hydromet Plant Commissioning

Commissioning will involve testing and commissioning of equipment and systems in preparation for operations.

Non-process infrastructure, namely buildings, wastewater treatment plant, and other equipment, will be commissioned in a fashion in line with typical commercial-, or industrial-style applications.

Later stages of commissioning are generally carried out using air and/or water. Once commissioning is complete, start-up commissioning takes place with ore, reagents and other process materials. When the pre-determined levels of output and quality are achieved, the plant will be handed over to operations personnel for optimisation and routine operation.

4.7 Stage 5 – Beneficiation Plant Construction

The Beneficiation Plant will be awarded on a lump sum EPC basis, with engineering and construction work being carried out by the Contractor and procurement activities for major equipment packages managed by Arafura and free issued to the Contractor.

The Beneficiation Plant will include crushing, grinding and classification, flotation, tailing dewatering, process water pond and beneficiation reagents preparation infrastructure.

4.8 Stage 6 – Sulphuric Acid Plant Construction

The sulphuric acid plant shall be procured by Arafura and free issued to the nominated construction contractor which may be the main Hydromet Plant construction contractor.

The sulphuric acid plant consists of solid sulphur receipt and handling, sulphur melting and filtration, contact and absorption processes product acid cooling. Sulphur is burned in pure oxygen, not air, and therefore the plant area also includes a cryogenic oxygen plant, consisting of air intake, compression, purification, heat exchange, distillation and heat exchange equipment.

4.9 Stage 7 – Non-process Infrastructure

Non-process Infrastructure (NPI) relates to infrastructure to support construction and mining activities. The Non-process Infrastructure included in this stage of works includes the development of the following areas:

1. The Operations Complex
2. Vehicle Washdown
3. Fuel Supply and Distribution

Water Supply and Distribution proposed works within each of these areas are described below.

The NPI works will be contracted to specialist contractors for the various design, supply and construction contracts who will be directly managed by Arafura's integrated Project management team.

These works and infrastructure have been captured under Infrastructure within the securities presented in APPENDIX CC.

4.9.1 Operations Complex

An operations administration complex will be constructed centrally to the processing plant, complete with the following infrastructure to support the production activities, but not necessarily limited to:

- Security gatehouse, including emergency response and first aid with a carpark for the site ambulance, fire truck and emergency response trailer.
- Process plant administration building with office, meeting rooms, storerooms, kitchen and training facilities.
- Process plant control room.
- Changing rooms and associated laundry sized to suit the full workforce during operations allowing for a clean-in/clean-out operating philosophy to be adopted.
- Process plant laboratory including ventilation systems and specialised drainage systems.
- Process plant maintenance offices.

All of these facilities will be of prefabricated modular construction. The following facilities will be structural steel fabricated buildings:

- Fixed plant maintenance workshop containing areas for the various trades and a washdown bay for decontamination of equipment prior to maintenance.
- Process plant warehouse for spares and consumables including an adjacent fenced laydown yard.
- Reagent stores to store bulk bags and intermediate bulk containers (IBCs) of reagents with the store potentially broken into separate storage areas to facilitate safe storage and ventilation requirements.

The operations complex will also include two carparks, with one for vehicles confined to the controlled area and one for vehicles accessing only clean and public areas.

As described under the preceding sub-sections, NPI as it relates to the process plant, is focused primarily on the operations administration complex, maintenance facilities, and other general services (wastewater treatment, overhead powerline, water and power reticulation and communications/other operational technology systems). The construction of these facilities and services will be executed in parallel to the process construction and are expected to be complete in a timely manner, ahead of mobilisation of operations personnel.

4.9.2 Vehicle Washdown

Vehicle washdowns will be constructed at key locations around the site will provide for the effective removal of mud and dust and ensure vehicle cleanliness for maintenance, but also aid in site radiation management.

Vehicle washdowns will be incorporated at the process plant main gate and mine infrastructure area. The mine area washdown will incorporate washdowns for light vehicles and road trains and heavy vehicles in separate washdown areas.

Washdown areas will utilise a combination of automatic sprays, manual cannons and manual hose reels. It will be constructed over a containment slab which will drain to a sump system / sediment trap, complete with bobcat / front end loader accessibility for removal of heavy sediments. This will occur before the collected water is directed through an oily-water separator for treatment to remove hydrocarbons and sediments. Clean water will be directed to either the mine dust control water system or the beneficiation process water pond. Hydrocarbon impacted sediments will be removed by a bobcat and remediated at the site hydrocarbon bioremediation facility. Hydrocarbon contaminated soils will be collected and treated within the bioremediation facility located within the Village area (see Section 4.4.8.3 above) as a preference wherever possible. It may also be relocated to the RSF or removed from site by a specialist contractor if required or exceeding treatment capacity.

4.9.3 Fuel Storage and Distribution

4.9.3.1.1 Construction

Temporary bulk fuel storage and distribution infrastructure will be employed to service the construction activities. This will be strategically located to best service the construction work fronts, initially the largest consumer being the bulk earthworks, and it's envisaged this will be located adjacent the contractor's temporary construction offices, so it remains in place for the entire construction programme.

Where possible, the bulk fuel pod for the power generating sets at the village will have additional provision for distribution to light vehicles.

4.9.3.1.2 Operation

Diesel fuel will be required on site to service mining operations (both fleet and support vehicles), non-mining fleets (light vehicles, buses, emergency gensets, etc.), borefield power generation and to supplement the power station.

Diesel fuel storage will be installed at the mine infrastructure area, process plant, village, power station, and each of the borefields. With supply of diesel by road tanker from Alice Springs. Fuel storage tanks will be double skinned, self-bunded fuel tanks with loading/unloading slabs constructed to contain spills and 10-year ARI 24-hour design storm events.

A refuelling facility will be installed at the mine infrastructure area, complete with a light vehicle bay (provision for B-triples) and a heavy vehicle (haul truck) bay, and at the village and process plant areas, with refuelling only for light vehicles.

Permanent fuel dispensing forecourts shall provide a reinforced concrete slab containment area, with both spill and runoff areas to be drained to a collection sump for pumping and processing in a hydrocarbon oily-water separator installed as part of the vehicle washdown systems.

Smaller remote generating sets at the RSF, explosives magazine and for diesel driven pumps around the site will run from internal belly tanks filled from the service truck.

Fuel storage volumes will be:

- Mine infrastructure area – 1 x 10,000 L tank, for fuel supply to mine area generating sets.
- Process plant area – 1 x 20,000 L tank, for low flow dispensing and backup generator fuel supply to the power station.
- Village – 1 x 2,500 L tank for day supply; and 1 x 30, 000 L tank for bulk fuel storage, with temporary integrated low flow dispensing to provide fuel supply to the generating sets at the village.
- Power station – 2 x 60,000 L diesel tanks; and 3 x 10,000 L tanks for storage of lube oil.
- Borefields – 1 x 30,000 L main tank and 1 x 20,000 L booster tank at Borefield D; 1 x 30,000 L tank at Borefield C; 1 x 20,000 L tank at Borefield B; and 1 x 10,000 L tank at Borefield A, providing fuel supply to the generating sets at each borefield.

4.9.4 Water Supply and Distribution

4.9.4.1 Initial Construction Water Supply

Developed under Stage 1 – Early Construction Works, this consists of two (2) production bores located at Borefield D. These bores pump to a turkey's nest storage pond adjacent to the plant site.

4.9.4.2 Water Supply

Raw water to supply the Project will be pumped from the Southern Basins aquifers (Reaphook Palaeovalley Aquifer) located in the proposed borefield approximately 25 km to the southwest of the processing site.

The Project's projected water demand is a maximum of 4.8 GL per year. The Company's Groundwater Extraction License has been approved by DEPWS.

The borefields consist of at least three (3) and potentially up to six (6) other borefield clusters in addition to borefield D developed under Stage 1 – Early Construction Works, where the layout consists of the following infrastructure at each bore cluster:

- At least three (3) production bores (nominally 100-200 metres apart) fitted with variable speed bore hole pumps (to allow operation at an average of 12 L/s), headworks and buried delivery pipelines. Totalling a minimum of ten (10) additional productions bores planned, with capacity to extend this up to nineteen (19) depending on borefield performance and environmental response over time.
- Three (3) observation bores for constant level monitoring.
- Collection tank(s) for water from the bores.
- Pumps to transfer the water from the collection tanks to the central borefield collection tank (located at Borefield D) via buried delivery pipelines.
- Diesel fired generating set and diesel storage tank.
- Control system including instrumentation and microwave communications back to the process plant.
- Fenced compound.
- Minor service tracks.

The central borefield (Borefield D) has been fitted with a larger collection tank and will pump directly from the borefield area to the process plant via a buried pipeline installed predominately adjacent to the alignment of the Amadeus Gas Pipeline.

The borefield layout has been designed to concentrate the drawdown on the easternmost portion of the Reaphook Palaeovalley Aquifer and extract additional groundwater resource from the feeder palaeovalley to the east. This design also allows extraction within a relatively close proximity to the Nolans site whilst minimising the impact on areas to the west and south thought to have the potential to contain groundwater dependent ecosystems (GDEs).

A significant groundwater monitoring program has been designed to provide ongoing information on aquifer properties, groundwater modelling validation and drawdown impact. New monitoring bores will be designed and installed throughout the reaches of the Reaphook Palaeovalley Aquifer systems and monitoring will continue for the life of mine.

The existing Nolans Dewatering Test Bore (located in the proposed pit outline) will be upgraded if required, and additional bore(s) will be installed externally to the pit footprint area to provide additional water supply and dewater the ore body ahead of mining.

4.9.4.3 Water Distribution

Raw, potable and desalinated water will be reticulated throughout the plant area for use in the process and for domestic users.

In addition, water will be pumped to the various consumers around site through a combination of overland and buried pipelines. This includes raw, potable water and brine water being pumped from the process plant to the mine infrastructure area for use in the mine and raw water being pumped to the camp. Potable water will be produced via a reverse osmosis plant at the camp with brine pumped to evaporation ponds for potential use in dust suppression on tracks/roads.

During construction temporary pipelines may be installed along the site access road and mine access road along with temporary storage for use in road construction and dust suppression for borrow and quarrying areas.

4.10 Stage 8 – Power Supply and Distribution

4.10.1 Power Station

The power station, located within the processing area, will be let under a build, own and operate style contract with the contractor responsible for the construction of the facilities. The power station will consist of a number of natural gas fired turbines, each equipped with duct firing and a heat recovery boiler as well as auxiliary gas fired package boilers and back-up gas and/or diesel fired reciprocating engine generating sets. The power station will also include an overhead powerline to the accommodation village.

Natural gas will be sourced from a newly constructed letdown station connected to the Amadeus Gas Pipeline. The power station will supply all the electrical power required to operate the process plant and non-process infrastructure and will supplement the steam produced by the sulphuric acid plant.

4.10.2 Village

An overhead power line will be installed between the power station and the accommodation village.

A local diesel generator will be included at the accommodation village substation to allow for emergency power to be provided to selected equipment during a power outage. This diesel generator will be directly connected to the substation low voltage motor control centre (LV MCC). Diesel for this generating set will be supplied from a local self-bunded tank.

During construction the village will be operated on local diesel fired generators.

4.10.3 Mine Area

Power for the mine area will be provided from a local diesel generating set feeding into an outdoor kiosk style LV MCC. Diesel for the mine area generating set will be drawn from the main mine diesel storage.

4.10.4 Borefields

Each borefield will have a dedicated local diesel generating set and self-bunded fuel storage tanks. The generating set size and fuel storage will be sized for the anticipated power draw. Power will be distributed to the borefield equipment through an outdoor kiosk style LV MCC.

4.11 Stage 9 – Residue Storage Facility

The RSF is discussed in Section 6 of the Definitive Feasibility Study (DFS) and the Section 14A Report: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_DFS_Summary_Report_-_Final_for_website.pdf)

Details of the RSF design and planning are also presented in the Sections below. The DFS report and the below sections discuss the Life of Mine design and operation of the RSF.

A total of 69 ha has been allowed for within the security calculation presented in APPENDIX CC for initial construction of the RSF which includes the first RSF cell, containment corridor, access and laydown area, which is considered to be more than required. This will provide storage for 7 to 9 years of operations. Security will then be calculated and paid for each additional cell prior to construction and use.

4.11.1 Residue Characterisation

Waste characterisation studies have been completed by Knight Pièsold to determine the physical behaviours and chemical properties of the anticipated residue streams. The detailed testing procedures and results of the assessment are discussed in the individual residue testing reports.

- Knight Pièsold, Tailings Testing Report – Water Leach Residue, prepared for Arafura Resources Pty Ltd, March 2019, Document Reference PE801-00140/16.
- Knight Pièsold, Tailings Testing Report – Blend Tailings, prepared for Arafura Resources Pty Ltd, March 2019, Document Reference PE801-00140/17.

Key characteristics of the residue slurries reporting to the RSF have been included in Table 4—2 below.

Table 4—2 Key Characteristics of Residue Slurries

Parameter	Beneficiation and Gypsum Residue	Water Leach Residue
Solids Specific Gravity	2.5	2.3
Liquid Specific Gravity	1.0	1.0
Solids by weight	27.0%	29.0%
Density	0.8 – 1.2 t/m^3	0.8 – 0.94 t/m^3
Supernatant Release	24-35%	0 – 23%
Underdrainage Release	32%	32%
Radioactivity (max head-of-chain)	Solids = 5.9 Bq/g Liquids = <1.0 Bq/g	Solids = 1.2 +/- 0.1 Bq/g Liquids = <0.12 Bq/L

4.11.1.1 Waste Radiation Classification

Based on the waste characterisation testing completed by Knight Pièsold (2019b, 2019c), the RSF is classed as a nuclear waste disposal facility in accordance with Australian Radiation Protection and Nuclear Safety Agency regulations (Australian Government 2005; Australian Government 2017) for "Very Low-Level Waste" with the radioactivity of the head-of-decay chain elements within the residue and the liquor in both BF/GYP and WL Facilities in the range of 1 to 10 Bq/g or 1 to 10 Bq/L. The RSF designs account for these elevated radiation levels, specifically relating to seepage, dust control, and capping requirements. The management of radiation and limiting exposure are outlined in the Radiation Protection and Radioactive Waste Management Plan (APPENDIX K).

The Radiation Protection and Radioactive Waste Management Plan (Rev 4) has been assessed and approved by the Commonwealth regulator (DCCEEW) under the EPBC Act approval. The updated version is now included at APPENDIX K.

4.11.1.2 Acid Potential

Acid base accounting completed during the waste characterisation testing indicated that both BF/GYP Residue and WL Residue are likely Non-Acid Forming and therefore very low risks of acid generation are calculated within the Facilities.

4.11.2 Overarching Residue Storage Facility Design Parameters

The RSF has been designed to meet the following standards:

- Australian National Committee on Large Dams (ANCOLD): *Guidelines on the Consequence Categories for Dams*.
- Australian National Committee on Large Dams (ANCOLD): *Guidelines on Tailings Dams, Planning, Design, Construction, Operation and Closure*.
- Northern Territory Environmental Protection Authority: *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory*.
- Department of Mines, Industry Regulation and Safety's Code of Practice: *Tailings storage facilities in Western Australia*.
- Department of Mines, Industry Regulation and Safety: *Guide to the preparation of a design report for tailings storage facilities (RSFs)*.
- Global Industry Standard on Tailings Management.

4.11.2.1 Minimum Design Parameters

A failure consequence assessment and determination of the hazard categories for the RSF has been completed in accordance with Department of Mines, Industry Regulation and Safety's (DMIRS) Code of Practice for *Tailings Storage Facilities in Western Australia* and the ANCOLD *Guidelines on the Consequence Categories for Dams*.

Minimum design requirements for the RSF were determined by applying the ANCOLD minimum design parameters from the ANCOLD *Guidelines on Tailings Dams* associated with the determined ANCOLD hazard category. This in conjunction with the site conditions were used to develop the minimum design parameters. The adopted values for the design of each RSF are summarised in Table 4—3 below.

Table 4—3 Minimum Design Parameters for the RSF

Criteria	Minimum Design
Design Climatic Conditions	Design Storm Depth:

Criteria	Minimum Design
	▪ 1 in 100 year AEP 24-hour storm: 196 mm ▪ 1 in 100 year AEP 72-hour storm: 298 mm ▪ PMP 24-hour storm: 670 mm ▪ PMP 72-hour storm: 1,090 mm
Embankment Freeboard	The critical elevation out of: ▪ Minimum of 0.5 m to maximum residue ▪ Minimum of 1.0 m to maximum design pond. ▪ Minimum of 0.1 m for maximum emergency spillway flow (PMP)
Spillway Capacity	Sized to safely discharge any excess water due to a PMP rainfall event after attenuation in the facility.
Design Earthquake Loading	OBE - 1 in 1,000 year: 0.024g MDE - 1 in 10,000 year: 0.045g Post Closure - MCE: 0.053g
Minimum Factor of Stability	Long term drained 1.5 Short term undrained. Potential loss of containment 1.5 No potential loss of containment 1.3 Post seismic: 1.0 to 1.2

4.11.2.2 RSF Design Strategy

Detailed description of the design and operational requirements, including monitoring, are provided within the Design Report and RSF Operating Strategy compiled by Knight Pièsold:

- Knight Pièsold, Residue Storage Facility, Definitive Feasibility Study – Design Report, prepared for Arafura Resources Pty Ltd, March 2019, Document Reference PE801-00140/12.
- Technical Memorandum titled "Nolans Project – Definitive Feasibility Study Design Update, prepared for Arafura Resources Pty Ltd, March 2022, Document Reference PE22-00303.
- Knight Pièsold, Residue Storage Facility Operating and Monitoring Manual, prepared for Arafura Resources Pty Ltd, November 2018, Document Reference PE801-00140/8.

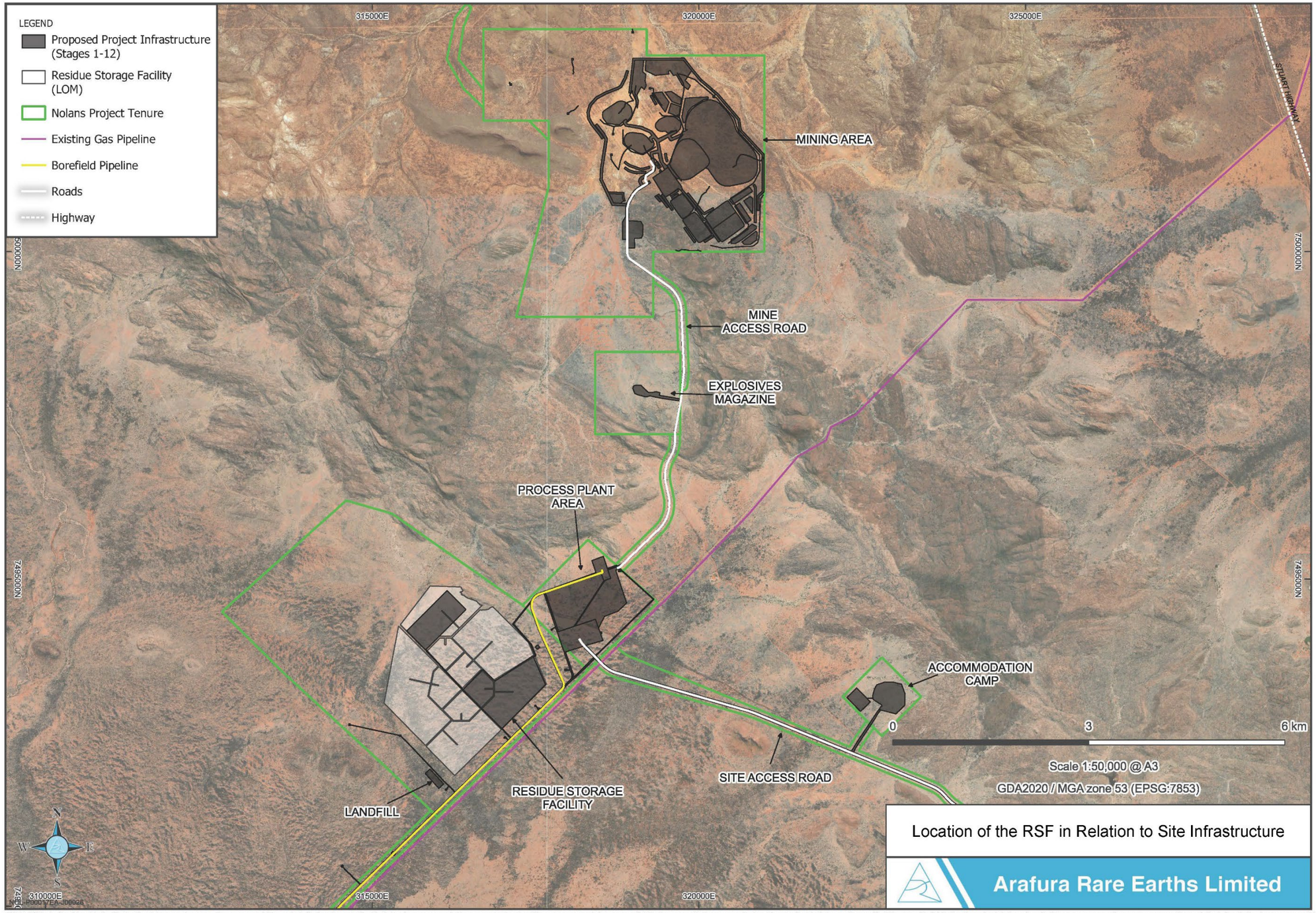
The Project will produce three residue wastes delivered to the RSF as two different streams: a combined beneficiation tailings stream (BF) and gypsum (GYP) residue stream and a water leach (WL) residue stream. The wastes will be transferred in a bunded corridor from the nearby processing facilities to the RSF and deposited into their respective storages as shown in Figure 4—1 below. The RSF is designed to operate two separate residue facilities concurrently, one to receive BF and GYP residue and the other to receive WL residue. The two separate residue facilities operating concurrently will share an adjoining embankment and are considered one cell.

Each BF/GYP RSF section will be approximately 50 ha each, and each WL RSF section will be approximately 16 ha each. Each cell is therefore approximately 66 ha each.

Each cell will be constructed sequentially, with Cell 1 constructed for initial operational activities, which allows for storage for the operational activities planned in Stages 11 and 12 of works. A total of 69 ha has been allowed for within the security calculation for the initial construction of the RSF, which includes 66 ha for Cell 1, and 3 ha for a containment corridor, access and laydown area. This will provide storage for 7 to 9 years of operations. Security will then be calculated and paid for each additional cell prior to construction and use.

To limit the operational area, as well as the final height, a total of three cells will be constructed sequentially during the first 20 years of the Project life. A further three cells will be constructed for the remainder of the 38-year LOM, with the facility being mirrored to the south once the first three cells are completely filled. The scope of these works, and security for these planned further cells (beyond cell 1) will be covered in subsequent updates to this MMP.

The construction footprint of the first three cells (3 x BF/GYP sections and 3 x WL sections) will be approximately 240 ha. The detailed design of these first three cells is illustrated in Figure 4—2 below. The full current design footprint for RSF for cells 1-6 is shown in Figure 4—1. Detailed design for cells 4-6 will be undertaken prior to their construction, and will be included at such time in subsequent updates to this MMP.



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Figure 4—1 Location of the RSF in Relation to Site Infrastructure

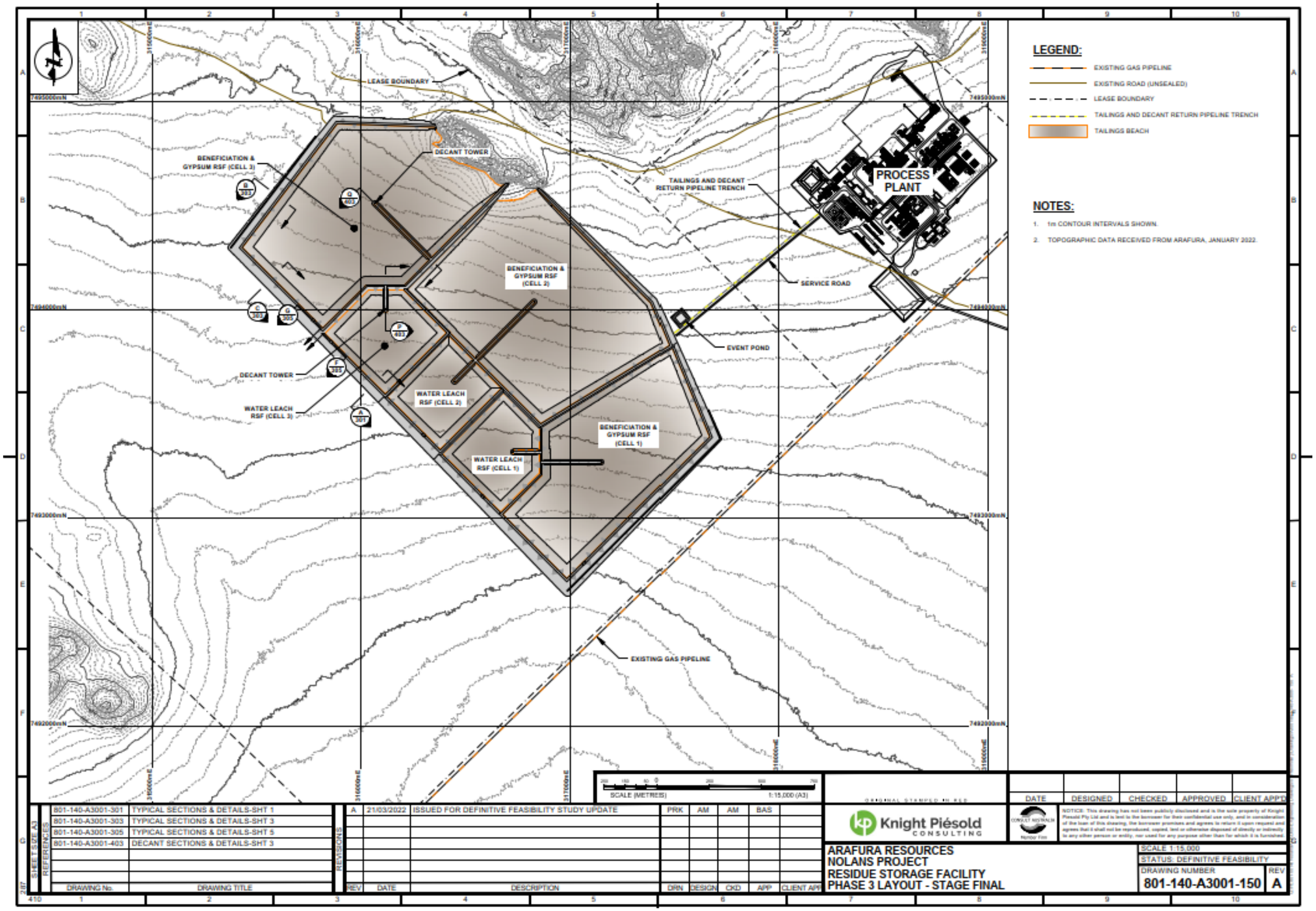


Figure 4—2 Detailed design of RSF Cells 1-3

The two residue facility types (BF/GYP and WL) have been designed with consideration to the geochemical properties of the waste streams being deposited. To provide seepage control and to mitigate potential seepage losses, engineered basin liners and underdrainage features have been integrated.

The BF/GYP RSF sections will incorporate a reworked soil lined basin with a full piped underdrainage network. The embankments will have a low permeability soil upstream fill zone and will be built using modified centre line construction techniques. A cut-off trench will be located beneath the entire length of the embankment and will be excavated into a competent foundation layer.

The WL RSF sections will include additional seepage measures comprising of two basin liners, a primary HDPE geomembrane overlying a secondary engineered soil liner. The WL RSF sections will incorporate an underdrain network above the HDPE liner with an additional leakage control and recovery system below the HDPE liner providing stringent seepage management. The embankments will have a low permeable upstream fill zone as well as a HDPE geomembrane liner and, like the BF/GYP RSF sections, include a cut-off trench beneath the entire length of the embankment, excavated into a competent foundation layer. To allow for continuous lining of the embankments, embankment lifts will be constructed using downstream construction techniques.

Detailed designs of the embankments for both the BF/GYP RSF and WL RSF sections have been provided in Figure 4—3 and Figure 4—4.

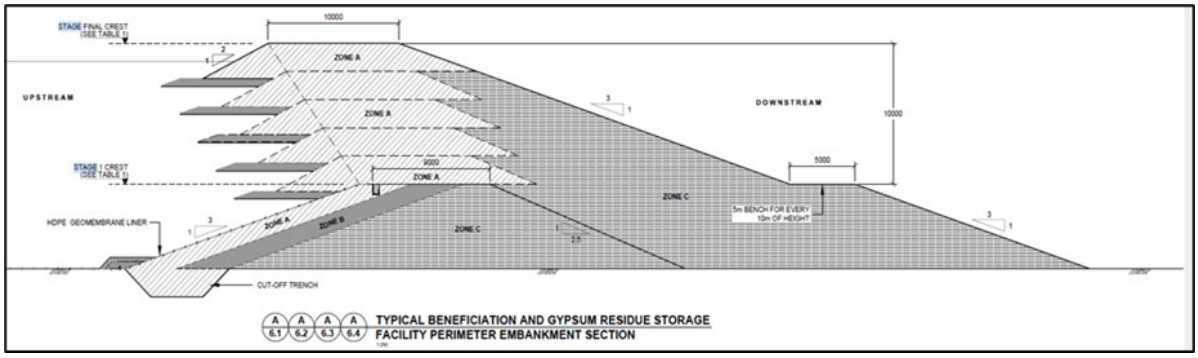


Figure 4—3 Typical Beneficiation and Gypsum Residue Storage Perimeter Embankment Section

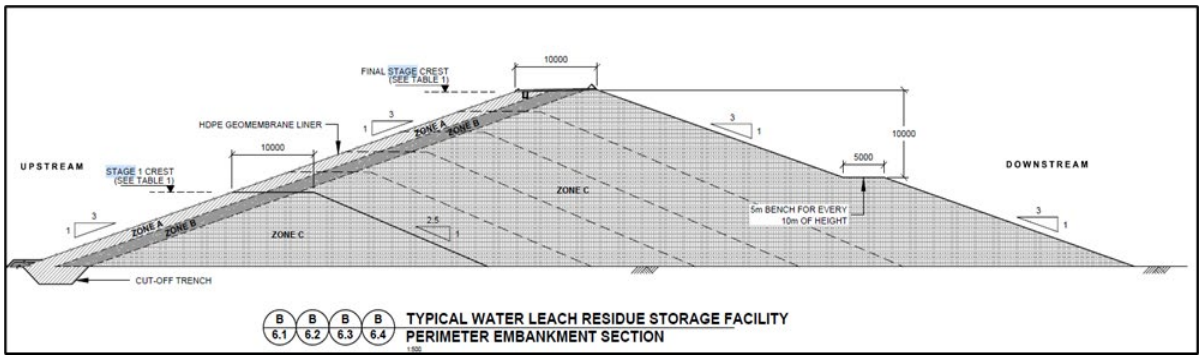


Figure 4—4 Typical Water Leach Residue Storage - Perimeter Embankment Section

4.11.3 Key Residue Storage Facility Features

The following key RSF features have been summarised from the KP (2019a) RSF Design Report. The report should be referenced for specific designs details.

4.11.3.1 Residue Deposition System

The deposition of the residue into both the BF/GYP RSF and WL RSF sections will be done sub-aerially from the perimeter embankments. Multiple spigots inserted along the residue distribution line will be used to control deposition. The spigots will be systematically relocated to control the location of the supernatant pond. A suitable cycle time will be confirmed after the initial establishment of the residual beaches to ensure even residue deposition, thereby maintaining the supernatant pool at a suitable location and maintaining the formation of the residue beach.

4.11.3.2 RSF Seepage Control

Seepage control and underdrainage features have been incorporated into the RSF design to mitigate potential seepage losses and to increase settled densities of the residue streams.

4.11.3.3 RSF Cut-off Trench

A cut-off trench will be installed along the entire length of the embankments to prevent near surface seepage. For the RSF cells 1-3, construction of the cut-off trench will be excavated into foundation soils to competent foundation materials and backfilled with low permeability fill. The cut-off trench will vary in depth depending on the extent of the competent foundation material. The cut-off trench will be directly below the upstream Zone A (see Figure 4—3 and Figure 4—4 for embankment zones) of the embankment and will run the full length of the embankment.

4.11.3.4 RSF Basin Area Lining

The basin areas will be lined to reduce seepage potential from the RSF. During the initial construction, the basin areas will be cleared and grubbed prior to excavation. The basin surface will be left with sufficient low permeability material which will be worked to create a compact soil liner. For the WL RSF sections, an addition HDPE liner will be added to further reduce seepage losses.

4.11.3.5 RSF Underdrainage System

A collector drain will be installed through the centre of the basin with connecting finger drains that will make up the underdrainage system. In addition, the underdrainage will connect into the toe drains with all drainage reporting to the underdrainage sump located at the RSF embankment. The benefits of the system include:

- Reduced seepage through the basin and under/through the embankment. This is beneficial to the environment and promotes increased embankment stability.
- Residue mass drainage, thus increasing the density of the residue and consequent facility efficiency in terms of constructed storage capacity.
- Increased strength of the residue mass immediately adjacent to the embankment.

- Reduced phreatic surface in the residue mass and RSF embankments.

4.11.3.6 RSF Underdrainage Collection Tower

At the lowest point of the BF/GYP RSF sections basin and adjacent to the embankment upstream toe, an underdrainage collection tower will be positioned. The underdrainage sump will collect solution from the underdrain system before being pumped to the residue surface via a submersible pump located beneath the underdrainage collection tower. Recovered solution will be pumped to the surface of the RSF where it will report to the supernatant pond and ultimately the decant tower.

4.11.3.7 RSF Underdrainage Collection Sump and Riser Pipe

Like the underdrainage recovery tower associated with the BF/GYP RSF sections, a sump will be excavated within the WL RSF sections to collect solution from the lined HDPE basin. The sump will incorporate a submersible pump and riser pipe to remove excess solution. Ingress of residue will be avoided by backfilling with coarse drainage rock and appropriate filters.

4.11.3.8 RSF Leak Collection and Recovery System

As a matter of contingency, a leakage collection and recovery system will be installed beneath the HDPE basin liner of the WL RSF sections. A network of collector pipes will direct solution that has breached the HDPE liner to a collection sump. The sump will act as a monitoring point to detect leaks and, if required, as an abstraction point for solution.

4.11.3.9 RSF Decant System

Each cell will have a decant tower during operation that will remove supernatant water via a submersible pump. The initial supernatant pond for Cell 1 will be located on the eastern edge of the RSF. Solution recovered from the decant system will be pumped back to the plant for re-use in the process circuit.

4.11.3.10 RSF Spillways

Each cell of the RSF will be designed to contain the greater of a 1 in 100-year ARI and a 1% AEP 72 hour storm event in addition to the maximum supernatant pond under average rainfall conditions. Under normal operating conditions the stormwater capacity will be more than the event volumes and no discharge from the facility is expected.

To prevent uncontrolled overtopping of an embankment in an event that exceeds the design parameters, spill ways have been included in the design for each cell. The spillways allow for the safe management of stormwater in an emergency event up to the PMP event.

4.11.3.11 RSF Delivery and Decant Return Pipeline Corridor

The residue delivery pipelines and decant return pipeline that run between the RSF and the processing plant will be installed within a HDPE lined bund. An event pond located at the toe of the RSF will be adequately sized to recover the entire content of the pipeline in the event of a failed pipe.

4.11.4 RSF Design Storage

Per Table 4—4 below, tailings disposal into the RSF cell 1 is scheduled to occur through year eight of the disposal staging schedule, with tailings disposal occurring through the construction of four staged wall height increases (lifts) up to a maximum wall height of 15 metres in total prior to the construction of additional cells to the west side of the facility. The current RSF design works on a two-year construction cycle for each stage of embankment lifts. An estimated construction/disposal schedule for the first three cells (20 years) has been provided in Table 4—4 and Table 4—5 below. These are the design considerations and will be adjusted as required throughout the LOM.

Table 4—4 Estimated Disposal Staging Schedule for Beneficiation/Gypsum Residues for cells 1-3 (20 years)

Cell		Stage	Construction Year	Crest Elevation (mRL)	Storage Capacity		Cumulative storage (Mt)		Density	Cumulative Storage in Cell (Mm^3)
					(month)	(Mt)	in Cell	in Facility	(t/m^3)	
Beneficiation & Gypsum Residue Cells	1	1	-1	663.4	30	1.58	1.58	1.58	1.03	1.53
		2	3	666.0	30	2.22	3.80	3.80	1.18	3.22
		3	5	668.1	24	1.45	5.25	5.25	1.23	4.27
		4	7	670.4	24	1.60	6.85	6.85	1.29	5.31
	2	1	9	666.8	12	0.94	0.94	7.79	0.75	10.39
		2	10	669.9	24	1.99	2.93	9.78	1.06	9.23
		3	12	672.1	24	2.05	4.98	11.83	1.18	10.03
		4	14	674.2	24	1.92	6.89	13.75	1.24	11.09
	3	1	16	668.2	12	0.99	0.99	14.74	0.76	19.39
		2	17	671.6	24	2.06	3.05	16.80	1.08	15.56
		3	19	674.4	24	1.96	5.01	18.76	1.16	16.17
		4	21	676.4	24	1.05	6.06	19.81	1.23	16.11

Table 4—5 Estimated Disposable Staging Schedule for Water Leach Residues for cells 1-3 (20 years)

Cell		Stage	Construction Year	Crest Elevation (mRL)	Storage Capacity		Cumulative storage (Mt)		Density	Cumulative Storage in Cell (Mm^3)
					(month)	(Mt)	in Cell	in Facility	(t/m^3)	
Water Leach Residue Cells	1	1	-1	662.9	36	0.30	0.30	0.30	0.89	0.35
		2	3	665.4	24	0.28	0.59	0.59	0.91	0.67
		3	5	667.6	24	0.28	0.87	0.87	0.92	0.99
		4	7	669.7	24	0.29	1.15	1.15	0.93	1.30
	2	1	9	663.5	12	0.15	0.15	1.30	0.66	0.23
		2	10	666.6	24	0.27	0.41	1.57	0.82	0.55
		3	12	669.0	24	0.29	0.70	1.86	0.87	0.86
		4	14	671.2	24	0.29	0.99	2.15	0.89	1.18
	3	1	16	665.2	12	0.14	0.14	2.29	0.66	0.23
		2	17	668.1	24	0.29	0.43	2.58	0.82	0.55
		3	19	670.4	24	0.29	0.73	2.87	0.87	0.85
		4	21	672.0	24	0.20	0.92	3.07	0.89	1.08

4.11.5 RSF Construction

Construction will be completed during the dry season, on a two-yearly cycle. Embankments will be constructed with slopes of 3H:1V upstream and 2.5H:1V downstream during operation. These slopes will then be flattened to 3.5H:1V during the last RSF construction stage to present a final closure profile.

For the initial RSF cells 1-3 embankment, the bulk construction materials will be sourced from the RSF footprint to reduce the total disturbed area impacted by the facility and to generate storage volume for future cells. Material not sourced from within the RSF footprint will be sourced from a rock outcrop on the northern extent of the RSF, from the mining operations waste stockpiles or local borrow sources.

A summary of the required construction material has been provided in Table 4—6 and typical cross sections of the RSF Embankments (including fill zones) are provided in Figure 4—3 and Figure 4—4.

Table 4—6 Summary of Construction Materials Including Source and Zone Compaction Specifications

Zone Type	Zone Description	Zone Compaction Specifications	Marial Source
Zone A	Low permeability material.	98% SMDD, 0% < OMC < =3% 300mm layers	From local borrow.
Zone B	Transitional fill	95% SMDD, -3% < OMC < +3% 500mm layers	From local borrow.
Zone C	Structural fill	95% SMDD, -3% < OMC < +3% 500mm layers	From local borrow.
Zone E	Erosion protection	Uniform density free from cavities, 300mm layers	From local borrow or supply from mining operation.
Zone F	Drain filter material	Uniform density free from cavities, Moist	Imported from offsite or processed onsite and supplied to local stockpile.
Zone G	Coarse rockfill	Uniform density	Processed onsite or supplied from mining operations.

4.11.5.1 RSF Sediment Control

Construction of the embankments will predominantly take place during the dry season to reduce sediment runoff.

4.11.6 RSF Operation

The purpose of the RSF Management Plan (APPENDIX Q) is to provide a framework that will assist with the identification and management of the key environmental risks associated with the RSF. The RSF EMP provides guidance on the RSF environmental monitoring and reporting requirements and assigns

actions when performance thresholds are exceeded. The objective of the Plan is to ensure that the RSF operates in a manner that causes no adverse impacts to people or the environment.

The RSF EMP should be read in conjunction with the RSF supporting documentation. This includes the RSF Design Report and the associated RSF Operating and Monitoring Manual.

- Knight Pièsold, Residue Storage Facility, Definitive Feasibility Study – Design Report, prepared for Arafura Resources Pty Ltd, March 2019, Document Reference PE801-00140/12.
- Knight Pièsold, Residue Storage Facility Operating and Monitoring Manual, prepared for Arafura Resources Pty Ltd, November 2018, Document Reference PE801-00140/8.

4.11.7 RSF Closure

Each cell will operate for 7 to 9 years before deposition shifts to newly built cells. On decommissioning, each cell will be capped to isolate the deposited residue and reduce rainfall infiltration.

Long-term stable water management structures will be constructed across the facility and rockfill placed to control erosion in critical area. The facility will then be revegetated.

All closure activities, including progressive rehabilitation of the RSF, will be described further within the Mine Closure Plan.

4.11.8 RSF Surface Water Management

Surface water management will be characterised into dirty water systems and clean water systems.

Dirty Water Systems

Stormwater falling within the RSF area, including areas where any spillage may occur from piping and spigots, will drain into the RSF storage cells. Any stormwater collected in the piping corridor will be directed to lined sediment collection sumps for later clean-out or directed into the process plant dirty water system.

Clean Water Systems

Catchments include natural watercourses and drainage lines outside of the RSF and from the outside walls of the RSF with provision of infrastructure for flood protection levees, clean water diversions, and open drain systems.

Flow and stormwater diversion banks and cut off drains will be installed across the RSF area to divert clean water away from the disturbed areas and around infrastructure. This water flow, once directed around the disturbed area will be fed to downstream erosion and sediment control devices to manage and direct (disperse) new potentially focussed flow paths.

4.12 Stage 10 – Mine Complex and Surface Water Management

4.12.1 Mine Infrastructure Area

The MIA and Ammonium Nitrate Explosives Storage Area (ANESA) will be developed to support the operation of the mine. The MIA will be located only a short distance from the open pit and Run of Mine (ROM) pad. The MIA layout will be based on appropriate risk assessment processes as well as the efficient grouping of facilities and placement of buildings to minimise clearing and aid safe and effective operation. Heavy vehicle parking (go-line /deadline), turnarounds and mine laydown area will form part of the overall layout and function of the MIA.

4.12.1.1 Buildings

The buildings at the MIA will include:

- Mine administration complex (modular transportable complex).
- Ablutions and crib facilities (modular transportable units).
- Mine heavy and light vehicle workshop (domes between modular containers).
- Mine stores (modular transportable complex)
- Core cutting and storage container complex (modular transportable complex).
- Sample prep lab and assay storage (modular transportable unit).

4.12.1.2 Other Facilities

The MIA will also include the following facilities not described elsewhere:

- Tyre change pad, fitting area and storage.
- Fuel storage facilities – one fuel storage tank is planned
- Washdown pad facilities for heavy and light vehicles, and road trains
- Water storage tanks and ponds.
- Carpark.

4.12.1.3 Explosives Storage

The ANESA will be located within the explosives magazine, located off the mine access road approximately 2.5 km south of the mine.

The ANESA will consist of two compounds (modular containers), one for the storage and mixing of ammonium nitrate prill and emulsion and one for the storage of detonators and high explosives. The facilities will be provided either under the mining or explosives supply contract. The design will adhere to AS2187, Explosives Storage, Transport and Use and the relevant NT legislative requirements. The final layout designs will be reviewed by independent consultants as part of the required dangerous goods licensing requirements.

The ANESA compounds will be fenced with high security fencing, with lights for night-time operation and security monitoring.

4.12.2 Mine Area Surface Water Management

The Mine area surface water management consists of:

- Stage 1 Kerosene Camp Creek diversion for mine site development
- Flood protection bunds and channels to prevent water flow into the mine area
- Mine area water collection ponds and other surface water management structures.

The surface water management description should be read in conjunction with PSM's Kerosene Camp Creek Diversion and Mine Surface Water Management 50% Level Design Report that was undertaken to obtain a permit to interfere with a waterway from the Northern Territory water regulator, as attached in APPENDIX BB.

Surface water management will be characterised into clean water systems, dirty water systems and ore contact water. Figure 4—5 below shows the general mining surface water management systems for the Stage 1 mine design and Figure 4—6 for the final mine design. The security calculations presented in this submission of the MMP however, only focuses on the first stage of the Kerosene Camp Creek diversion in conjunction with the surface water management structures to support the first nine (9) year mine development.

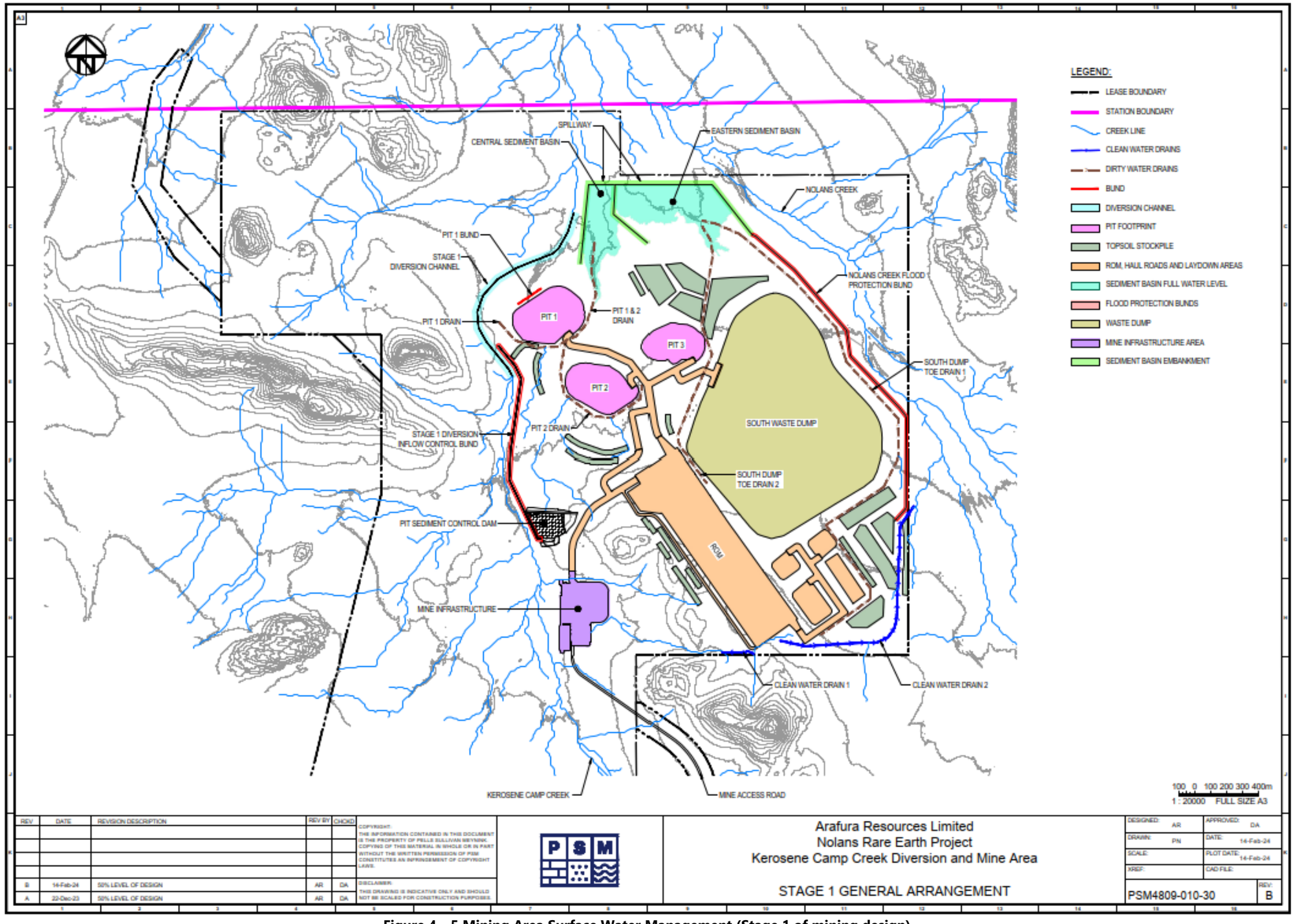


Figure 4—5 Mining Area Surface Water Management (Stage 1 of mining design)

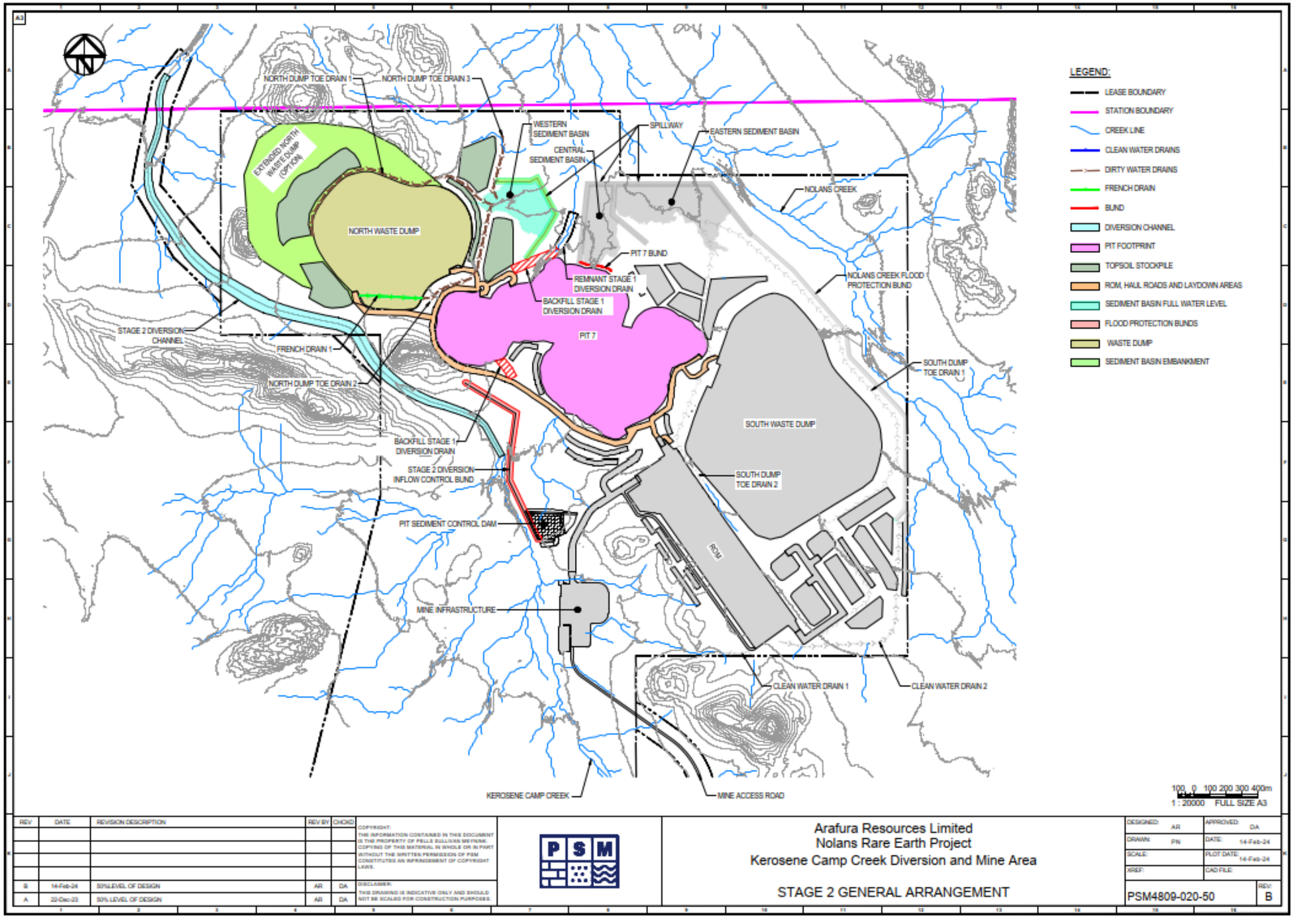


Figure 4—6 Mining Area Final Surface Water Management (final mining design)

4.12.2.1 Clean Water Systems

Catchments for clean water systems include natural watercourses and drainage lines outside of the operational mining areas, with provision of infrastructure for flood protection levees, clean water diversions, and open drain systems.

Flow and stormwater diversion banks will be installed across the mine site to divert clean water away from the disturbed areas and around infrastructure. The major management structures include:

- Diversion channel, cut off bund and paleochannel cut off, of the Kerosene Creek alignment to divert flow around the mining area including the open pit.
- Flood protection bund to the eastern side of the mine area which mitigates risks associated with the Nolan's Creek flood plain impacting mine infrastructure, eastern waste rock dump.
- Downstream erosion and sediment control devices to manage and direct (disperse) new potentially focussed flow paths.

4.12.2.2 Dirty Water System

Sediment water catchments include areas disturbed by mining activities (i.e. haul roads, waste rock dump(s), etc.). Surface water drainage systems will be employed to intercept and direct sediment-laden water to sediment management structures which will be constructed downstream of any disturbed mining or infrastructure areas (typically from haul roads, waste dumps, stockpiles and other exposed pavements).

Infrastructure consists of overland open channel drains/catch drains, sediment basins and erosion and sediment control structures (upstream and downstream). The overland flow catch drains will direct stormwater to sediment settlement ponds.

Stormwater retention ponds (or sediment basins) will contain stormwater runoff from any respective catchments reporting to them in accordance with a retention capacity of 100-years ARI (equivalent to the 1% AEP) 72-hour design storm event, while maintaining a minimum freeboard of 500mm to the embankment crest.

4.12.2.3 Ore Contact Water

The ore contact water system manages runoff water generated within the open pit, and stockpile (ROM pad). As a result, ore contact water typically includes elevated pollutant levels that should not be discharged into the downstream environment without suitable treatment.

Within the open pit, pit sumps will be used to manage most runoff generated within the pit area and inflows from the stockpile erosion and sediment control drainage. During periods of extended or extreme rainfall, it is expected that the pit sumps will be overtopped, flooding the pit floor and potentially some lower benches. During these periods, mining operations will be moved to upper benches (if safe to do so) or suspended whilst the pit is dewatered.

The pit will be dewatered into water storage ponds (turkey's nests) for use in dust suppression.

4.12.2.4 Kerosene Camp Creek Diversion

Stage 1 of the KCC diversion consists of the following:

- A channel approximately 1,400 m in length and a profile consisting of a variable depth (averaging 4m) and width (averaging 50 m). The total disturbance area is approximately 8.3 Ha.
- An inflow pit protection bund of approximately 1,440 m in length and a crest width of 10 m. The total disturbance area is approximately 3.0 Ha.

The KCC diversion design report included in APPENDIX BB provides design to date (50% level design). This design has been approved by DEPWS Water Regulation with grant of a Permit to Interfere with a Waterway (IWW: KCC-001).

4.13 Stages 11 & 12 – Mining Operations and Processing Activities

4.13.1 Mining Activities

Mining will use conventional open-pit mining methods including drill and blast, waste and ore mining with hydraulic excavators and rear dump trucks and ROM haulage activities to transport ore to the process plant approximately 8.5 km to the south. The mine is expected to have a life of 28 years with processing of ROM stockpiles to continue until fully depleted for a further 10 years. Other ancillary mining activities include:

- Vegetation clear and grub
- Topsoil removal and stockpiling (See the Topsoil Management Plan at APPENDIX A)
- Pit dewatering
- Surface water management for mining activities
- Dust suppression
- Road Maintenance
- Long-term stockpile management
- Mine landform and disturbance rehabilitation.

Whilst the mining operation below talks to a Life of Mine (38 years), the definition within the security calculations (APPENDIX CC) focuses on the initial nine (9) years of development. Further development will be aligned with the construction of the second stage of the Kerosene Camp Creek diversion (final stage), which opens up access to the north-west of the mine ML for further development of the pit and northern waste rock dump. Securities for these future stages of the Project will be established in time when design matures after the initial years of operation.

4.13.1.1 Mine Scheduling

The open pit will be mined in seven Pit Stages as either discrete pits or as pit wall cutbacks over the LOM plan with an average strip ratio of 4.5 (t:t). The mining sequence is determined by the production schedule to maintain adequate ROM stocks and achieve a target rare earth feed concentrate production of 340,000 tpa. This allows for mining for the first seven years to be achieved on a campaign

basis before becoming a continuous operation. The current planned campaigns can be broken down as:

- Mining Campaign 1 (Stage 11):
  - Pre-strip activities for 4 months before process plant ore commissioning
  - 12-months of production mining.
  - 12-month break from mining activities (during Year 2).
- Mining Campaign 2 (Stage 12):
  - Mining activities re-commence in Year 3 for approximately 48 months.
  - 3-year break from mining activities (during Years 7, 8 and 9).
  - Mining then recommences on a continuous basis for the remainder of the mine life.

During both mining campaign breaks, ROM haulage of ore to the process plant will continue with reclamation of ore from the ROM stockpiles built up during the mining campaigns. Supporting mine ancillary activities will also continue through the mining breaks.

Mining takes place in Pit Stage 1 during campaign 1 (see Figure 4—9 below), and Pit Stages 1, 2 and 3 during campaign 2 (see Figure 4—10 below) which significantly minimises the total mining disturbance footprint during the initial years of operation.

Changes to the current mining campaign timeframes are possible and could be influenced by the following factors:

- Increases or decreases in the process plant commissioning ramp-up period.
- Process plant performance:
- Mining performance to plan during the campaign periods including ore grade performance.
- The availability of ore on the ROM stockpiles to meet production needs.
- Contractual obligations and limitations with the engaged Mining Contractor.

Either of these factors could result in a delay to the mining breaks commencing, extension of the mining breaks or even cancellation of the mining breaks to maintain the continued supply of ore to the ROM and process plant.

The estimated mine movements during mining campaigns 1 and 2 are shown in Table 4—7 below.

Table 4—7 Mining Campaign 1 and 2 Mining Quantities by Pit

		Mining Campaign 1 (Stage 11)			Mining Campaign 2 (Stage 12)					
Pit	**Material**	**Pre-Production**	**Yr1**	**Yr2**	**Yr3**	**Yr4**	**Yr5**	**Yr6**	**Yr7**	**Total**
Pit 1	Ore (Mt)	0.1	1.5	-	1.8	1.1	-	-	-	**4.5**
	Waste (Mt)	1.4	3.7	-	4.0	1.0	-	-	-	**10.1**
	LT Stockpile (Mt)	0.0	0.2	-	-	-	-	-	-	**0.2**
Pit 2	Ore (Mt)	-	-	-	-	0.4	0.8	0.8	0.2	**2.2**
	Waste (Mt)	-	-	-	-	1.4	2.1	2.0	0.2	**5.7**
	LT Stockpile (Mt)	-	-	-	-	-	-	-	-	**-**
Pit 3	Ore (Mt)	-	-	-	-	0.1	0.4	0.6	-	**1.1**
	Waste (Mt)	-	-	-	-	1.8	2.4	2.2	-	**6.4**
	LT Stockpile (Mt)	-	-	-	-	-	-	-	-	**-**
Total	Ore (Mt)	**0.1**	**1.5**	**-**	**1.8**	**1.6**	**1.2**	**1.4**	**0.2**	**7.8**
	Waste (Mt)	1.4	3.7	-	4.0	4.2	4.5	4.2	0.2	22.2
	LT Stockpile (Mt)	-	0.2	-	-	-	-	-	-	0.2
	ROM Haulage (Mt)	-	0.6	0.8	0.7	0.8	0.8	0.9	0.9	5.5

Continuous mining currently commences late in Year 9 of operations and continues without any planned breaks until the end of mine life. Figure 4—7 below shows the current LOM plan with tonnage mined per year.

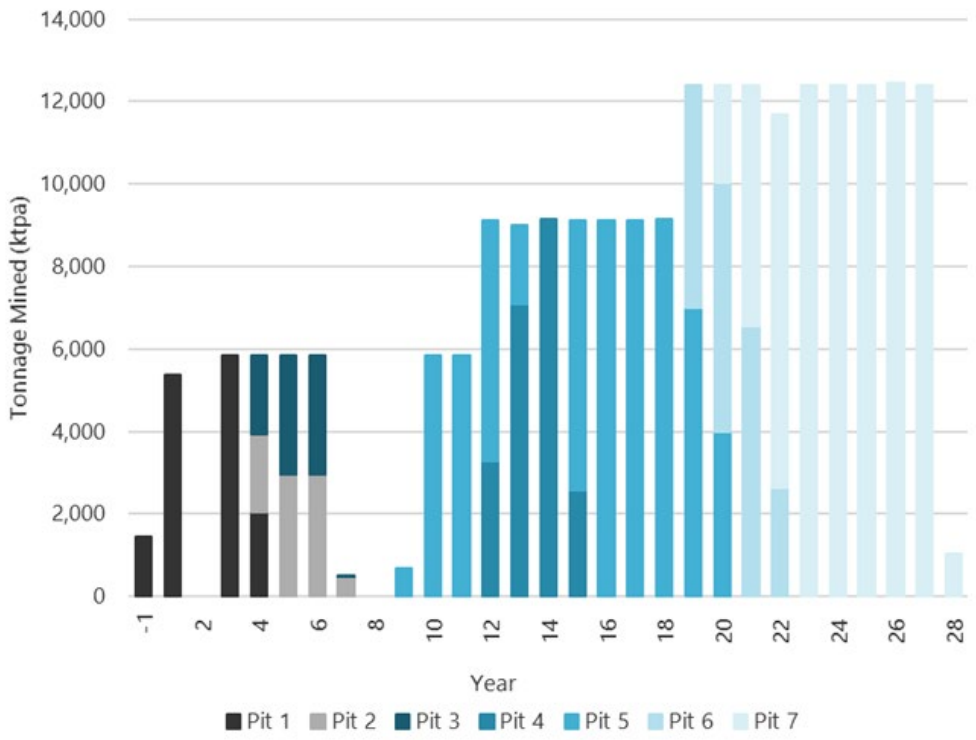


Figure 4—7 LOM Plan – Ore Production

Mining rates are driven by the processing constraints along with the requirement to minimise total material movements out of the pits while maintaining adequate ROM stockpile levels. These constraints drive a nominal annual mining rate of 6.0 Mtpa for the first 11 years including the breaks in mining. The mining rate rises to approximately 9.0 Mtpa for years 12-18 and then to 12.0 Mtpa from Year 19.

The current LOM plan will be routinely updated as the Project progresses towards and into operations but is not expected to materially change to achieve the planned production targets of the Project.

4.13.1.2 Mine Design

Ore will be selectively mined on bench heights to be no greater than 5 metres with mining typically undertaken on three, 2 metre flitches when blast heave is included. All ore mined will be stockpiled on the ROM pad in fingers for blending with no direct feed of the process plant occurring. ROM ore will be loaded onto road trains by front end loader and delivered to the process plant.

Waste from the mine will be stockpiled in two WRDs, one to the east and one to the west of the pit. The western WRD is not established until the permanent Kerosene Creek diversion is in place and mining is required to commence in the western parts of the deposit (currently Pit 5 in Year 9).

Mineralised material not presently classified as suitable ore types for processing (referred to internally as “non-preferred” ore types) will be stockpiled in the designated “long-term stockpile” (LTS) area. These LTS areas will also contain low-grade ore that may or may not be processed throughout the LOM. For material types that do not end up being processed, these LTS areas will buttress the eastern

waste rock dump to facilitate eventual shaping and encapsulation with benign waste material and eventual rehabilitation with the eastern WRD.

Figure 4—8 shows the overall mine layout at the end of mine life with Figure 4—9 and Figure 4—10 showing the mine layout at the end of campaigns 1 and 2, respectively.

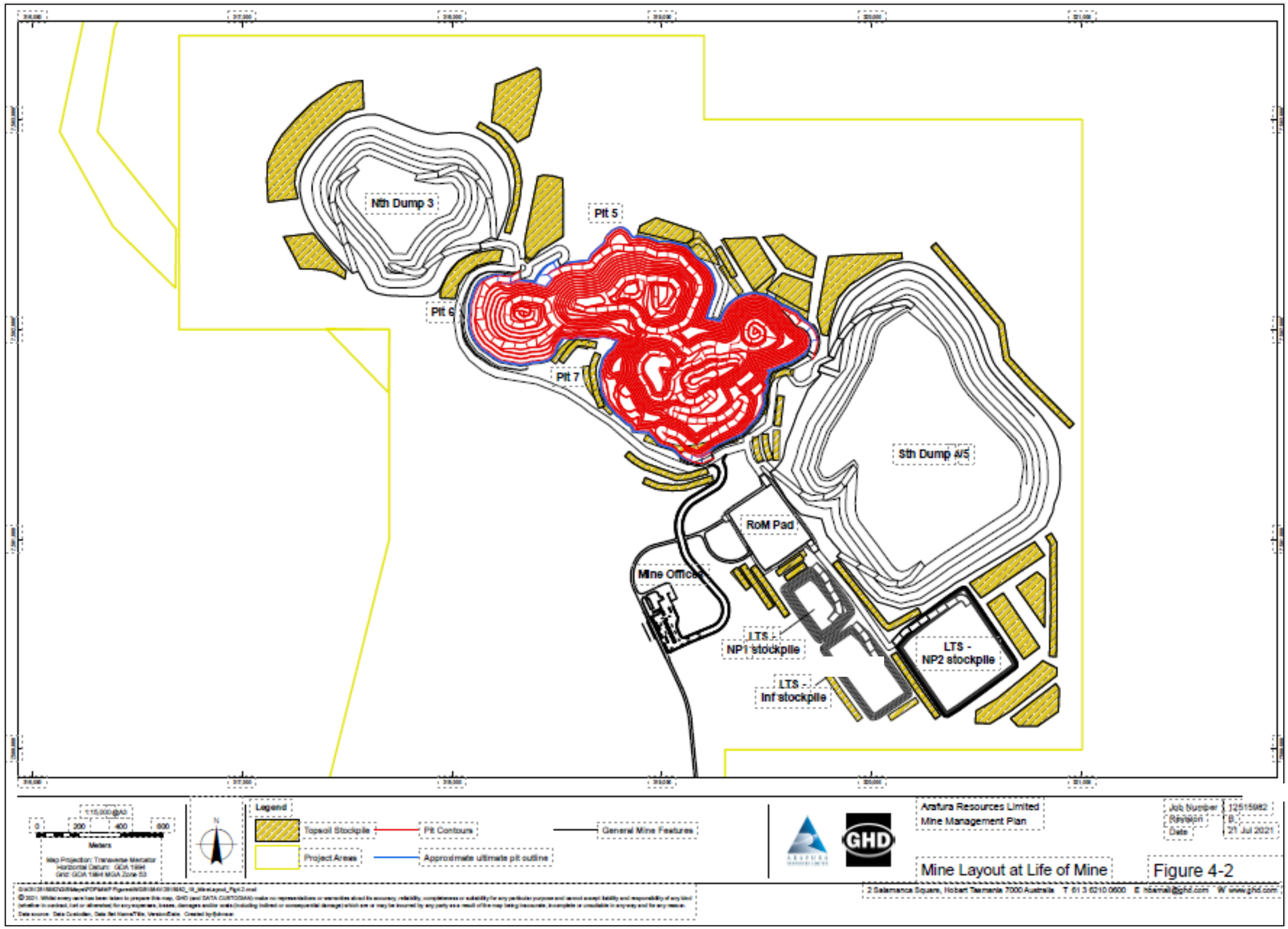


Figure 4—8 Mine Layout at Life of Mine

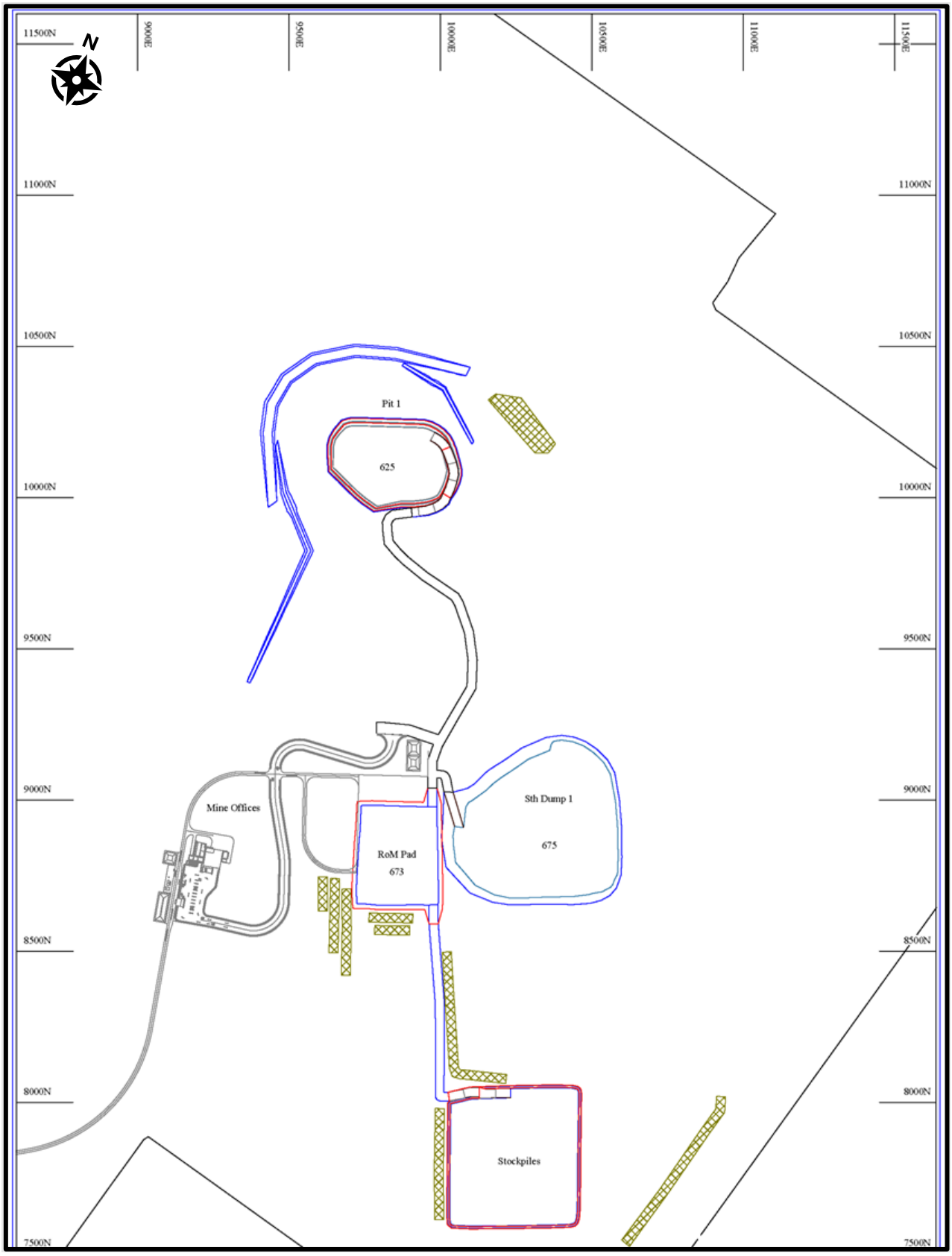


Figure 4—9 Mine Layout at end of Campaign 1 – end of Year 1 (local grid)

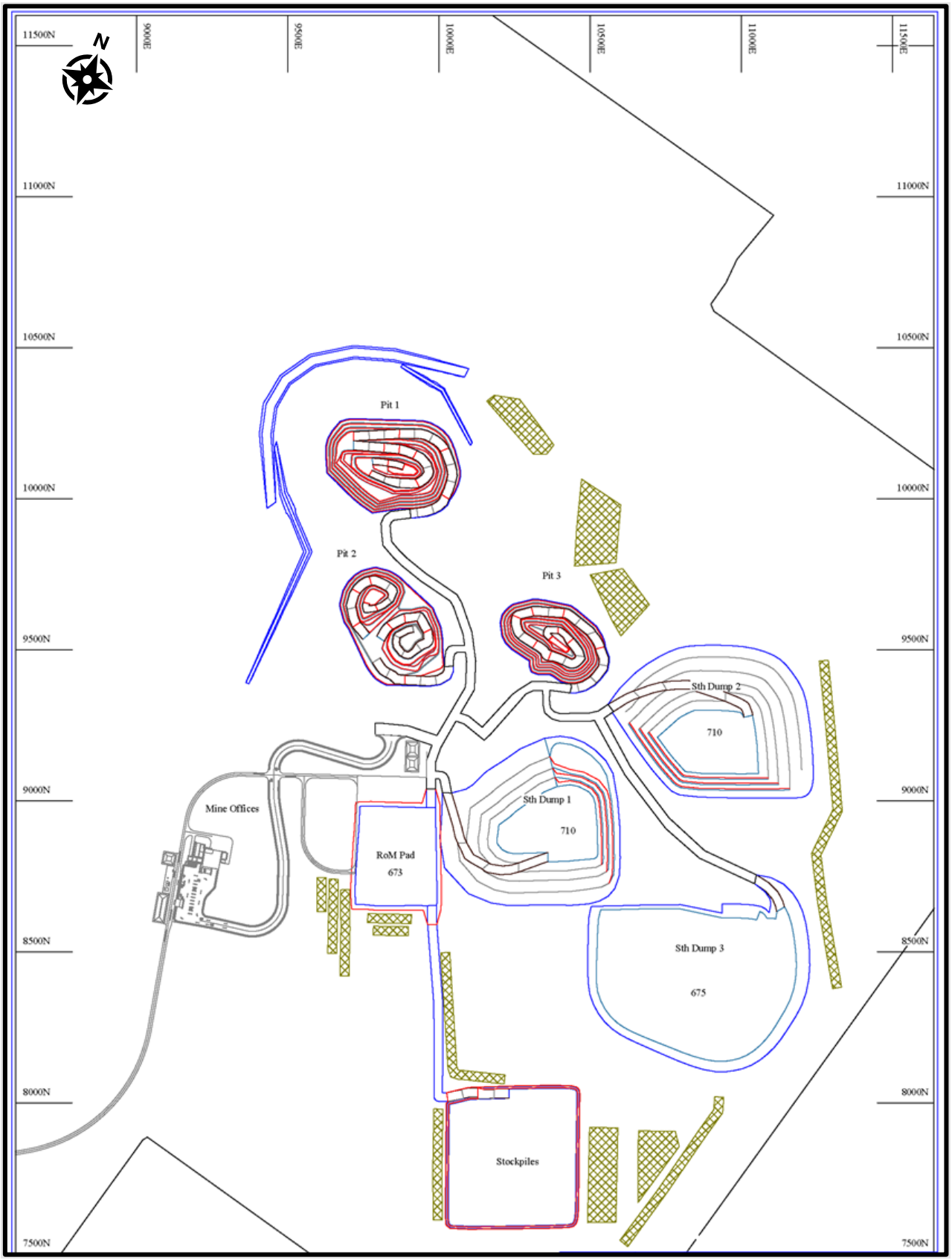


Figure 4—10 Mine Layout at end of Campaign 2 – start of Year 7 (local grid)

4.13.1.2.1 Pit Design

The open pit mine design is shown in Figure 4—11. The LOM open pit is currently planned to reach a depth of about 220 m with a surface area of approximately 100 ha. The final pit dimensions are 1.6 km long, 1 km wide at its widest point. The final pit is the result of merging individual Pit Stages and final pit wall cutbacks.

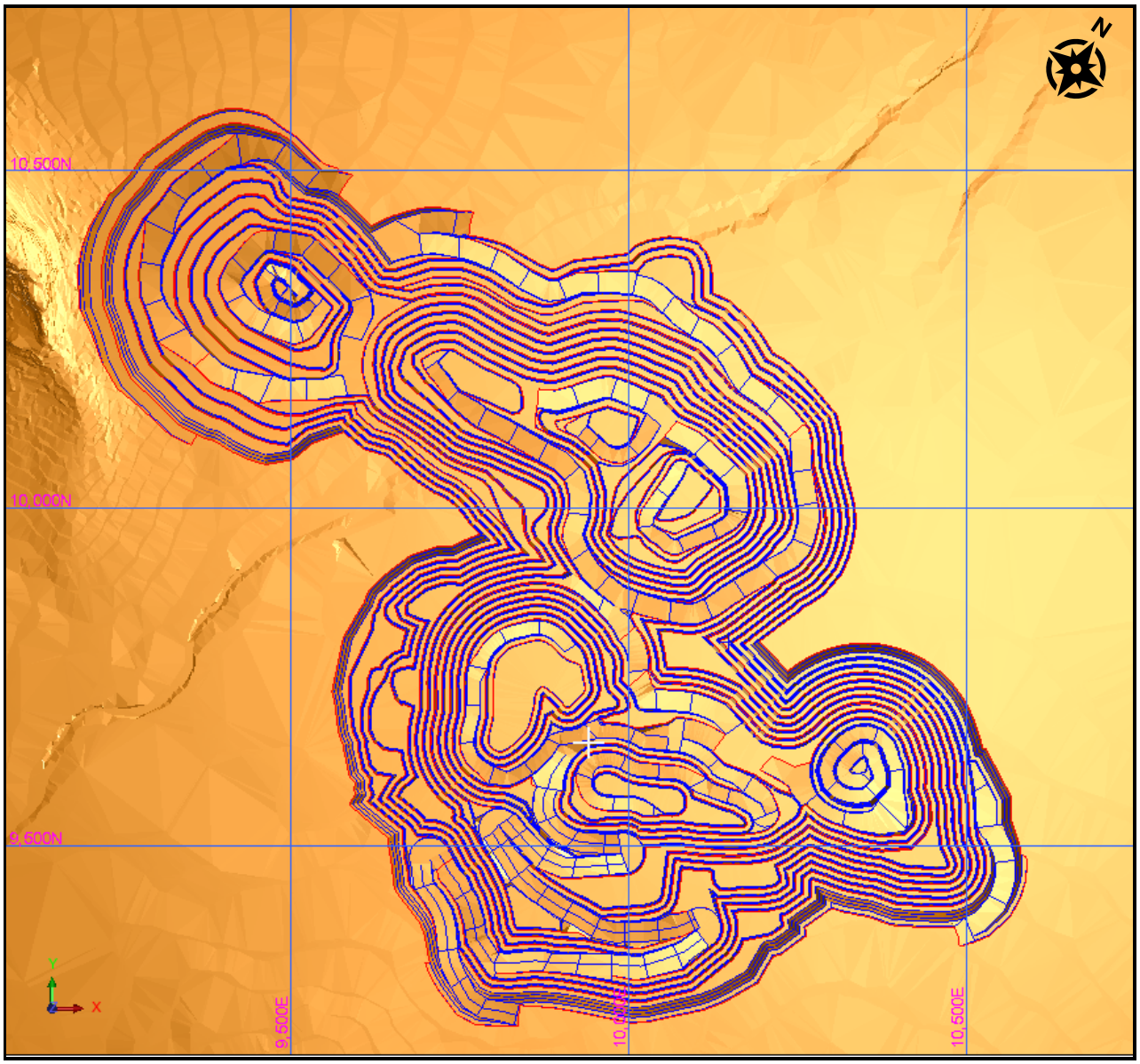


Figure 4—11 Final Pit Design (local grid)

The first three Pit Stages are independent of each other with the Pit Stage 1 being in the western portion of the deposit and centred on the measured mineral resources. Pit Stages 2 and 3 are in the eastern part of the deposit. As shown in Figure 4—12 below.

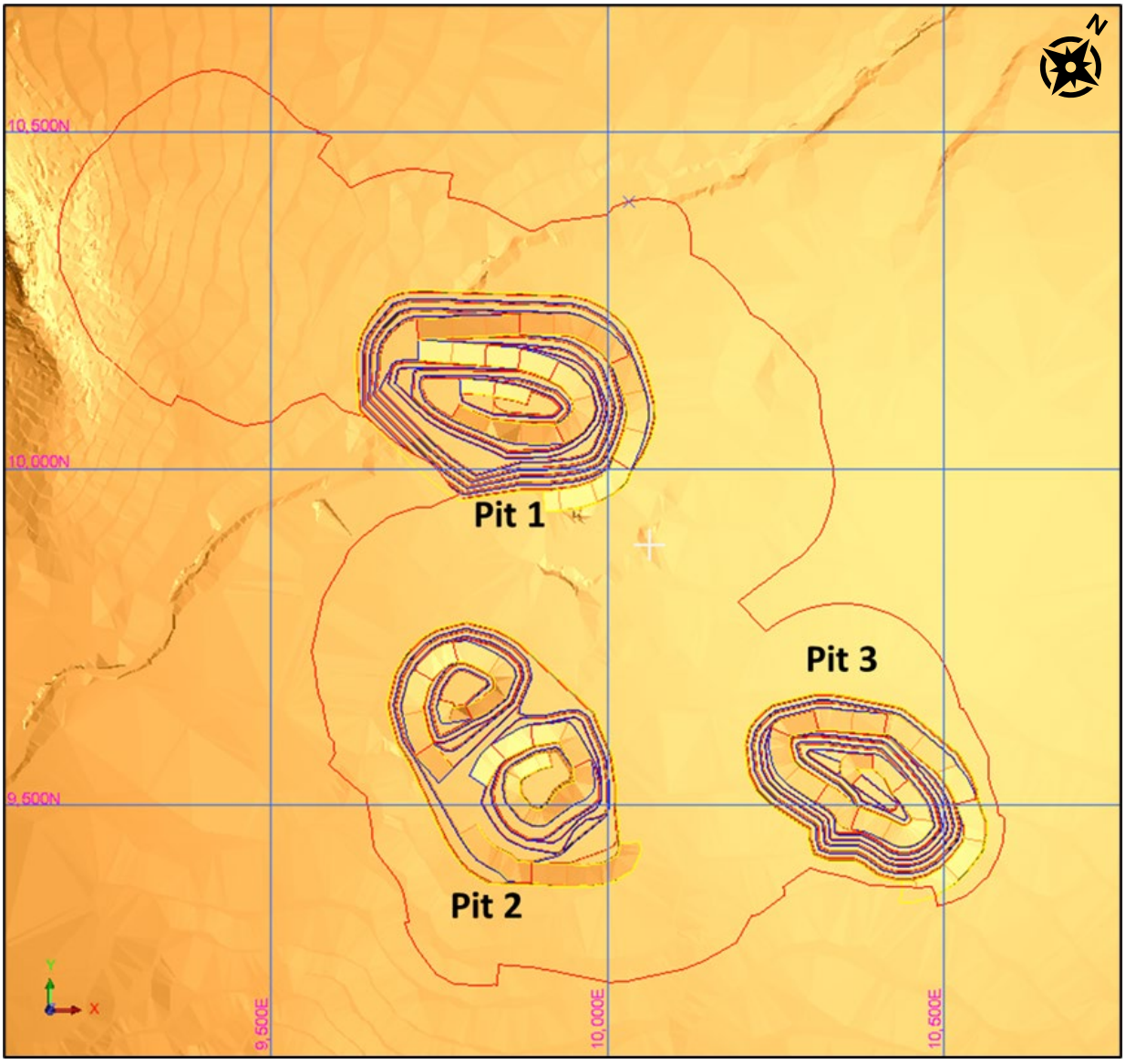


Figure 4—12 Pit Stages 1, 2 and 3 Design to the End of Mining Campaign 2 (local grid)

Pit Stage 1 is 400 m by 250 m in size and will get to a depth of 35 m by the end of mining campaign 1. It is completely mined out during mining campaign 2 to a depth of 120 m.

Both Pit Stages 2 and 3 are mined during mining campaign 2 and are similar dimensions as Pit Stage 1. Pit Stage 2 reaches a maximum depth of 70 m with stage 3 reaching 90 m depth upon completion.

Total scheduled quantities for the three Pit Stages are shown in Table 4—7 above.

4.13.1.2.2 Ore and Mineralised Stockpiles

The active ROM stockpile area is where road train loading and haulage activities occur and will cater for the target ore types and blending as determined by grade control processes and detailed mine scheduling. The ROM and LTS's have a current planned disturbance area of approximately 60 hectares, with the active ROM pad approximately 300 by 250 m in size. Non-preferred and lower grade mineralisation will be stockpiled in the designated LTS areas until later in the mine life when they are either reclaimed to feed the process plant or encapsulated and rehabilitated with the eastern WRD.

The maximum ROM stockpile size will reach 14 Mt (in size) in Year 27 of operations and will be primarily dumped into fingers on the active ROM pad (2.5 Mt design capacity), and in larger stockpiles adjacent to the active ROM constructed in ten metre lifts to cater for the additional capacity. Stockpile sizes during the mining campaigns will look to only maximise the active ROM pad storage capacity in an effort to eliminate the need for a rehandle truck and shovel fleet to relocate additional ore from adjacent stockpile areas during the mining break.

The two stockpile areas (ROM and LTS) combined are sufficient in size to stockpile all required quantities for processing, including the 2.1 Mt of non-preferred ore types and lower grade mineralisation. ROM and LTS design requirements will be reviewed in preparation for and throughout operations to optimise the storage and blending requirements for the Project, as well as to minimise total disturbance and optimise rehabilitation requirements of the remaining long-term stocks at the end of mine life.

Monitoring and management of stockpiles and associated infrastructure have been outlined within the Water Management Plan (APPENDIX R) to manage seepage and drainage from the stockpile areas.

4.13.1.2.3 Pit Dewatering

The aquifer at the Nolans open pit is localised and contained within the ore body with the surrounding rocks (gneiss, granites and schists) having a significantly lower permeability. Dewatering of the ore body will be achieved with screened bores placed within the orebody between longer-term Pit Stages in conjunction with in-pit sumps and surface pumps to achieve dewatering requirements outside of the surface bore zones of influence. The abstraction is covered under licence L10010.

The pit water balance including groundwater inflows and rainfall estimates that a maximum long-term extraction rate of 0.32 GL/annum (10 L/s) may be required to be pumped, however, lower rates should be expected. Higher pumping rates will be achieved using the in-pit sump pumps to decrease dewatering times and manage the main risks of recharge which come from precipitation and run-off.

Water from pit-dewatering will be pumped to a central de-silting pond, which will overflow to the dust suppression water pond.

4.13.1.2.4 Haul Road Design

Mine haul roads and pit ramps are designed to accommodate 150 t payload class dump trucks. Table 4—8 below shows the haul road design parameters and Figure 4—13 the pit ramp dimensions.

Table 4—8 Haul Road and Ramp Design Criteria

Road & Ramp Design Parameters	Quantity	Unit
Dual Lane Surface Haul Road width (Minimum running pavement)	35 (21)	Metres
Dual Lane Ramp width (Minimum running pavement)	28 (21)	Metres
Single Lane Ramp width (Minimum running pavement)	21 (14)	Metres
Maximum length of single lane ramp	100	Metres
Maximum haul road /ramp gradient	10	Percent
Maximum downhill gradient leading into intersections	3	Percent
Minimum length of intersection (3% gradient section)[1]	85	Metres
Minimum Stand off from pit crest	8	Metres

1. Based on loaded dump truck at 30 km/h using MSHA Haul Road Inspection Handbook with a 1.5 times FOS

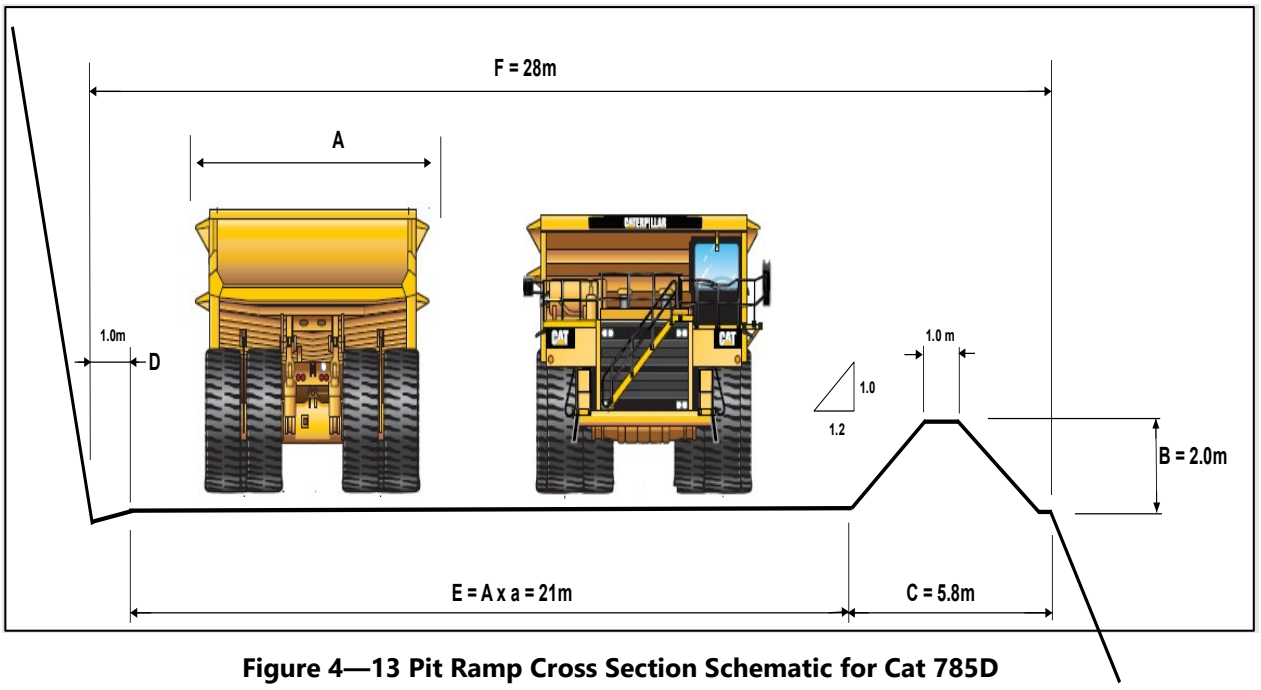


Figure 4—13 Pit Ramp Cross Section Schematic for Cat 785D

4.13.1.2.5 Dust Management

Dust management in the mine will use the following strategies to minimise dust:

- Water cart(s) will use water sprays and a water cannon to suppress dust in the following areas:
  - Active pit work areas.

  - Mine roads.
  - Active stockpiles.
  - Active WRD tip or other work locations.
  - Mine access road.
- Fixed water sprays on the ROM stockpiles, where practicable.
- Timing of blasting to be risk assessed based on weather conditions with blasting timed for periods of low wind.
- Washdown of all vehicles leaving the mine area and travelling to the process plant on the mine access road.

Water for dust suppression will be sourced from the dust suppression water pond. Water for this pond will be supplied from the following sources, in order of preference:

- Pit dewatering water.
- Water reclaimed from mine area storm water management.
- Brine from the process plant reverse osmosis (RO) plants.
- Raw water.

4.13.1.2.6 Waste Rock Dumps

Overburden and waste rock will be deposited in two purpose constructed WRDs over the LOM, with a final waste rock quantity of approximately 180 Mt. The two (2) WRDs will hold waste volumes built to Relative Level (RL) 720 mAHD, with a height of approximately 60 m above natural surface and consistent with local topography. The waste rock dumps have a combined footprint of approximately 210 ha. The design concept for rehabilitation is to achieve a concave slope with no berms. The rehabilitated waste rock dump designs are shown in Figure 4—14 and Figure 4—15 below.

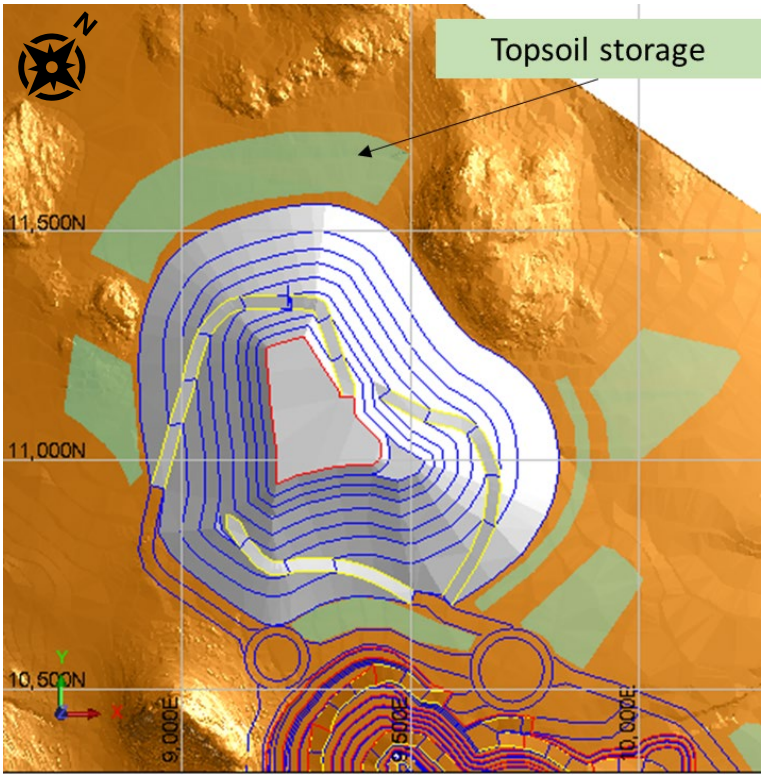


Figure 4—14 Western Waste Rock Dump (local grid)

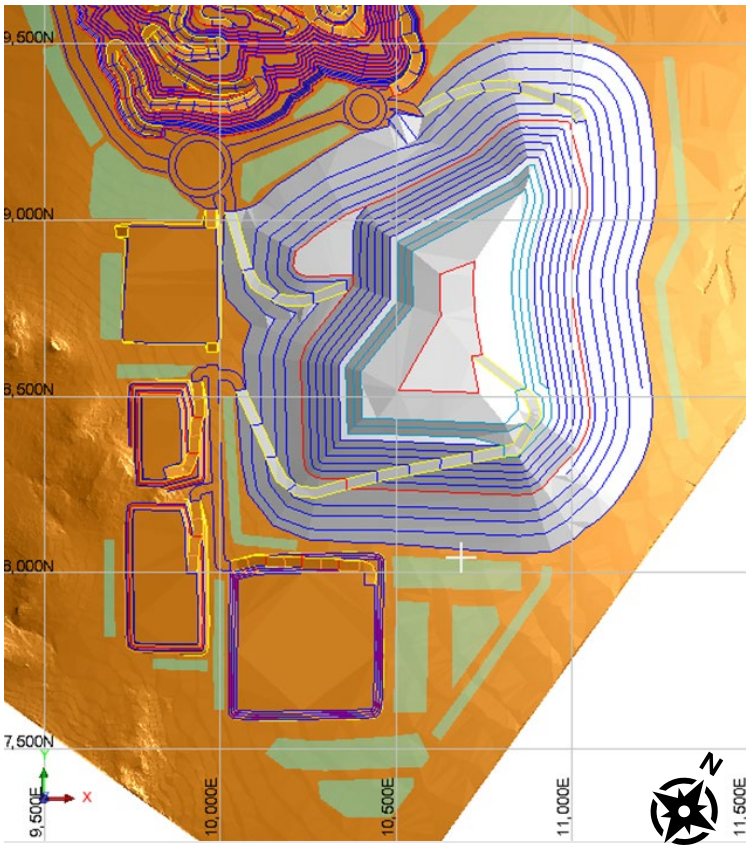


Figure 4—15 Eastern Waste Rock Dump, ROM and stockpile areas (local grid)

Each of the two WRD locations have been divided into several discrete WRD Stages to allow staged encapsulation and progressive rehabilitation over the LOM plan.

The Eastern WRD, which will contain all waste produced during Stage 11 and 12, is the largest WRD (approx. 1 km by 1.25 km) split up into five WRD Stages with a total capacity of 69.2 M cubic metres. The final WRD Stage contains the majority of the volume capacity (63%) consisting of entirely benign waste to encapsulate the previous four WRD Stages. The Western WRD is smaller (approximately 1 km by 750 m) and split up into three WRD Stages with a total capacity of 22.2 M cubic metres. Development of the Western WRD is not currently planned to occur until year 12 of operations.

The current WRD as-built design criteria for the Project is:

- 10 m lift
- 5 m berms for each lift
- 37 degrees angle of repose
- Maximum height RL 720 m (approx. 50 – 60 m above natural topography).

The as-built design criteria will be reviewed before operations as per approval conditions (by an Independent Certifying Engineer). Reviews on the berm widths and encapsulation requirements will be key focus areas with regard to rehabilitation and closure objectives, with total disturbance footprints unlikely to change from the current designs.

The proposed WRD construction cross-sectional profile is illustrated in Figure 4—16 below.

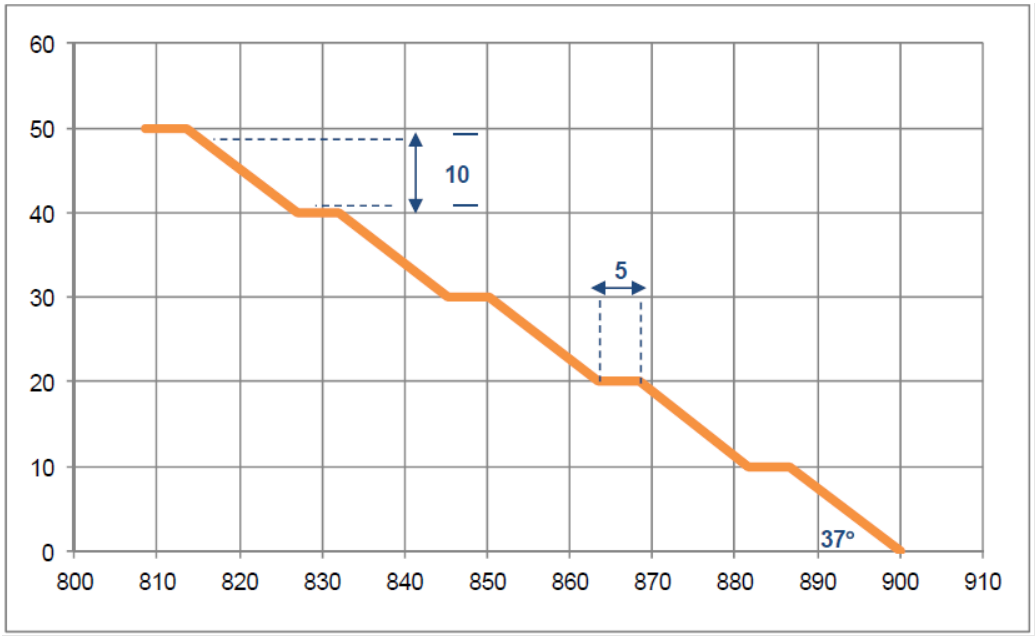


Figure 4—16 Proposed WRD profile during construction

Encapsulation of the NORM waste is achieved using benign waste material mined during the life of the Project. NORM material is centrally located within each WRD Stage and lift with benign waste used at the waste dump extremities to provide encapsulation requirements.

Table 4—9 quantifies the estimated benign and NORM waste volumes expected for the first two mining campaigns.

Table 4—9 Waste Quantities for Mining Campaign 1 and 2 (East WRD)

Waste Material	Unit	Pre-production	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7
Benign	M BCM	0.5	0.9	0.0	1.0	1.0	1.0	0.8	0.0
NORM	M BCM	0.2	0.7	0.0	0.7	0.8	0.9	1.0	0.1

Acid and metalliferous drainage (AMD) assessment has revealed very low sulphur content and significant apparent neutralising capacity in most lithologies and waste streams. The static and kinetic AMD and geochemical testing indicates that the proposed waste rock, ore and pit wall material has a very low risk of generating acidic, metalliferous or saline leachate.

See EIS Volume 1, Chapter 8 – Groundwater; and EIS Volume 2, Appendix L – Acid, Metalliferous Drainage Report for further detail:
(https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Chapter_8_LOW_RES_web.pdf)

(https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_L_web.pdf)

Conceptually, potential acid forming (PAF) material if found will be contained and encapsulated within benign waste in designated areas of the WRD along with NORM classified waste material. Based on the waste rock characterisation assessment completed for the Project there is a low risk of acid metalliferous drainage resulting from the waste rock associated with the Project.

Cells will be constructed within each WRD to dispose of and encapsulate contaminated waste streams produced on site that are not suitable for landfill (e.g. NORM/radioactive waste, and remediated hydrocarbon contaminated soils). This will be contained within the footprint of the WRD and progressively encapsulated as the WRD is filled.

Rehabilitation of the constructed WRDs will likely entail pushing the berms down into a concave slope with an average overall slope angle of 16 degrees (see the Strategic Guidance for Rehabilitated Waste Landforms in APPENDIX Z).

Progressive rehabilitation of the WRD's is planned to occur when sections of the WRD's can be re-sloped without impacting ongoing WRD development and NORM waste encapsulation processes. Currently, only two (2) section of the Eastern WRD are planned to be rehabilitated during the first two (2) mining campaigns equalling a total of 38 ha across the first nine (9) years of mining operations. Progressive rehabilitation is limited during the campaign mining periods due to the overall limited disturbance and mined volumes.

4.13.2 Processing Activities

The ore from the mine is processed over a 38-year life to produce rare earth products and a merchant grade phosphoric acid by-product. The flowsheet for the process is shown in Figure 4—17. The process plant is initially designed to process up to 1 Mtpa of ore to produce a maximum of 340,000 tpa of high-phosphate rare earth bearing feed concentrate. Average production over the LOM includes

4,440 tpa of NdPr oxide, 474 tpa of SEG/HRE oxides, and 144,000 tpa of 54% P_2O_5 merchant grade phosphoric acid. The production of a cerium rare earth product has been deferred until after commissioning and ramp up of the processing plant.

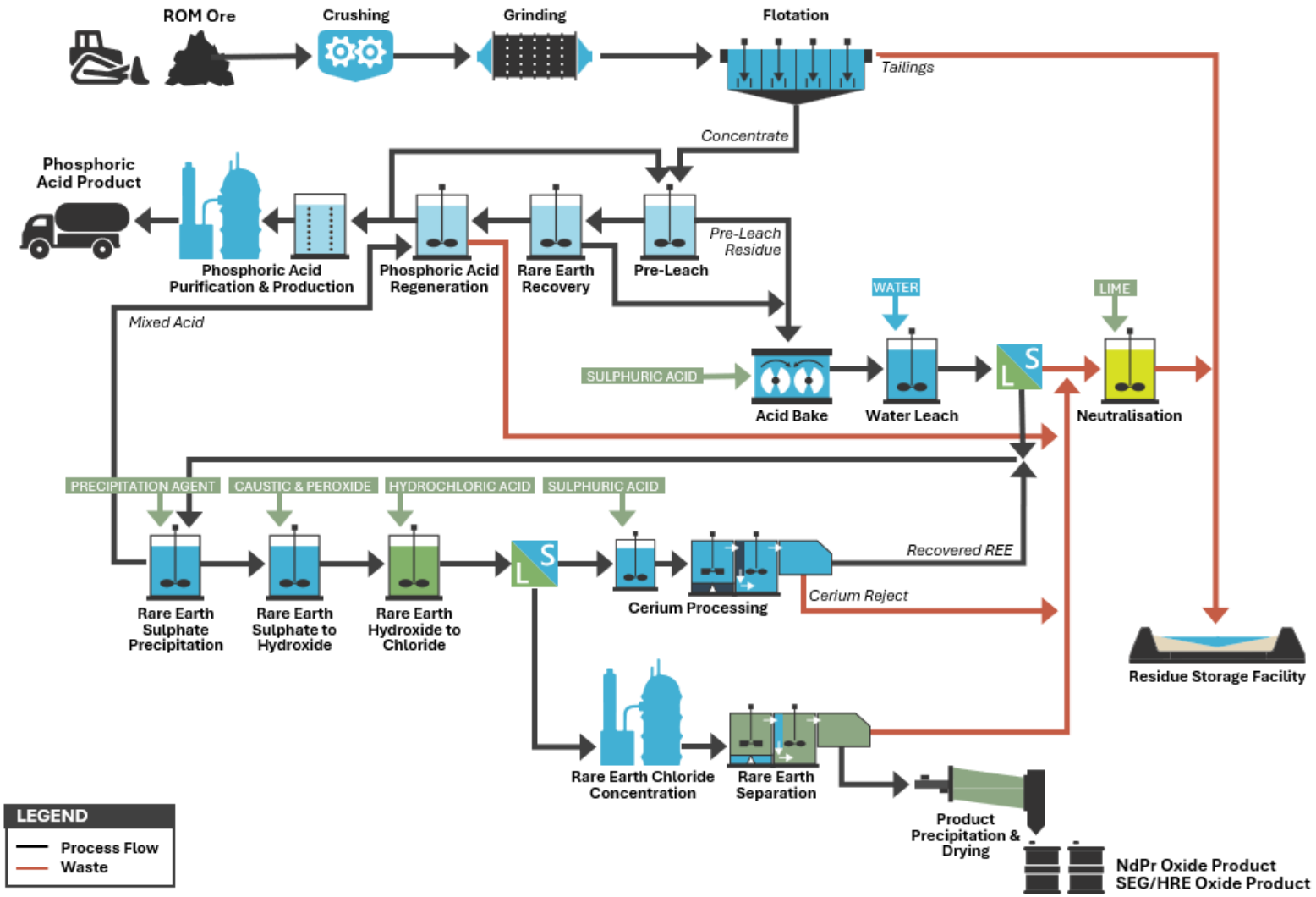


Figure 4—17 Metallurgical Process Flowsheet

At a high level, the process consists of the following production steps:

- Beneficiation
- Phosphate extraction – which consists of:
  - Pre-leaching the high phosphate concentrate in phosphoric acid.
  - Heating of the weak phosphoric acid to precipitate minor dissolved rare earths.
  - Separation of the leach residue and precipitated rare earths for further processing in rare earth extraction.
  - Regeneration of the weak phosphoric acid with sulphuric acid, which is recycled from the rare earth extraction, to produce a gypsum waste and a strong phosphoric acid.
  - Purification of the excess phosphoric acid to produce a merchant grade phosphoric acid for sale.
- Rare earth extraction which processes the rare earth rich residue from the phosphate extraction as follows:
  - Acid baking in paddle mixers with sulphuric acid at a nominal 250ºC followed by water leaching of the discharge.
  - Precipitation of a clean rare earth sulphate from the water leach liquor to produce a mixed acid which is recycled to phosphoric acid regeneration.
- Rare earth processing where the rare earth sulphate is dissolved in water before precipitation of the rare earths as a hydroxide using sodium hydroxide before selective leaching of non-cerium rare earths with hydrochloric acid to produce a cerium free rare earth chloride solution and a low-grade cerium product.
- Cerium processing where the low-grade cerium is dissolved in sulphuric acid before processing in a simple solvent extraction circuit to produce a high-grade cerium liquor, which will initially be sent to waste, and a recycle stream to recover the remaining rare earths.
- Separation which consists of two sequential rare earth solvent extraction circuits for the production of a SEG/HRE rare earth product and an NdPr product which are both precipitated using oxalic acid prior to calcining.
- The forecast production over the 38-year LOM is given in Table 4—10 below, and the plant layout is shown in Figure 4—18 below.
- Further details on the stages of processing are detailed in Sections 4.13.2.1 - 4.1.3 below.

Table 4—10 Forecast Production by Operating Year

Year	yr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ore Processed	kt	590	814	699	765	814	919	853	853	854	1,098	980	740	947	1,020	999	1,384	1,296	998	771	835
Head Grade																					
P_2O_5	%	13.0	12.6	14.2	14.8	14.9	14.5	15.0	14.9	14.9	11.9	12.5	15.8	13.2	13.7	14.7	11.0	11.0	13.0	15.2	14.8
TREO	%	3.3	3.2	3.4	3.3	3.3	3.2	3.3	3.3	3.3	2.7	2.7	3.3	2.8	3.0	3.2	2.6	2.6	2.8	3.2	3.1
Beneficiation																					
P2O5 Recovery	%	68.8	78.7	85.7	84.1	80.9	75.6	77.0	77.0	77.0	76.1	83.2	87.7	80.3	68.6	67.3	61.9	67.6	78.9	86.4	80.8
TREO Recovery	%	66.5	75.8	83.5	79.0	74.9	67.0	70.2	70.3	70.3	67.2	74.9	82.6	72.4	59.0	59.4	49.8	57.9	71.4	81.2	75.5
Concentrate	kt	198	278	280	314	326	341	333	333	333	341	340	334	334	334	340	340	340	342	334	333
Final Production																					
NdPr Oxide	t	2,529	4,485	4,621	4,661	4,706	4,677	4,710	4,709	4,708	4,533	4,472	4,648	4,374	4,270	4,505	4,123	4,531	4,620	4,639	4,679
SEG/HRE Oxide	t	374	595	610	611	606	596	601	601	601	589	579	602	567	544	572	539	602	612	607	606
P_2O_5	kt	47	66	68	76	79	81	79	78	78	79	82	82	80	77	79	76	77	81	81	80
MGA Phos Acid	kt	88	123	126	141	145	149	146	145	145	147	151	152	147	142	146	140	143	150	150	148

Year	yr.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	TOTAL
Ore Processed	kt	1,116	1,101	1,232	1,111	879	864	901	940	940	1,125	1,351	1,351	1,351	1,511	1,506	1,506	1,506	1,423	**39,940**
Head Grade																				
P_2O_5	%	12.1	11.5	11.2	12.4	15.5	16.0	15.8	15.3	15.3	13.3	11.6	11.6	11.6	8.6	8.1	8.1	8.1	8.1	**490**
TREO	%	2.7	2.7	2.5	2.7	3.4	3.4	3.4	3.3	3.3	2.9	2.6	2.6	2.6	2.1	2.0	2.0	2.0	2.0	**110**
Beneficiation																				
P2O5 Recovery	%	73.4	74.8	69.9	70.6	72.4	72	69.1	68.7	68.7	64.6	59.5	59.5	59.5	57.9	57.5	57.5	57.5	57.5	**2,714**
TREO Recovery	%	65.3	66.9	56.9	58.3	65.3	65.0	61.1	59.8	59.8	53.1	44.9	44.9	44.9	39.0	37.8	37.8	37.8	37.8	**2,345**
Concentrate	kt	341	325	340	340	340	341	340	340	340	341	340	340	340	276	258	258	258	243	**12,147**
Final Production																				
NdPr Oxide	t	4,662	4,578	4,133	4,144	4,585	4,590	4,498	4,448	4,448	4,128	3,701	3,701	3,701	2,841	2,610	2,610	2,610	2,754	**157,946**
SEG/HRE Oxide	t	610	604	540	533	584	587	575	570	570	530	477	477	477	373	345	345	345	326	**20,480**
P_2O_5	kt	79	75	77	78	79	80	79	79	79	77	75	75	75	60	56	56	56	53	**2,813**
MGA Phos Acid	kt	146	139	143	144	146	147	146	146	146	143	138	138	138	112	104	104	104	98	**5,209**

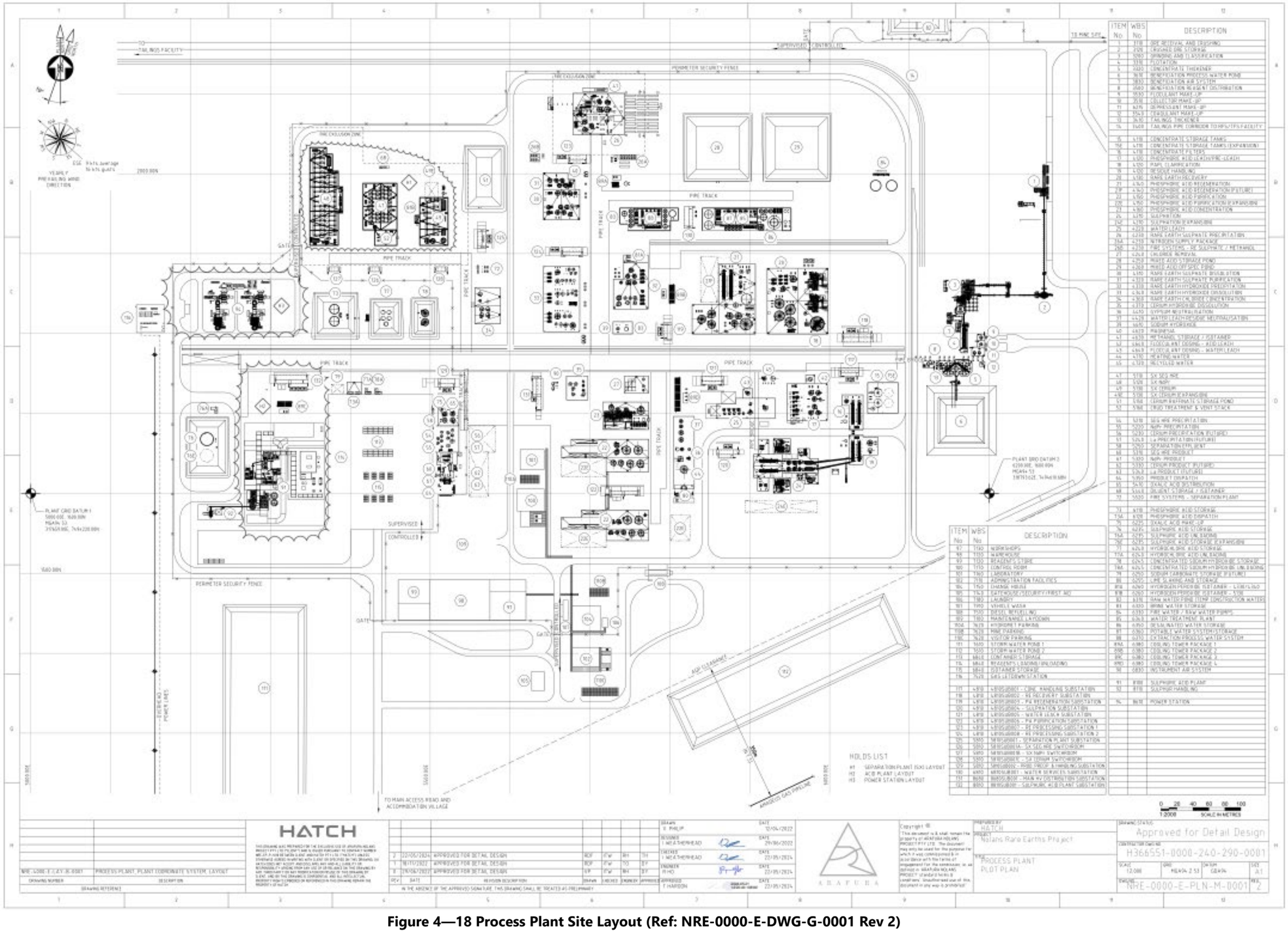


Figure 4—18 Process Plant Site Layout (Ref: NRE-0000-E-DWG-G-0001 Rev 2)

4.13.2.1 Beneficiation

Ore from the mine will be transported to the processing plant by road trains and directly tipped into a low-profile apron feeder to limit dust emissions. The ROM material will then feed into a single stage roll sizer to crush the ore. Water sprays on the discharge of the sizer are employed to limit potential dust emissions. After crushing the ore, material is conveyed to a coarse ore bin with six (6) hour storage capacity. Ore from the coarse ore bin is then fed into a single stage semi-autogenous grinding mill in closed circuit with hydro-cyclones for grinding the ore to 80% passing (P80) 150 micron.

Ground ore from the semi-autogenous grinding mill circuit will be heated using hot water from the extraction plant before flotation of a high phosphate concentrate in a rougher flotation circuit. Concentrate and tailings from the flotation circuit will be thickened in traditional hi-rate thickeners with the thickened concentrate reporting to the extraction plant for filtration and the thickened tailings being pumped to the residue storage facility (RSF). Overflow water from the thickeners, and returned filtrate from the concentrate filter, will be recycled through the process water pond for re-use in the flotation circuit.

The beneficiation circuit above will use the following reagents:

- Oleic acid (collector).
- Sodium silicate (depressant).
- Flocculant.
- Coagulant.

4.13.2.2 Phosphate Extraction and Phosphoric Acid Production

The phosphate extraction section of the processing plant consists of five sub-sections that together separate the phosphate from the rare-earths, and in doing so, produce a phosphoric acid by-product.

The sub-sections include:

- Phosphoric acid pre-leach.
- Rare earth recovery.
- Phosphoric acid regeneration.
- Phosphoric acid purification.
- Phosphoric acid concentration.

4.13.2.2.1 Phosphoric Acid Pre-Leach

Concentrate from the beneficiation plant is filtered to produce a moist filter cake that is stored in a bin before being conveyed into the pre-leach circuit. The pre-leach consists of a two-stage counter-current leach with phosphoric acid and solid-liquid separation with centrifuges after both stages.

The solids from the second stage centrifuges are filtered and stored for processing in the rare earth extraction. The liquor from the first stage centrifuges, which has some of the rare earths in solution, is processed in the rare earth recovery.

4.13.2.2.2 Rare Earth Recovery

The small amounts of rare earths that are dissolved in the pre-leach are precipitated in the rare earth recovery and then recovered by filtration before mixing with the pre-leach solid residue for feeding to rare earth recovery.

The dissolved rare earths are precipitated by heating with steam to the boiling point of ~107ºC, which, in the presence of calcium in solution causes them to precipitate. Following precipitation, the liquor is filtered for recovery of the rare earths prior to cooling and feeding to the phosphoric acid regeneration.

4.13.2.2.3 Phosphoric Acid Regeneration

In the phosphoric acid regeneration, liquor from the rare earth recovery will be treated to regenerate the phosphoric acid for use in the pre-leach and to precipitate gypsum waste. This regeneration is achieved through the addition of sulphuric acid, contained in recycle streams from other parts of the circuit, or as concentrated sulphuric acid. Cooling of the regeneration reactors is required to ensure efficient operation.

The regeneration precipitates the calcium leached from the concentrate as gypsum, which is filtered from the phosphoric acid. The gypsum filter cake is re-pulped and then neutralised with lime and pumped as a slurry to the RSF.

The regenerated phosphoric acid is recycled to the pre-leach with the excess phosphoric acid, produced from leaching of the phosphates in the concentrate, feeding to phosphoric acid purification.

4.13.2.2.4 Phosphoric Acid Purification

Phosphoric acid purification is designed to remove the uranium, thorium, and other minor impurities, from the phosphoric acid to meet the required product specification. The removal of uranium and thorium from the phosphoric acid is achieved by nano-filtration, which is similar in nature to reverse osmosis used in water treatment.

The nano-filtration operates over a number of stages with the addition of recycled acid liquor to adjust the chemistry and achieve the desired recovery and rejection rates. The nano filtration produces three products:

- Clean phosphoric acid, which is sent to phosphoric acid concentration.
- Low grade mixed phosphoric and sulphuric acid, which is used in phosphoric acid regeneration.
- Reject liquor, which contains the majority of the uranium and thorium, which is sent to water leach residue neutralisation for neutralisation with lime prior to disposal in the RSF.

4.13.2.2.5 Phosphoric Acid Concentration

In phosphoric acid concentration, excess water is removed by evaporation to obtain the required P_2O_5 concentration of 54%, meeting the specification for MGA phosphoric acid. The evaporated water is condensed and recycled into the hot water circuit.

The concentrated phosphoric acid is stored as a merchant grade phosphoric acid product for shipment.

Therefore, the reagents used in the phosphoric acid extraction include:

- Phosphoric acid (a very small amount used during plant start-up).
- Sulphuric acid (a minor addition, with the main source being mixed acid recycled from other parts of the process plant).
- Flocculant and coagulant.
- Quicklime (used in the residue neutralisation prior to being discharged into the RSF).

The reagents used in the phosphoric acid production include:

- Sulphuric acid (a minor addition).

4.13.2.3 Rare Earth Extraction

The rare earth extraction section of the process plant consists of three subsections, which together, separate the rare earths from the gangue minerals, and in doing so, recover the excess acid for re-use in the phosphate extraction area. The sub-sections include:

- Sulphation.
- Water Leach.
- Rare Earth Sulphate Precipitation.

4.13.2.3.1 Sulphation

In sulphation, rare earth minerals are converted from their phosphate and silicate forms to a sulphate form using sulphuric acid at elevated temperature making them amenable to recovery and separation from impurities.

Wet pre-leach residue will be conveyed to two trains of sulphation equipment operating in parallel. Each train will consist of a sulphation dryer, acid mixer, acid bake and sulphation cooler units.

The dryers will dry the pre-leach residue at 120°C to remove moisture before it is mixed with concentrated sulphuric acid for feeding into the acid bake. The acid bake, which is carried out in indirect, oil heated, paddle mixers, bakes the mixture at up to 250°C to drive the sulphation of the rare earths. The product from the acid bake will discharge directly into the sulphation coolers where it is cooled to 50°C before discharging directly into the water leach circuit.

The acid mixer, acid bake and sulphation cooler units will generate gases, which will be extracted to a local scrubber.

4.13.2.3.2 Water Leach

During water leach, the rare earth sulphate and acid (sulphuric and phosphoric) contained in the sulphated paste are separated from the gangue through leaching in cold water which dissolves the soluble rare earth sulphates and separates them from insoluble gangue material.

Following water leach, the solids and liquor are separated using counter current centrifuges. The final washed solids are repulped in waste process liquor prior to neutralisation with lime in the water leach neutralisation circuit and pumping to the RSF for disposal.

The rare earth sulphate liquor is forwarded to the rare earth sulphate precipitation area.

4.13.2.3.3 Rare Earth Sulphate Precipitation

During the rare earth sulphate precipitation, rare earth elements are separated from sulphuric acid and phosphoric acid, along with most of the contained impurities in the water leach liquor. The precipitation is achieved through the addition of methanol which selectively depresses the solubility of rare earth sulphates over most other components of the water leach liquor, and results in the formation of a rare earth sulphate precipitate. Thorium also co-precipitates with the rare earth sulphates.

The precipitated rare earth sulphates are separated from the methanol and mixed acid solution by filtration with the filter cake being washed with methanol before being dried and stored for further processing.

The filtrate containing the methanol and mixed acid is forwarded on to a methanol strip where methanol and mixed acid are separated by distillation with the recovered methanol being recycled in rare earth sulphate precipitation. The mixed acid is used in the phosphate extraction area (predominately to drive the regeneration of the phosphoric acid) with two ponds, on-spec and off-spec, included for storage of the mixed acid to decouple the sections of the process.

This area of the plant contains a significant inventory of flammable organic liquor and to manage this risk we have designed a nitrogen purge and dedicated foam-based fire protection system to control any ignition at the source.

The reagents used in rare earth extraction above include:

- Concentrated sulphuric acid.
- Methanol.
- Quicklime.
- Flocculant.

4.13.2.4 Rare Earth Processing

The rare earth processing section of the process plant consists of four subsections which together separate rare earths from impurities and produce a purified, cerium-free rare earth chloride liquor to feed separation. The sub-sections include:

- Rare earth sulphate dissolution and purification.
- Rare earth hydroxide precipitation.
- Rare earth hydroxide dissolution.
- Rare earth chloride concentration.

4.13.2.4.1 Rare Earth Sulphate Dissolution and Purification

The rare earth sulphate precipitate from rare earth extraction is leached in desalinated water to dissolve the rare earth sulphate while leaving most impurities behind as insoluble phosphates (such as thorium). Following dissolution over two stages, the rare earth sulphate liquor is filtered with the solids sent to the water leach residue neutralisation for neutralisation with lime and disposal to the RSF.

The clarified rare earth sulphate liquor still contains some impurity elements such as aluminium, iron, uranium, and residual thorium. These impurities are precipitated using magnesia which drives the precipitation of impurities such as phosphates and hydroxides.

The solution from the purification stage is filtered with clear purified liquor and sent to rare earth hydroxide precipitation. The solids from the filter are recycled to the pre-leach filter feed tank in the phosphate extraction for recovery of rare earths.

4.13.2.4.2 Rare Earth Hydroxide Precipitation

Rare earth hydroxide precipitation is the first part in a two-part process to separate cerium from the other rare earth elements. Sodium hydroxide is added to drive the precipitation of the rare earths contained in the purified rare earth sulphate liquor as hydroxides. Hydrogen peroxide addition is used to oxidise cerium.

The final rare earth barren sodium sulphate liquor is recycled for water recovery, while the washed rare earth hydroxide cake is repulped and fed to the rare earth hydroxide dissolution.

4.13.2.4.3 Rare Earth Hydroxide Dissolution

Rare earth hydroxide dissolution separates cerium from the other rare earth elements through selective leaching of the non-cerium rare earths using hydrochloric acid.

Rare earth hydroxide dissolution is configured in a multi-stage counter current configuration, with dosing of hydrochloric acid over multiple tanks in each stage, with filtration between each stage. This configuration is designed to separate the cerium from the other rare earths while minimising the losses of NdPr to the cerium product.

The final cerium-free rare earth chloride liquor is forwarded on to rare earth chloride concentration, while the low-grade cerium hydroxide sent to cerium processing.

4.13.2.4.4 Rare Earth Chloride Concentration

The rare earth chloride solution is concentrated in the rare earth chloride evaporator then stored for further processing in the rare earth separation. Evaporated water is condensed and recycled in the hot water circuit.

Reagents used in rare earth processing above include:

- Magnesia
- Sodium hydroxide (caustic soda)
- Hydrogen peroxide

- Hydrochloric acid.

4.13.2.5 Rare Earth Separation

The rare earth separation section of the process plant consists of three circuits which separate the various rare earths products, recover valuable rare earths from the low-grade cerium hydroxide and precipitate, calcine and package the final products for sale. The sub-sections include:

- Rare earth chloride solvent extraction.
- Cerium processing.
- Product handling.

4.13.2.5.1 Rare Earth Chloride Solvent Extraction

There are two solvent extraction circuits which process the rare earth chloride liquor from rare earth processing in series. The first circuit separates the middle and heavy rare earths (SEG/HRE) and the second separates the NdPr, leaving the lanthanum in the final raffinate. The lanthanum could be recovered at a later stage should price warrant the cost of processing through the addition of a third circuit.

Each circuit consists of a series of mixer settlers which extract the desired rare earths onto an organic extractant in the first group of mixer settlers, scrub unwanted rare earths from the organic extractant in the second group and then strip the separated rare earths from the organic extractant to produce a concentrated strip liquor in the final group. The chemistry of the rare earth movement between the aqueous and organic phases is controlled through careful control of pH through the addition of hydrochloric acid and sodium hydroxide.

This area of the plant contains a significant inventory of flammable organic liquor. The design includes a dedicated foam-based fire protection system that can be directed into specific sections of the mixer-settler circuits to control any ignition at the source.

The SEG/HRE and NdPr strip liquors are forwarded to separate precipitation circuits while the raffinate is sent to the gypsum neutralisation circuit for disposal to the RSF.

4.13.2.5.2 Cerium Processing

The low-grade cerium hydroxide, which contains recoverable NdPr, from rare earth processing, is dissolved using sulphuric acid, then purified using solvent extraction where the cerium is readily separated from the other rare earth elements, to produce:

- Purified cerium strip liquor
- Rare earth sulphate raffinate.

The cerium strip liquor will initially be sent to neutralisation for precipitation with lime and disposal to the RSF, however, the production of a high-purity cerium product may be installed later should cerium price warrant its production.

The rare earth sulphate raffinate is recycled to water leach in the rare earth extraction process to recover the contained rare earths.

This area of the plant contains a significant inventory of flammable organic liquor. The design includes a dedicated foam-based fire protection system that can be directed into specific sections of the mixer-settler circuits to control any ignition at the source.

4.13.2.5.3 Product Handling

The purified liquors from the rare earth chloride solvent extraction are processed in separate, but similar, precipitation and calcining circuits before feeding to a packaging plant.

Each circuit consists of precipitation using oxalic acid to produce a rare earth oxalate, which is then filtered and washed prior to feeding into a calciner where the rare earth oxalates are converted at high temperature to rare earth oxides. The calcined product from each circuit is cooled, then stored for packaging where product from all circuits is processed through a single packaging facility.

Barren liquors from each precipitation circuit are combined and recycled for water recovery.

Reagents used in rare earth separation include:

- Sodium hydroxide (caustic soda).
- Hydrochloric acid.
- Sulphuric acid.
- Hydrogen peroxide.
- Oxalic acid.

4.13.2.6 Sulphuric Acid Plant

The sulphuric acid plant (SAP) will produce concentrated sulphuric acid by melting, with minor amounts of lime and surfactant to aid melting sulphur, and then burning elemental sulphur and then converting the sulphur dioxide to sulphur trioxide through multi-pass catalytic conversion and absorption into sulphuric acid. Residual sulphur dioxide will be exhausted from the SAP through a stack.

The SAP will produce approximately 1,000 tpd of sulphuric acid which will be pumped to storage on site. The SAP will also produce steam for use in the process for heating and other duties.

4.13.2.7 Reagents

The reagents used in the process, average consumption, storage and form of transport are summarised in Table 4—11 below.

Table 4—11 Reagent Consumptions Storage and Transport

Reagent	Consumption Rate (t/y)	Storage (t / days)	Transport Type	Storage Type
Sulphuric Acid	287,410	4,000 t / 5 d	Produced from SAP	Tank
Sulphur (used in SAP)	93,016	1,800 t / 7 d	20' shipping	Containers

Reagent	Consumption Rate (t/y)	Storage (t / days)	Transport Type	Storage Type
		66 containers	container, end-tip	
Hydrochloric Acid (32%)	40,273	770 t / 7 d	Isotainer 20ft	Tank
Caustic Soda (50%)	49,175	940 t / 7 d	Isotainer 20ft	Tank
Quicklime	25,462	120 t / 1.7 d	Isotainer 20ft with onboard blower	Silo
Methanol	2,625	19 t / 2.6 d	Isotainer	Tank
Hydrogen Peroxide (70%)	2,821	54 t / 7 d	Isotainer	Tank
Oxalic Acid	6,034	120 t / 7 d	1 m^3 Bulk Bag	Reagent Shed
Sodium Silicate	1,319	44 t / 12 d	Isotainer	Tank
Oleic Acid	493	16 t / 12 d	Isotainer	Tank
Flocculant	255	15 t / 21 d	1 m^3 Bulk Bag	Reagent shed
Coagulant	349	17 t / 16 d	Isotainer	Tank
Magnesia	356	20 t / 20 d	1 m^3 Bulk Bag	Reagent shed
Diluent Shellsol D70	75	40 t	Isotainer	Tank
Extractant P507	11	1 t	1 m^3 IBC	Reagent Shed
Extractant DEPHA	3	1 t	1 m^3 IBC	Reagent Shed
Extractant TOPO	1	1 t	1 m^3 IBC	Reagent Shed

Note: Average consumption is calculated as the average following ramp up for the first seven years of production.

Reagents will be delivered to site from the Alice Springs rail terminal by road train. Once at site the reagents will be unloaded from the trailers with empty containers or outgoing product containers backloaded on the trucks. Unloading of the containers will be as follows:

- Sulphur will be stored in the purpose-built containers in a stack and then unloaded using a tipping frame directly into the SAP.
- Bulk liquid reagents in isotainers will be unloaded into storage tanks in an isotainer unloading facility.
- Lime will be pneumatically unloaded into a silo.
- Bagged and liquid reagents in IBCs will be destuffed from the shipping containers and stored in the reagents shed(s).

- Flammable reagents, methanol and diluent, will be unloaded into tanks within the plant to contain all flammable reagents in close proximity.

In addition, for start-up, minor quantities of concentrated sulphuric acid and phosphoric acid will be imported and loaded into the storage tanks.

Evaluation of the nature and storage volumes is currently underway to determine if the facility needs certification as a major hazard facility.

4.13.2.8 Product Storage and Shipping

Rare earth products, once bagged, will be loaded into containers adjacent to the road train unloading area ready for back loading and transport to customers.

Bulk phosphoric acid product will be stored in a 2,700-t tank, which is equivalent to 7 days storage. Phosphoric acid will be loaded into isotainers in a section of the isotainer unloading area before being backloaded onto road trains for transport to customers.

4.13.2.9 Services

The services for the plant area will include raw water, fire water, potable water, desalinated water, recycled water, hot water, steam and compressed air.

Raw water is stored in a lined pond at the process plant and distributed to the Beneficiation Plant, Hydromet Plant and other users. The raw water pond will also serve as the source of fire water which will feed from dedicated pumping systems into a ring main around the facilities.

Raw water will be processed on site in RO plants to produce desalinated water, for use in the process, and potable water for domestic consumption. In addition, a separate RO plant will process waste liquors from rare earth process and rare earth separation for recovery of water to produce desalinated water and RO reject water for the repulping of tailings streams.

Hot water from around the plant, primarily from evaporators, will be collected and then cooled in evaporative cooling towers to allow it to be re-used in the process.

Steam, which is generated from desalinated water in the SAP and power station, and dry compressed air are reticulated to users throughout the process plant.

4.13.2.10 Ponds and Processing Area Water Management

4.13.2.10.1 Ponds

Four ponds will be located in the process plant, their volumes and construction include:

- Beneficiation process water pond – 5,000 m^3 pond, equating to an 11-hour full flow operation, lined with a single 1.5 mm thick high-density polyethylene (HDPE) geomembrane.
- Mixed acid storage ponds – two of, 10,000 m^3 ponds, double lined with 1.5 mm thick HDPE geomembrane, separated by a sandy layer containing a geopipe network draining to a sump for the early detection of leaks in the top membrane.

- Cerium raffinate pond – 7,500 m^3 pond, double lined with 1.5 mm thick HDPE geomembrane, separated by a sandy layer containing a geopipe network draining to a sump for the early detection of leaks in the top membrane.

Consideration will be given to floating covers on the permanent storage ponds to reduce evaporation or prevent interaction of fauna with the pond contents.

These ponds will be maintained according to a regular maintenance schedule to ensure that sediment does not build up.

The ponds will be located within the Process Plant Footprint shown at Figure 1-6 of the MMP. Detailed designs showing the exact location of these ponds within the processing plant area are being finalised, the current design is shown within Figure 4—18 above.

4.13.2.10.2 Surface Water Management

Surface water management will be characterised into process systems, dirty water systems and clean water systems.

Process Systems

All process equipment will be bunded in concrete or other bunds designed to meet Australian standard for size and storage volumes, with lining for chemical compatibility with the process chemicals. Spillages and any collected water in the process bunds will be returned into the process or pumped to the RSF.

Overflows from the process bunds will report into the dirty water systems.

Dirty Water Systems

Stormwater within the process plant disturbed area and any spillage from process bunds will be collected from hardstands and other areas through drainage structures and directed to stormwater pond(s). The stormwater pond(s) will be sized with a retention capacity of 100-year ARI (equivalent to the 1% AEP) 72-hour design storm event while maintaining a minimum freeboard of 500mm below the embankment crest. Stormwater pond(s) will be sized with a suitable spillway for the check storm event.

Stormwater ponds will be clay lined in the batters and floors. The final number of stormwater ponds will be dictated by catchment areas, earthworks and drainage design and constructability concerns.

Clean Water Systems

Catchments include natural watercourses and drainage lines outside of the operational process areas, with provision of infrastructure for flood protection levees, clean water diversions, and open drain systems.

Flow and stormwater diversion banks and cut off drains will be installed across the broader process plant site to divert clean water away from the disturbed areas and around infrastructure. This water

flow, once directed around the disturbed area will be fed to downstream erosion and sediment control devices to manage and direct (disperse) new potentially focussed flow paths.

5.0 ENVIRONMENTAL MANAGEMENT

5.1 Environmental Management Structure

The environmental management structure is presented in Figure 1—3 above.

Arafura has developed an Environmental and Social Management System (ESMS) for the Project. The ESMS forms the basis on which Arafura will plan, monitor, measure and improve its environmental performance, to ensure that risks are well understood, effective mitigations and controls are both in place and tested for effectiveness over time. The ESMS provides Arafura with a methodical approach to managing environmental and social risks in a structure way, based on the Plan – Do – Check – Act process of continual improvement.

5.2 Environmental Policy

One of Arafura's key objectives is to minimise impact on the environment. Arafura's current Environment Policy is available on Arafura's website.

As an organisation, Arafura will:

- Integrate the principles of sustainable development into everyday operations.
- Comply with all legislative requirements for the environment.
- Work collaboratively with the community and governing bodies to ensure that a best practice approach is taken to environmental management.
- Encourage employees to value the environment in which Arafura operates.
- Sustainably manage the use of valuable natural resources, like groundwater, and actively look for Project efficiencies to minimise impacts.
- Protect the biodiversity of the area.
- Actively reduce, re-use and recycle materials and consumables.
- Maintain an open consultation process with regulators and the community.
- Ensure the rehabilitation of disturbed areas.

5.3 Environmental Commitments

5.3.1 Commitments Contained in the MMP

A summary of Project commitments is presented in Table 5—1 to Table 5—14 for the following groups:

- Residue Storage Facility
- Processing Plant
- Waste Rock Dump
- Water Management
- Community
- Traditional Owners
- Air Quality
- Heritage
- Radiation
- Transport
- Waste
- Human Health
- Hazardous Substances
- Emergency Management

Table 5—1 Residue Storage facility commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Residue Storage Facilities	Final RSF design to be included in the Mine Management Plan. ▪ All storage structures will be built to ANCOLD guidelines ▪ RSF will have a design storage capacity to contain a 1 in 100-year ARI average annual rainfall whilst retaining sufficient additional freeboard to accommodate a PMP 72-hour storm rainfall event. ▪ RSF design will include a low permeability liner system to reduce potential seepage vertically and laterally. ▪ The liner system will achieve a minimum 1 x 10-8 m/s permeability when placed. If clay liners are used it will be placed in layers and compacted and tested.	General design and requirements detailed in Section 4.11. Not yet complete to final design level.	Section 4.11: Stage 9 – Residue Storage Facility; and the RSF Management Plan (APPENDIX Q). KP, DFS RSF Design Report Rev 0. Final design in development.	80% Complete
	All RSF construction will be supervised by qualified engineering personnel. A construction quality assurance plan be implemented to ensure constructed dams meet design criteria. The plan will include quality control measures during the construction of the storage facilities, including records of the construction process and quality control results.	Post Approval	The RSF complex has been designed by competent engineers to the appropriate standards. It will be constructed under engineering supervision with testing to confirm design and construction criteria are being met.	Not yet complete
	Undertake further site investigations to identify suitable borrow areas on site and nearby. Alternative borrow areas subject to additional regulatory approval prior to commencing with construction works.	2021	Geotechnical investigation is being undertaken to identify the suitable sources of construction materials.	Not yet complete
	Management plans will be developed and implemented to ensure that the dams are operated and managed in accordance with the design intent and will require that relevant records are kept. Monitoring Plan for the RSF to include: ▪ Embankment piezometers to monitor the phreatic surface within the RSF embankment. ▪ Install shallow seepage detection bores outside but near the toe of embankments. ▪ Daily inspections to identify evidence of seepage.	Prior to construction	This is included in the current concept design for the RSF and will be included in the final design report and installed in construction. RSF Management Plan (APPENDIX Q).	To be completed after FID
	Annual dam safety audit will be completed by a suitably qualified person to inspect all the aspects of the dam, which includes the geotechnical stability of the dam and seepage.	Post construction	This is a detailed in the RSF Management Plan (APPENDIX Q).	To be completed
	Develop a Water Management Plan which incorporates an Emergency Response Plan including with specific actions to be implemented proactively to reduce the potential of an uncontrolled release or dam failure.	Yes / 2021	Section 6: Water Management Plan (see also APPENDIX R) and the Emergency Response Management Plan (APPENDIX I).	100% Complete

Table 5—2 Process plant commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Processing plant	Final process plant design to be included in the Mining Management Plan, with a statement that the processing area will be inspected, and action taken to clean spills and maintain sumps and sump pumps.	Yes	Hazardous Materials Management Plan (APPENDIX E)	100% Complete
	Processing area will be lined and drained to sumps for pumping back into the process or discharge to the tailings and residue storages.	Post approval	EPA 14 A notification - KP Design Docs	100% until approval

Table 5—3 Waste Rock dump commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Waste Rock Dump	Final WRD design to be detailed in the Mining Management Plan when 'representative' waste rock is available from the mining process for further test work.	Post approval	Section 4.13.1.2.6: Waste Rock Dumps Waste Rock Management Plan (APPENDIX L)	100% until approval
	Studies to be completed during operations utilising local material, to validate information on the degradation of engineered barriers and capping over time.	Post approval	Section 4.13.1.2.6: Waste Rock Dumps Waste Rock Management Plan (APPENDIX L)	100% until approval
	WRD design to manage potential seepage into groundwater or surface water drainage lines.	Yes / 2020	EPA 14 A notification - KP Design Docs Waste Rock Management Plan (APPENDIX L) Section 4.12: Stage 10 – Mine Complex and Surface Water Management	100% Complete
	Undertake further testing the proposed thickness of covering for radioactive materials in WRDs.	2021	Radiation Protection and Radioactive Waste Management Plan (APPENDIX K) Waste Rock Management Plan (APPENDIX L)	100% complete

Table 5—4 Water management commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Turkeys Nest	Turkey's nest dams are to be located outside of flood affected areas.	Yes / 2023	Section 4.2: Stage 1 – Early Construction Works	Complete for Stage 1 works
Slurry Pipeline	Telemetry systems to be used to monitor the pipeline for leaks, which will automatically stop pumping and alert maintenance staff. Provide minimum 400m^3 storage in the event ponds, and bunding of the pipe corridor.	Post construction	N/A - 14A notification outlines the design change to the process which removes the need for a Slurry pipeline.	To be completed post construction
Water Balance	The water balance model will be updated when final detailed design is completed.	Yes	Plant and RSF water balance updated and presented in 14A notification document.	100% Complete
	The water balance will be updated when operational to assess the performance of the proposed water management system.	Yes	Section 6.0: Water Management Plan Water Management Plan (APPENDIX R)	100% / ongoing assessment

Table 5—5 Community commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Community	Develop and implement a Social Impact Management Plan including: ▪ Establish a community reference group if requested by stakeholders. ▪ Appoint a community liaison person. ▪ Establish a presence in Alice Springs office. ▪ Develop protocols to manage all community related matters including a register to record, resolve and report on issues raised.	Complete	Section 2.2 Cultural Heritage Management Plan (APPENDIX G) Social Impact Management Plan (APPENDIX H) Territory Benefit Plan (APPENDIX W) Indigenous Engagement Strategy (APPENDIX X)	Partially complete, some aspects won't be in place until after FID commitment or when requested by stakeholders
	Produce the following management plans and make them available on company website: ▪ Environmental, health and safety plan ▪ Community engagement plan ▪ Workplace and employment plan ▪ Traffic Management Plan ▪ Waste Management Plan, and ▪ Local Industry Participation Plan.	Partially Complete	These plans have been developed and are available at: https://www.arultd.com/projects/nolans/approvals/ The Traffic Management Plan is to be developed following FID. This will be provided to the DEPWS Mines Division once completed.	Partially complete, to be completed after FID
	Establish an annual budget for continued communication on the project.	Complete	Communications on the Project are being budgeted for and implemented on an ongoing basis	Ongoing
	Establish an annual budget for sponsorship of projects within its area of operations.	Complete	A local sponsorship program is being budgeted for and implemented on an ongoing basis. This will be updated as the Project progresses.	Ongoing
	All staff and contractors to complete cultural awareness training.	In progress	In development	Ongoing
	Develop, in consultation with community reference group, key indicators to be monitored and reported on annually.	In progress	Part of Native Title Agreement, in progress. The community reference group meets regularly and data is being collated, reviewed, and reported to the relevant stakeholders as required.	Ongoing

Table 5—6 Traditional owners commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Traditional Owners	Finalise the mining agreement/ILUA with the CLC and Traditional Owners including: ▪ Access to land ▪ Annual visits to the mine site (if requested) ▪ Ongoing engagement commitments ▪ Protection and management of cultural sites and objects ▪ Environmental commitments ▪ Community benefits package and ▪ Employment and business development. ▪ Onsite meetings with Traditional Owners to discuss the management of archaeological sites and/or sacred sites prior to any works being undertaken and the likelihood of bush tucker consumption from the mine area.	Executed in June 2020 and ongoing Revised agreement executed in 2024.	A Native Title Agreement has been signed with the registered body corporates that represent the Native Title Holders. The agreement outlines a number of commitments that meet these requirements. In addition, a Stakeholder and Community Engagement and Communication Framework and Plan; Territory Benefit Plan (APPENDIX W); and an Indigenous Engagement Strategy (APPENDIX X) have been written in collaboration with a wide range of Project stakeholders.	Completed and registered with the National Native Title Tribunal. Revised in 2024.

Table 5—7 Air Quality commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Air Quality	Develop and implement an Air and Dust Management Plan to mitigation dust impacts, including: ▪ Chemical treatment or water spraying to treat roads ▪ Implement road speed limits ▪ Seal access road from Highway to Mine ▪ Minimise open areas exposed to wind erosion ▪ Topsoil striping to occur only during suitable wind and weather conditions ▪ Ore to be sprayed with water prior to entering crushing circuit ▪ Float cells will be installed on the windward side of the crushing circuit and a dust suppression system over the jaw crusher and ▪ Continuous dust monitoring as required during preproduction and construction at site boundary and sensitive receptors Develop and implement Erosion and Sediment Control Plan. ▪ Design of all aspects of the rare earths plant to include emission controls (scrubbers) to minimise dispersion of emissions. ▪ Power Station stack height to be a minimum of 12.5 m and have an internal diameter of 0.6 m. ▪ Acid Plant stack height to be a minimum of 20 m and have an internal diameter of 1.36 m.	Yes / 2020	All roads are being designed and will be managed to minimise dust emission. The main access road will be bitumen sealed when feasible to do so (initially the first section to prevent movement of dirt on to the Highway). Where required speed limits will be mandated. Air Quality and Dust Management Plan (APPENDIX C) Erosion and Sediment Control Management Plan (APPENDIX F) Crushing circuit is fully enclosed. Plant is being designed to meet all appropriate Australian emissions control standards. Dust monitoring has been in place at site for in excess of 10 years and will continue.	Plan Complete

Table 5—8 Heritage commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Heritage	Liaise with Traditional Owners and custodians, via onsite meetings, regarding cultural heritage management and specifically including the management of RWA 8. ▪ Gain AAPA clearance certificate and CLC clearance certificates prior to construction commencing. ▪ Gain regulatory approval if removal of cultural sites is required. ▪ Undertake archaeological survey to identify sites of heritage value. Develop and implement a Cultural Heritage Management Plan, including: ▪ Buffer distances or fencing surrounding identified and agreed archaeological sites and/or sacred sites ▪ Pre-clearing / disturbance visual investigations ▪ Research plan for an appropriate recording and salvage program (if requested) ▪ Procedure for managing unexpected finds and unintentional disturbance ▪ Mine site induction to all employees/visitors to include the identification and management of artefacts and cultural sites. Investigate options to realign access road to avoid RWA 8 Continue to liaise with Traditional Owners regarding the management of RWA 8 Finalise Mining Agreement including provisions for: ▪ Access to land and ▪ Visits to the mine (if requested). Undertake archaeological surveys and gain permits to remove identified archaeological/heritage items from within Project areas. Undertake removals and store appropriately as consulted with and agreed with Traditional Owners.	Ongoing	Cultural Heritage Management Plan (APPENDIX G)	Plan currently being implemented as appropriate to stages of works. CLC Sacred site clearance in place for entire Project area. New AAPA certificate currently under assessment to include new Project areas. Restricted Work Area identified along the site access road (RWA8) has been avoided with realignment of haul/mine access road. Archaeological surveys completed. Approvals to remove items (approval to Carry out Work on a Heritage Place) were issued to Arafura by the Heritage Council NT on 9 February and 28 September 2023. Stages 1 and 2 of removals were undertaken by Arafura during 2023. Stage 3 removals to be undertaken prior to recommencing construction works.

Table 5—9 Radiation commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Radiation	Develop and implement a Radiation Management Plan (including Regulator approval), referencing appropriate ARPANSA Codes of Practice including: ▪ Determine baseline radiation levels, with ongoing monitoring of radiation levels at the processing site and accommodation ▪ A baseline dataset of uranium levels in groundwater to be obtained prior to development works on site. ▪ Water to be used for dust suppression will need to comply with certain criteria before being used. The final criteria will be part of the approved Air Quality and Dust Management Plan (part of the Mine Management Plan). ▪ Radiation action levels, for both workers and the public that trigger internal investigations or other controls ▪ Identification of Controlled Areas ▪ Undertake regular testing of radiation levels and implement occupational health and hygiene practices for staff. Radiation doses will be incorporated into the ARPANSA ANRDR. and ▪ Radiation Safe Work Permits for work within a Controlled Area. ▪ All materials leaving site will be transported in accordance with the relevant transportation codes. A grade control management system to be implemented with trucked waste rock to pass through two radiometric analysers when exiting the pit Equipment exiting the Controlled Areas will first require formal decontamination clearance. Equipment and vehicles exiting will be required to pass through the Clean/Dirty boundary with wash down bay and facilities provided.	Completed	All of these matters are addressed in the EIS and the Radiation Protection and Radioactive Waste Management Plan (APPENDIX K). This plan has been recently revised to meet requirements under the Commonwealth EPBC Act. The updated plan is now included at APPENDIX K.	Previous Radiation Management Plan completed and approved by NT regulator. Updated Radiation Protection and Radioactive Waste Management Plan approved by the federal regulator and now included at APPENDIX K.

Table 5—10 Transport commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Transport	Develop and implement a Traffic Management Plan, including: ▪ Journey Management Plans ▪ Channelisation of Stuart Highway ▪ Site speed restrictions ▪ Tyres and rims management plan and ▪ Compliance with AS1742.3.		Traffic Management Plan to be developed after FID commitment. This will be provided to the Mines Division once developed.	To be completed.
	Consultation with NT Department of Infrastructure, Planning and Logistics (DIPL) regarding Stuart Highway intersection. Implement intersection construction as agreed with DIPL, to meet all requirements.	Partially / 2023	Intersection plan agreed and mine access road constructed during Stage 1 works. Road to be sealed for the first 100 m prior to recommencement of works to meet DIPL requirements.	Initial road construction during Stage 1 works in 2023. Road construction to be completed within Stage 2 works.

Table 5—11 Waste commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Waste	Develop and implement a Waste Management Plan including compliance with: ▪ Central Australian Remote Landfill Operating Manual ▪ Waste Management Guidelines for Small Communities in the Northern Territory ▪ Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites In the Northern Territory ▪ Cover landfill rather than burn it.	Yes / 2021	The Waste Management Plan is included at APPENDIX D. This was recently updated to include the recent updates and further detailed planning of waste management and landfill construction on site, as included within this MMP update.	Plan Complete

Table 5—12 Human health and safety commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Human health and safety	Develop and implement a Health and Safety Management Plan to mitigate the risk to human health and safety. The Management Plan will include: • Emergency response procedures in the event of an emergency or accident for mining and construction projects • NT DoH requirements for mining camps and construction camps in the NT (https://nt.gov.au/property/building-and-development/health-requirements-mining-construction-projects) • NT DoH Guidelines for Preventing Mosquito Breeding Sites Associated with Mining Sites (https://digitallibrary.health.nt.gov.au/entities/publication/14f9ce2b-7dee-42b4-9205-1ea8fa5f64c5/details).	Yes / 2024	Arafura has developed a Construction Health Safety and Security Management Plan. The plan is construction specific, which will then be modified and transitioned into an operational plan.	Plan Complete

Table 5—13 Hazardous substances commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Hazardous Substances	Develop and implement a Hazardous Substances Management Plan including: Ensure handling and storage of hazardous substances are in accordance with relevant Australian standards Detail hazardous substances inventory requirements and Detail fuel inventory and investigation requirements. Detail fuel inventory and investigation requirements. Provide spill response procedures and subsequent investigation requirements. Finalise onsite chemical inventory and update risk assessment.	Yes / 2021	The Hazardous Materials Management Plan is included at APPENDIX E.	Plan Complete

Table 5—14 Emergency management commitments summary

Mining Area	Commitment	Complete / Date	MMP Reference / Comment	Performance
Emergency Management	Liaise with the Local Emergency Coordinators regarding potential off-site emergencies.	Ongoing	Ongoing	Ongoing
	Guidance, advice and assistance to be provided as requested by the Local Controller.	Ongoing	Ongoing	Ongoing
	Finalise onsite chemical inventory and register (and update risk assessment).	Ongoing	Ongoing	Ongoing
	Provide the Local Controller a copy of all MSD Registers.	Ongoing	Ongoing update of the Hazardous Substances Management Plan	Ongoing
	Develop and implement an Emergency Response Management Plan including: ▪ Emergency Response Team will undergo regular training and participate in regular mock and desktop exercises regulatory reporting requirements ▪ Emergency Response Plans for potential incidents and ▪ Trained emergency response personnel will also be available to assist in emergency management as required by the Local Controller upon request.	Yes / 2021	The Emergency Response Management Plan is included at APPENDIX I.	Plan Complete

5.3.2 Recommendations Resulting from Formal Environmental Assessment

The Project was assessed by the NT EPA, with assessment provided in the form of a formal report: NT EPA, Environmental Assessment Report 84, Nolans Project Arafura Resources Ltd December 2017.

A set of sixteen recommendations were presented as part of the NT EPA assessment of the EIS, as documented in the NT EPA, Environmental Assessment Report 84, Nolans Project Arafura Resources Ltd December 2017. A summary of the recommendations and reference to where they have been addressed is presented in Table 5—15.

Table 5—15 Environment impact assessment recommendations and issues

Recommendation	Reference Sections	Performance against Commitment
The Proponent or Operator shall ensure that the Nolans Project is implemented in accordance with all environmental commitments and safeguards outlined in the final Environmental Impact Statement for the Nolans Project (draft Environmental Impact Statement and Supplement) recommendations from the Assessment Report 84.	Section 5.3 Environmental Commitments	**Complete:** Recommendation has been met through the development of the MMP and associated water, borefield, closure and general environmental management plans.
The Proponent or Operator shall provide written notice to the Northern Territory Environment Protection Authority and the responsible Minister if it alters the Nolans Project and/or commitments in such a manner that the environmental significance of the action may change, in accordance with clause 14A of the Environmental Assessment Administrative Procedures.	N/A	**Complete and Ongoing:** This was undertaken to address previous changes to Project planning (see *Arafura Resources Ltd – Nolans Project Section 14A notification*, May 2019 Ref: 4322795, GHD). This will continue to be undertaken with any further such changes to this MMP.
Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator a Water Abstraction Management Plan (WAMP) for the Nolans Project.	Section 6.0 Water Management Plan Water Management Plan (APPENDIX R)	**Complete:** Recommendation has been met through the WAMP document and associated studies which have been used to inform its development. The WAMP has been approved by DEPWS Water Division within Water Licences (L10010 and L10013); and by the federal regulator (DCCEEW) within EPBC approval.
The WAMP established in recommendation 3 must include assessment and management of any stock or drinking water bores that could be impacted by the Project, in agreement with the owners and/or operators of those bores.	Section 6.0 Water Management Plan Water Management Plan (APPENDIX R)	**Complete:** Recommendation has been met through the WAMP document and completion of a Hydro Census to identify surrounding water users; and implementation of ongoing monitoring of these users.
The WAMP established in recommendation 3 must incorporate an assessment of groundwater dependent ecosystems.	Section 6.0 Water Management Plan Water Management Plan (APPENDIX R)	**Complete:** Recommendation has been met through the WAMP document and associated studies which have been used to inform its development. As well as the development and ongoing implementation of the Reaphook Palaeovally Adaptive Management Plan and associated Monitoring Plan (as required under Water Licence L10013). Which stipulate an extensive program of monitoring of potential groundwater dependent ecosystems across the predicted groundwater drawdown area from Project water extraction.
Mining approvals in relation to groundwater abstraction should include conditions that require the Proponent or Operator to: ▪ Allocate clear responsibilities and accountabilities for water use and management ▪ Provide, in the Water Management Plan, regular updates of the projected water balance for the Project, including detailed estimates for the various stages of the Project and specifying the source and quantity of the water to be used ▪ Demonstrate how water considerations are integrated in Project planning including final Project design and technologies ▪ Report on continual improvement initiatives in water use and efficiencies including the provision of relevant water use targets ▪ Provide details on how water would be effectively managed during Project operations, including minimising water	Section 6.0 Water Management Plan Water Management Plan (APPENDIX R)	**Complete:** Recommendation has been met through the Water Management Plan (APPENDIX R). As well as additional planning documents developed under the water licencing requirements, including the WAMP and the Reaphook Palaeovally Adaptive Management Plan and associated Monitoring Plan.

Recommendation	Reference Sections	Performance against Commitment
consumption, maximising water reuse and preventing water waste including unnecessary or excessive flow or flood of water ▪ Abstract water from bores only when equipped with operating flow meters ▪ Record the volume of water abstracted from the borefield and the mine site as reported in the WAMP (recommendation 3) ▪ Provide an annual Water Management Report to stakeholders. This is to include water use performance, performance in relation to triggers and any changes in triggers		
Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator an updated Kerosene Camp Creek diversion design and modelling that demonstrate how the diversion would: a) maintain the existing regional hydrologic regime by effectively delivering the natural flows of Kerosene Camp Creek to downstream reaches b) avoid surface and sub-surface flows reporting to the pit, even in a 1000 year average recurrence interval flood event (1000 year ARI event) c) maintain sediment transport and water quality regimes that allow the watercourse diversion to be self-sustaining d) maintain surface water quality (as informed by acid and metalliferous drainage testing of basement rock) The detailed diversion design is to be peer reviewed by an appropriately qualified independent professional and implemented to the satisfaction of the relevant regulator.	Section 6.0 Water Management Plan APPENDIX R Water Management Plan APPENDIX P Kerosene Camp Creek Management Plan APPENDIX BB Kerosene Camp Creek Diversion and Mine Surface Water Management Design	**Complete:** Recommendation has been met through the Kerosene Camp Creek Diversion Management Plan and management design; both of which have been reviewed and approved by DEPWS Water Regulation with grant of a Permit to Interfere with a Waterway (IWW: KCC-001).
Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator an updated AMD Management Plan for the Nolans Project. The AMD Management Plan must, at a minimum, provide: a) results of additional testing to demonstrate to a high level of confidence, that there is a low risk of AMD and NMD from all waste streams and stockpiled ore b) details of the scope of the additional kinetic, column and barrel leach tests to provide results on the long-term leachate generation from wastes c) a plan for the further testing required to design the waste rock dumps based on the results of AMD site-specific representative waste rock samples.	Section 5.6.3 Environmental Management Plans APPENDIX L Waste Rock Management Plan	**Partially Complete:** AMD studies indicate a low risk of AMD drainage associated with the Project. A Waste Rock Management Plan has been prepared (see Appendix L). An additional AMD Plan will be developed (in accordance with EPBC Commonwealth approval requirements) prior to undertaking mining activities.
Before approvals or decisions are given or made for the Project, the Proponent or Operator shall engage an appropriately qualified and experienced Independent Certifying Engineer (ICE) to oversee the design and any works undertaken at the waste storages (Tailings Storage Facility, Residue Storage Facility and Waste Rock Dumps). The ICE is to provide: a) objective and independent expert review to the relevant regulator on the suitability of the site selection for the waste rock dumps, tailings and residue storage facilities including review of alternative sites and assessment of comparative risks b) objective and independent expert review to the relevant regulator on the adequacy of the tailings and residue storage facility design, including details of the sub-surface drainage and type of low-permeability liners to ensure long-term containment of tailings/residues or leachate from waste rock dumps c) regular inspections, auditing and reporting to the relevant regulator during construction of the tailings and residue storage facilities and waste rock dumps to ensure construction and operation is in accordance with the endorsed design and design objectives d) objective and independent expert review of the proposed performance monitoring program for the waste storages including potential seepage and leachates from the storage facilities e) objective and independent expert review of the decommissioning and final rehabilitation to minimise long-term risks to the environment, community, future land use and visual amenity from the waste storages f) an independent assessment of the Project's management of tailings and residues, including performance monitoring	Section 5.6.3 Environmental Management Plans APPENDIX L Waste Rock Management Plan	**Partially Complete:** Mine closure plan has been developed which indicates a cost and preparation for the decommissioning and final rehabilitation of the RSF. A Waste Rock Management Plan has been prepared (see Appendix L). Detailed design shall be undertaken prior to commencement of mining activities.

Recommendation	Reference Sections	Performance against Commitment
results in an annual report to the relevant regulator and the Proponent or Operator. The annual report shall be provided on the websites of (as applicable), the Proponent and Operator and the relevant regulator.		
Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator an updated erosion and sediment control plan for the Project. The plan should outline all permanent and temporary erosion and sediment control measures proposed to be installed for the Project. The updated plan should be prepared by a suitably qualified person and in accordance with the international standards for erosion and sediment control (as amended from time to time) or higher standard. An independent, suitably qualified and experienced auditor should be engaged to review and approve the plan, and to inspect and approve work is undertaken according to the plan.	Section 5.6.3 Environmental Management Plans APPENDIX F Erosion and Sediment Control Management Plan APPENDIX O Sediment Sampling Procedure EIS Section 14A Notification, which outlines the final mine site design and water control structures available at: https://www.arultd.com/projects/nolans/environmental-impact-statement/	**Complete and Ongoing:** Erosion and Sediment Control Management Plan prepared. Successive site specific sub-plans to be prepared for each disturbance area.
Before approvals or decisions are given or made for the Project, the Proponent or operator shall provide to the relevant regulator a Biodiversity Management Plan for the Project. The Biodiversity Management Plan must, at a minimum, contain: ▪ an identification of potential Project impacts and risks, mitigation measures and preventative actions for the protection of biodiversity values and habitat for threatened species ▪ a procedure for pre-clearance surveys for threatened species, including the great desert skink ▪ the final alignment of the borefield access track, incorporating a buffer of at least 200 m around the known warren of the great desert skink ▪ the scope, standards and timeframes for a flora and fauna monitoring program ▪ procedures for managing fire risk from the Project on habitat for threatened species ▪ weed hygiene and control procedures for avoiding the introduction and/or spread of weeds into habitat for threatened species ▪ procedures for avoiding and/or managing the risk of introduced fauna on threatened species ▪ goals, measures and criteria for the rehabilitation of habitat for threatened species following the closure and decommissioning of the Project.	Section 5.6.3 Environmental Management Plans APPENDIX B Biodiversity Management Plan	**Complete:** The recommendation has been completed through the development of the Biodiversity Management Plan, attached to this MMP in APPENDIX B. This will be updated when needed as the Project progresses to remain current. This has been approved by the federal regulator (DCCEEW) within EPBC approval.
The Proponent shall establish the Community Reference Group as a forum to consult with stakeholders on agreed post mining land uses and engage on the broader environmental management and performance of the Project's operations including water use, monitoring results, and mine closure and rehabilitation.	Section 2.2 Socio-Economic Environment	**Complete:** A community reference group has been formed in consultation with the CLC, and meets on a regular basis.
Prior to the commencement of any construction, the Proponent or Operator must obtain relevant authorities and consents to disturb any/all sites of historical and cultural significance that may be disturbed by the Project.	Section 3.3 Sacred, Archaeological and Heritage sites	**Complete:** CLC Sacred Site Clearance Certificates and AAPA Authority Certificates have been granted for the Project area. These will be updated when appropriate to remain current to Project planning.
The Proponent or Operator shall engage an independent process safety expert, endorsed by the relevant regulator to: Develop a process safety plan that details how process safety systems would be implemented to prevent the occurrence of a major process safety incident.	In Progress	**Partially Complete:** This is currently underway. Process Safety Plan to be completed prior to the process plant commissioning.
Approvals and decisions for the Project shall have conditions that require the Mine Closure Plan to progressively include: ▪ Alternative risk-based rehabilitation options that identify a range of closure scenarios and strategies for the Waste Rock Dumps, Residue Storage Facility and the pit and provide justification that the preferred closure option	Section 8 Closure Planning	**Partially Complete:** A conceptual Mine Closure Plan was prepared (EIS Volume 1, Chapter 18). The Mine Closure Plan is to be updated with further

Recommendation	Reference Sections	Performance against Commitment
minimises environmental risks ▪ Identification and management of knowledge gaps relating to closure- specific technical information; including environmental baseline data, waste characterisation, pit lake characterisation, and review of monitoring data; to inform sustainable mine closure ▪ Details of pre-closure research trials, investigations and modelling aimed at closing knowledge gaps to inform detailed rehabilitation design. These are to include, but not be limited to, revegetation trials, final cover materials, capping design and groundwater studies particularly in respect of drawdown in the vicinity of the mine pit. ▪ The Mine Closure Plan is to be peer reviewed by an appropriately qualified independent professional prior to submission to the relevant regulator.		detail.
Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator a conceptual Mine Closure Plan that must be reviewed and updated every three to five years. Details of what should be included in the plan is outlined in the EPA recommendations report.	Section 8 Closure Planning	**Complete:** A conceptual Mine Closure Plan was prepared (EIS Volume 1, Chapter 18). The Mine Closure Plan has been reviewed and will be updated.

5.4 Environmental Training and Education

All employees and contractors will receive a site induction that will include:

- A Project overview.
- Site policies.
- Pertinent legislation and operating licenses covering the Project.
- Roles and responsibilities of the employees and management.
- Incident reporting guidelines.
- Job risk assessments.

In addition, the environmental portion of the induction will cover:

- Environmental department roles and responsibilities.
- Cultural heritage.
- Land clearing commitments and the site ground disturbance permit process.
- Weed management.
- Surface water management.
- Dust management.
- Chemical spills and hydrocarbon management.
- Flora and fauna highlights, issues and management.
- Environmental legislative and license commitments that must be followed.
- How the various jobs could affect any of the above.

In addition, all full-time employees and contractors will undertake a cross-cultural training programme.

5.5 Environmental Emergency Preparedness and Response

Environmental emergency preparedness and response is detailed in the Emergency Response Management Plan in APPENDIX I.

Arafura will establish and maintain an Emergency Response Group for the Project to provide emergency services for the construction and operations when required.

Training and response skills for the Emergency Response Group will include:

- Working at heights rescue.
- Confined space rescue.
- Medical evacuation.
- Fire (building, chemical and equipment) and bushfire management.
- Emergency evacuation.

- Critical incident management.
- Plant accident.
- Chemical spills and hazard containment.
- Management of the Project during a heavy rainfall event.

5.6 Implementation, Monitoring and Review

5.6.1 Identification of Environmental Aspects and Impacts

An assessment of the activities associated with the Project, including those carried out by contractors and suppliers, was completed. As per the MMP outline, the following environmental aspects have been considered:

- Emission to air.
- Releases to surface water or groundwater.
- Releases to land and or impacts to flora or fauna.
- Use of raw materials and natural resources.
- Use of energy.
- Energy emitted such as radiation, vibration, noise.
- Waste.
- Land management / soil.

Potential impacts may include, but are not limited to:

- Disturbance to heritage or cultural sites.
- Disturbance to communities.
- Erosion of land.
- Harm to threatened species.
- Pollution/contamination to air, water or land.
- Introduction and spread of non-native species.

5.6.2 Risk Assessment

The assessment of the environmental risks of the Project was initially completed as part of the EIS assessment of the Project. This assessment, combined with the other technical assessment was used to develop a risk register, which summarised the potential for environmental risks arising from Project activity / events as part of the construction and operation of the Project. A summary of the environmental risk register developed is provided in APPENDIX V.

In addition, an outline of how the environmental risks were assessed is also summarised, highlighting different areas of environmental concern and how the likelihood and consequence were assessed and will be assessed as the Project progresses. For each potential consequence, a set of activities, controls

or monitoring was proposed to prevent the risk to the environment. The residual risk was then assessed and assigned a rating of low, medium or high. The applicable document which corresponds to the details on how the environmental risk will be managed is then referenced.

Building on the initial risk assessment (APPENDIX V), to maintain up to date management of environmental and community risks on an ongoing basis, Arafura maintains an Environmental and Social Risk Register. This is updated on a regular basis, and will continue to be used to identify, track, and manage risks as the Project progresses.

The risk register is used to design the environmental management activities, controls and monitoring to prevent or minimise those environmental impacts.

The management of the environmental risks will be completed through a series of Project specific EMPs, which provide the following information around the management of the risk:

- Standards and procedures.
- Hazard identification.
- Risk assessment.
- Risk control.
- Frequency of assessment.

The Environmental and Social Risk Register and the Project EMPs are aspects of Arafura's wider ESMS. Within this system of continuous improvement, the risk register and EMPs will be reviewed and updated on a regular basis to remain current to the stage of Project activities over time.

5.6.3 Environmental Management Plans

A set of EMPs have been written to describe how Arafura will prevent, minimise or mitigate the environmental impacts identified from the risk assessment process, and to meet the environmental commitments and recommendations outlined in Section 5.3. They are provided in APPENDIX A - APPENDIX AA and cover:

- Weed Management Plan (APPENDIX A)
  - Weed monitoring / control form
  - Weed register
- Biodiversity Management Plan (APPENDIX B)
- Air Quality and Dust Management Plan (APPENDIX C)
  - Monthly dust reporting from dust deposition gauge
- Waste Management Plan (APPENDIX D)
- Hazardous Materials Management Plan (APPENDIX E)
  - Fuel inventory
  - MSDS register

  - Hazardous substance register
- Erosion and Sediment Control Management Plan (APPENDIX F)
- Cultural Heritage Management Plan (APPENDIX G)
  - Heritage inspection checklist
  - Unexpected finds procedure – historical cultural and heritage items
  - Unexpected finds procedure – suspected human remains
- Social Impact Management Plan (APPENDIX H)
  - Complaints Register
- Emergency Response Management Plan (APPENDIX I)
- Noise, Vibration and Light Management Plan (APPENDIX J)
- Radiation Protection and Radioactive Waste Management Plan (APPENDIX K)
- Waste Rock Management Plan (APPENDIX L)
- Groundwater Sampling and Data Collection Procedure (APPENDIX M)
- Surface Water Sampling Procedure (APPENDIX N)
  - Surface Water Sampling Form
  - Example COC
- Sediment Sampling Procedure (APPENDIX O)
  - Sediment Sampling Form
  - Example COC
- Kerosene Camp Creek Management Plan (APPENDIX P)
- Residue Storage Facility Management Plan (APPENDIX Q)
- Water Management Plan (APPENDIX R)
  - Hydro census data template
  - Bore construction template
  - Flow meter recording template
  - Bore trigger and SWL monitoring sheet
  - Annual water abstraction management report template
  - Vegetation survey form
- Mine Closure Plan (APPENDIX S)
- Incident/Accident Report Form (APPENDIX T)
- Stakeholder Consultation and Issues Register (APPENDIX U)
- Risk Register (Environmental) (APPENDIX V)
- NRE-0000-A-PLN-G-0001 Territory Benefit Plan (APPENDIX W)

- Indigenous Engagement Strategy (APPENDIX X)
- Baseline Soil Assessment (APPENDIX Y)
- Strategic Guidance for Rehabilitated Waste Landforms (APPENDIX Z)
- Topsoil Management Plan (APPENDIX AA)
- Kerosene Camp Creek Management Plan (APPENDIX BB)
- Security Calculation (APPENDIX CC)
- Threatened Species Assessment of Gravel, Magazine and Access Tenure (APPENDIX DD)
- Environmental Impact Self-Assessment, Explosives Magazine and Gravel Pits (APPENDIX EE)

5.6.3.1 Objectives and Targets

The objectives and targets for each EMP have been developed following the SMART principles outlined in the MMP guidance document:

- **S**pecific and unambiguous, with explicit targets.
- **M**easurable, so that performance can be measured against targets.
- **A**chievable. Does the company have the resources or the capability to meet targets?
- **R**ealistic, so not trying to achieve the impossible.
- **T**ime-based, so targets can be met within a certain time frame.

The objectives and targets have also been established to be consistent and measurable against the environmental policy and meet the relevant national and state statutory requirements, as referenced in Section 3.0.

5.6.3.2 Management and Mitigation Strategies

Detailed management and mitigation measures have been identified from the risk assessment and included where relevant, with timeframes for implementation of the controls.

5.6.3.3 Monitoring and Measurement

Detailed monitoring programs have been developed in the EMPs which can be used for the described stages of the Project. These include:

- Measuring performance against standards and targets.
- Sampling procedures and frequency.
- Recording of results.
- Required instruments and calibration.
- Sample preservation.

5.6.4 Review Effectiveness of Management and Mitigation Strategies

Per each EMP, regular reporting will be used to assess the results against trends, trigger levels and/or benchmarks to determine the effectiveness of control strategies and whether the targets are being met.

5.6.4.1 Non-Conformance and Corrective Action

Non-conformances and corrective actions are presented in the trigger, action and response plan (TARP) within each EMP. In addition, the incident reporting template used for the Project is provided in APPENDIX T.

All non-conformances and corrective actions taken during the previous reporting period will be reported at the end of each reporting period.

5.7 Key Environmental Activities for the Oncoming Period

All new environmental initiatives, developments, capital projects or changes proposed for the oncoming reportable period will be outlined in this section.

6.0 WATER MANAGEMENT PLAN

This section covers surface and groundwater located both on the mine lease and in the receiving environment both up and down gradient of the lease. In addition, it covers interactions of those waters with activities related to the operation of the mine and its infrastructure and how those interactions influence water quality and quantity and timing.

The EIS Volume 6, Appendix X_L – Water Management Plan: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_X_L_web.pdf)

And the EIS Supplement, Appendix 4 – Water Management Plan Framework (GHD, 2017) provide the original water management plans: (https://www.arultd.com/wp-content/uploads/2023/01/Appendix-04_Water-Management-Plan-Framework_WEB.pdf)

The Water Management Plan (APPENDIX R) is summarised graphically in Figure 6—1, demonstrating the components it relies on including procedures, plans and monitoring programs.

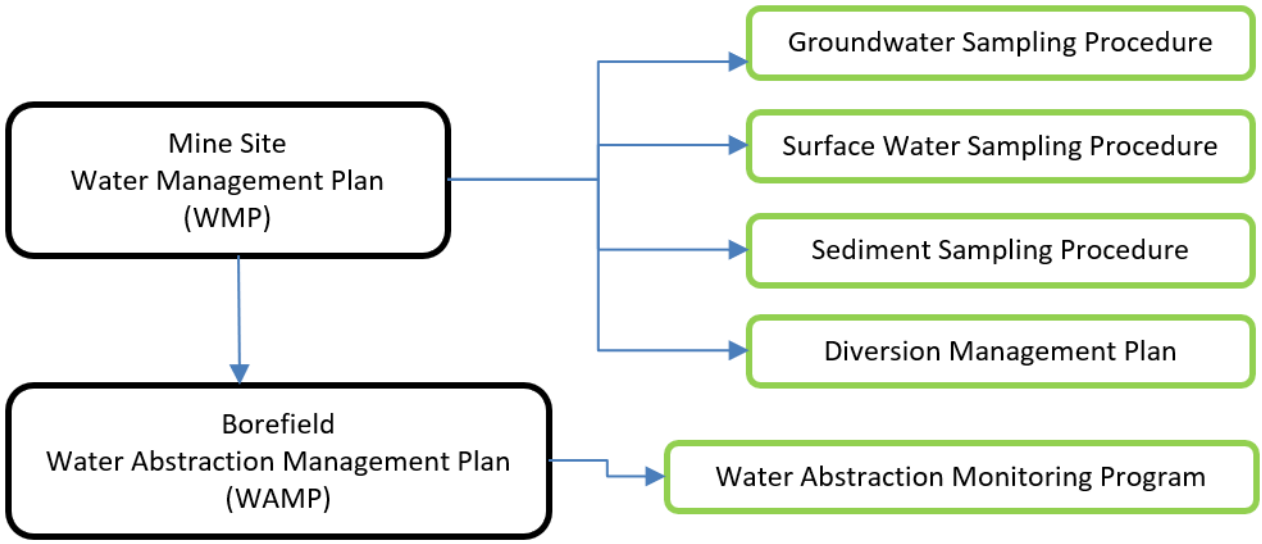


Figure 6—1 Water Management Plan Flow Diagram

6.1 Current Conditions

6.1.1 Surface water

The EIS Chapter 7: Surface Water and provides the original study for the site: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Chapter_7_LOW_RES_web.pdf)

Typically, there is limited surface water flows in the few creeks that cross the site. In 2020 it is likely that surface flows associated with rainfall events in the first three months and last month of the year

occurred. In December 2020, three events exceeded 50mm/day and a Feb event was just under 80mm/day. January, March and October had events registering good falls over the month nearing 50 mm (based on weather station recordings at Nolans. The December and February events resulted in widespread and extensive surface water flows with the December monthly total exceeding 308mm for the month.

Surface water management is addressed in the following EMPs:

- Surface Water Sampling Procedure (APPENDIX N)
- Sediment Sampling Procedure (APPENDIX O)
- Kerosene Camp Creek Management Plan (APPENDIX P)
- Water Management Plan (APPENDIX R)
- Kerosene Camp Creek Diversion and Mine Surface Water Management Design (APPENDIX BB).

6.1.2 Groundwater

The EIS Volume 1, Chapter 8 – Groundwater; EIS Volume 2, Appendix K – Groundwater Report; and EIS Supplement, Appendix 10 – Groundwater Models provides the original study for the site and borefield: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Chapter_8_LOW_RES_web.pdf)

(https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_K_web.pdf)

(https://www.arultd.com/wp-content/uploads/2023/01/Appendix-10_Groundwater-Models-139-307-400-v2_WEB.pdf)

In addition the DFS also provides additional groundwater studies for the borefield: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_DFS_Summary_Report_-_Final_for_website.pdf)

The over-arching Water Management Plan for the Project is provided in APPENDIX R, and the Groundwater Sampling and Data Collection Procedure is Provided in APPENDIX M.

A number of subsequent EMPs have also been developed to manage groundwater for the Project and in relation to Arafura's water licencing and federal approvals. This includes a Water Abstraction Management Plan, Groundwater Monitoring Plan, and Nolans Reaphook Palaeovalley Adaptive Management Plan. These documents are currently under assessment, and will continue to be updated to remain current in alignment with an adaptive management approach. Copies of the up to date versions can be provided on request.

6.2 Information/Knowledge Gaps

6.2.1 Identification and Filling of Information/knowledge gaps

There are knowledge gaps associated with the greenfields borefield. Arafura has undertaken a number of studies of the borefield area to date (as described in Section 6.1.2 above) and has an extensive program of ongoing monitoring of the borefield area. It is the intent of the Nolans Borefield Monitoring Program in conjunction with the Nolans Reaphook Palaeovalley Adaptive Management Plan to continue to address and manage these gaps in knowledge.

Likewise, background information at the mine site was sparse at the commencement of planning for this Project, with studies beginning in 2006. Arafura has undertaken a number of studies of the Project area and will continue monitor and improve environmental knowledge for the duration of the Project.

6.2.2 Water Account

Water extraction occurred on site during Stage 1 activities. A total of ~6.06 ML was extracted during the 2022-2023 financial year; and ~8.83 ML during the 2023-2024 financial year. With the majority of extraction occurring between August to October 2023. The amount extracted was approximately 0.4% and 0.2% respectively, of the annual water allocation allowed for each financial year within groundwater extraction licence L10013. No water extraction has occurred since October 2023.

Water extraction for the Project is being reported quarterly under water licences L10010 and L10013; and within annual compliance reports for these water licences and for this MMP. No water had been extracted under L10010 at the time of writing. Records and reporting will continue to be undertaken for the duration of the Project.

6.3 Risk Management

6.3.1 Identify Hazards and Rank Risks

The Water Management Plan (APPENDIX R) and associated EMPs identify hazards that could result from activities related to the operation and rank the associated risks of impacts to both surface and groundwater.

The EIS Volume 2, presents Appendix F – Risk Register (Environmental): (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Appendix_F_web.pdf)

In addition, focussed groundwater risks are addressed in the EIS Supplement, Appendix 11 – Risk Assessment: Impacts of Groundwater Changes to Groundwater Dependant Ecosystems (GDEs): (https://www.arultd.com/wp-content/uploads/2023/01/Appendix-11_Risk-assessment-potential-impacts-of-groundwater-changes-to-GDEs_WEB.pdf)

And the EIS Supplement, Appendix 12 – Peer Review of GDE Risk Assessment: (https://www.arultd.com/wp-content/uploads/2023/01/Appendix-12_Peer-Review-risk-assessment-groundwater-drawdown-GDEs_WEB.pdf)

Arafura maintains an Environment and Social Risk Register which is updated on a regular basis, and used to identify, track, and manage risks as the Project progresses.

6.3.2 Actions and Strategies in Response to Identified Risks

The Water Management Plan (APPENDIX R) and associated EMPs include strategies and actions that will be implemented to manage any risks identified in the risk assessment process.

The general approach to managing risks identified in the Environmental and Social Risk Register will be to address them through EMPs, processes and procedures as appropriate to the type of risk. The

implementation of actions and control strategies is being tracked through Arafura's Compliance Management System. All of which sit within Arafura's overall ESMS for continual improvement.

6.4 Monitoring

6.4.1 Monitoring Program, Data Review and Interpretation

The water monitoring programs, and related data review and interpretation requirements are detailed in the:

- Groundwater Sampling and Data Collection Procedure (APPENDIX M);
- Surface Water Sampling Procedure (APPENDIX N);
- Sediment Sampling Procedure (APPENDIX O);
- Kerosene Camp Creek Management Plan (APPENDIX P);
- Water Management Plan (APPENDIX R);
- The Nolans Borefield Monitoring Program (currently under assessment by the NT water regulator); and
- The Nolans Reaphook Palaeovalley Adaptive Management Plan (currently under assessment by the NT water regulator).

6.5 Management

6.5.1 Remedial or Corrective Management Actions

Not applicable to this reporting period. The amount of water extracted in the previous reporting period was minimal, and did not trigger any required remedial or corrective management actions.

6.5.2 Actions Proposed Over the Reporting Period and their Potential to Impact on Water Quality

The monitoring and adaptive management programs will be implemented on site as detailed in the above plans, procedures and programs (Section 6.4.1) in the coming reporting period.

7.0 INCIDENT REPORTING

Subsequent MMPs will provide details of incidents reported or included on Arafura's register during the previous reporting period. The incident report will include details about the incident, how it occurred, where and when it occurred, physical actions taken to rectify, remediate or rehabilitate, and operational actions to address the future management of incidents of this type.

The incident reporting will include the following key aspects:

- Reporting of identified hazards
- Reporting of accidents/incidents and system failures
- Determining the true cause
- Checklists for investigations
- Corrective actions taken.
- Preventative actions implemented.
- Review of corrective and preventative actions
- Reporting to statutory authorities
- Management of complaints.

8.0 CLOSURE PLANNING

The Mine Closure Plan (MCP) is documented in the EIS Volume 1, Chapter 18 – Rehabilitation, Decommissioning and Closure: (https://www.arultd.com/wp-content/uploads/2023/01/Nolans_EIS_Chapter_18_LOW_RES_web.pdf)

As well as in the EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report: (https://www.arultd.com/wp-content/uploads/2024/08/Nolans_EIS_Appendix_W_web.pdf).

The Section 14A Report also contains further closure considerations: (https://www.arultd.com/wp-content/uploads/2023/01/Notice_alteration_project_14A_nolans_june_2019.pdf)

The initial stage Mine Closure Plan is included at APPENDIX S.

Additional design, construction and operation, monitoring and closure information relating to the Revised Project RSF is available in Knight Piésold 2019 which is included at Appendix D of the Section 14A Report.

In lieu of NT specific closure guidelines, the Western Australia "Mine Closure Plan Guidance Version 3.0 March 2020" provide the framework for this section. The WA MCP checklist is provided in Table 8—1 below.

Table 8—1 Western Australia Mine Closure Plan Guidance Checklist

Q No	Mine Closure Plan (MCP) checklist	Y / N /NA	Page No.	Changes from previous version (Y/N)	Page No.	Summary
1	Has the Checklist been endorsed by a senior representative within the tenement holder/ operating company? (See bottom of checklist.)	Y				In the MMP signature
2	Are you aware that all approved MCPs will be made publicly available?	Y				Available on Arafura website: www.arultd.com
3	Is there any information in this MCP that should not be publicly available?	N				
4	If "Yes" to Q3, has confidential information been submitted in a separate document/section?	N/A				
5	Does the MCP cover page include: Project title Company name Contact details (including telephone numbers and email addresses) Document ID and version number Date of submission (needs to match the date of this checklist)	Y				Refer to MMP Cover Page
6	State why the MCP is submitted (e.g. as part of a mining proposal, a reviewed MCP or to fulfil other legal requirements)	Y				As part of EIS and MMP Mining proposal
7	Does the project summary include: ▪ Land ownership details (include any land management agency	Y				Refer to MMP Sections 1.2, 1.3 and 2.2.1

Q No	Mine Closure Plan (MCP) checklist	Y / N /NA	Page No.	Changes from previous version (Y/N)	Page No.	Summary
	responsible for the land / reserve and the purpose for which the land / reserve [including surrounding land] is being managed). ▪ Location of the project. ▪ Comprehensive site plan(s). ▪ Background info on the history and status of the project.					
8	Does the MCP include a consolidated summary or register of closure obligations and commitments?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 4 Also refer to MMP Section 5.3 Environmental Commitments
9	Have all stakeholders involved in closure been identified?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 5.1
10	Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?	Y				Refer to MMP APPENDIX U Stakeholder Consultation and Issues Register
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y				Refer to EIS, Volume 4, Appendix S – Social Impact Assessment; and MMP APPENDIX H Social Impact Management Plan
12	Does the MCP include agreed post-mining land use(s), closure outcomes and conceptual landform design diagram?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 6, and conceptual landform design diagram in Figure 4—8.

Q No	Mine Closure Plan (MCP) checklist	Y / N /NA	Page No.	Changes from previous version (Y/N)	Page No.	Summary
13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?	Y				The predominant land use is cattle grazing. Refer to MMP Section 2.2.1.
14	Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to regulators?	N/A				None has occurred.
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning & Closure Report, Sections 6.3 & 6.4
16	Does the MCP include baseline data (including pre-mining studies and environmental data)?	Y				Refer to EIS and MMP Section 6.2
17	Has materials character-isation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	Y				Refer to EIS Volume 2, Appendix L – Acid, Metalliferous Drainage Report
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	N				To be incorporated in to closure planning as it is progressed
19	Does the MCP identify all key issues impacting mine closure outcomes and outcomes (including potential contamination impacts)?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 7
20	Does the MCP include information relevant to mine closure for each domain or	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure

Q No	Mine Closure Plan (MCP) checklist	Y / N /NA	Page No.	Changes from previous version (Y/N)	Page No.	Summary
	feature?					Report, Section 2
21	Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 7
22	Does the MCP include the process, methodology, & has the rationale been provided to justify identification & management of the issues?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 7
23	Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning & Closure Report, Section 8 Refer to MMP Section 8, & APPENDIX S – Mine Closure Plan
24	Does the MCP include a closure work program for each domain or feature?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning & Closure Report, Section 8 Refer to MMP Section 8, and APPENDIX S – Mine Closure Plan
25	Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?	Partially				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 8 Will be updated as planning progresses
26	Does the MCP contain a schedule of research and trial activities?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning & Closure Report, Section 8.2.2
27	Does the MCP contain a schedule of progressive rehabilitation activities?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning & Closure Report, Section 8.4.1

Q No	Mine Closure Plan (MCP) checklist	Y / N /NA	Page No.	Changes from previous version (Y/N)	Page No.	Summary
28	Does the MCP include details of how unexpected closure and care & maintenance will be handled?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning & Closure Report, Section 7.2.1 Refer to MMP Section 8, and APPENDIX S – Mine Closure Plan
29	Does the MCP contain a schedule of decommissioning activities?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 8
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 8
31	Does the MCP contain a framework, including methodology, quality control & remedial strategy for closure performance monitoring including post-closure monitoring & maintenance?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning and Closure Report, Section 9
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	TBA				Refer to MMP Section 8.3 Security Estimate and APPENDIX CC Security Calculation
33	Does the MCP include a process for regular review of the financial provision?	N				Refer to MMP Section 8.3 Security Estimate and APPENDIX CC Security Calculation
34	Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?	Y				Refer to EIS Volume 4, Appendix W – Rehabilitation, Decommissioning & Closure Report, Section 8.6 Refer to MMP Section 8, and APPENDIX S – Mine Closure Plan

8.1 Life of Plan – Unplanned Closure

The MMP considers the possibility and impacts of unscheduled or unplanned termination of operations during the plan life. Specifically, the Initial Stage Closure EMP sets the Project up for either early or long-term closure.

8.2 Background for Costing of Closure Activities

The total proposed Project disturbance area is approximately 691.4 ha as shown in Table 8—2 below.

The total disturbance area of activities to date is approximately 182.5 ha. This includes activities undertaken within Stage 1 – Early Construction Works, as outlined within Sections 4.1 – 4.2 above. The calculations for Stage 1 activities have been reviewed and agreed with the Department.

The proposed disturbance areas include the disturbance areas planned for Stages 2 – 12 with an estimated total disturbance area of 508.9 ha. This includes development of the mine in the initial 9 years prior to the execution of the final stage of the Kerosene Camp Creek diversion and future expansion of the mine to north-west of the initial creek diversion, and future RSF cells. These are the disturbance areas that have been used to calculate the pre-mining closure security (see Appendix CC). Project design will be refined as the Project progresses, and updates will be made to the disturbance inventory and security calculations with any changes – and subsequent changes made to this MMP at such time.

Table 8—2 Disturbance Area Inventory

Disturbance type	Disturbance Inventory of Project activities to date (ha)	Proposed Disturbance Area (ha)	Total Project Disturbance
Open Pits	0	29.30	29.30
Waste Rock Dumps	0	115.00	115.00
ROM	0	49.50	49.50
Mine Topsoil Stockpiles	0	40.00	40.00
Residue Storage Facility (first cell)	0	69.00	69.00
Mine Surface Water Management	0	16.20	16.20
River Diversion and Bunds	0	10.40	10.40
Haul Roads	0	13.10	13.10
Access Roads and Tracks	120.30	35.30	155.60
Water Ponds / Dams	Included in Infrastructure	36.05	36.05
Landfill	0	3.00	3.00
Hydromet Process Plant	29.33	71.00	100.33

Disturbance type	Disturbance Inventory of Project activities to date (ha)	Proposed Disturbance Area (ha)	Total Project Disturbance
Mine Infrastructure Area	0	10.40	10.40
Explosives Magazine (ANESA)	0	5.20	5.20
Accommodation Village	27.00	0	27.00
Borefield and Pipelines	5.87	4.50	10.37
Communications Infrastructure	0	1.00	1.00
Total	**182.50**	**508.95**	**691.45**

8.3 Security Estimate

Security estimates are presented in APPENDIX CC.

Security has been calculated according to the twelve (12) planned Project stages as described in Section 4.0 (Operational Activities) above:

- Stage 1 – Early Construction Works (works completed to date)
- Stage 2 – Bulk Earth Works, Temporary Facilities and Communications
- Stage 3 – Process Plant Concrete and Village
- Stage 4 – Hydromet Plant Construction
- Stage 5 – Beneficiation Plant Construction
- Stage 6 – Sulphuric Acid Plant Construction
- Stage 7 – Non-process Infrastructure
- Stage 8 – Power Supply and Distribution
- Stage 9 – Residue Storage Facility
- Stage 10 – Mine Complex and Surface Water Management
- Stage 11 – Mining Operations and Processing Activities (Mining Campaign 1)
- Stage 12 – Mining Operations and Processing Activities (Mining Campaign 2).

9.0 REFERENCES

9.1 Arafura Resources Limited Documents

Ref No.	Title
A1.	Arafura, 2019, *Arafura Definitive Feasibility Study - Summary Report*
A2.	Arafura, 2021, *Arafura Feasibility Study Update Report*
A3.	Arafura, 2023, Nolans Construction Materials Mining Management Plan

9.2 Guidelines, International Codes and Standards

Ref No.	Title
B1.	ANCOLD 2012, *Guidelines on the consequence categories for dams*
B2.	ANCOLD 2019, *Guidelines on Tailings Dams, Planning, Design, Construction, Operation and Closure*
B3.	ANZECC / ARMCANZ. Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000
B4.	AS 1940: 2017 The storage and handling of flammable and combustible liquids
B5.	AS 2187.1: 1998 Explosives – Storage, transport and use
B6.	AS 2187.1: 1998/AMDT 1-2000 Explosives – Storage, transport and use
B7.	AS 2444: 2001 Portable Fire Extinguishers and Fire Blankets - Selection and Location
B8.	AS ISO 31000: 2018 Risk Management
B9.	AS/NZS 3833: 2007 Storage and Handling of Mixed Classes of Dangerous Goods in Packages and Bulk Containers
B10.	AS/NZS 4452: 1997 The storage and handling of toxic substances
B11.	AS/NZS 60079.10: 2009 Explosive atmospheres Classification of areas - Explosive gas atmospheres
B12.	Australian Code for the Transport of Dangerous Goods by Road & Rail, Edition 7.6, 2018
B13.	Australian Standard AS 4482.1–1999. Guide to the sampling and investigation of potentially contaminated soil - Part 2: Volatile substances.
B14.	Australian Standard AS 4482.1–2005. Guide to the investigation and sampling of sites with potentially contaminated soil - Part 1: Non-volatile and semi-volatile compounds
B15.	Australian Weeds Committee - Weeds of National Significance
B16.	Department of Mines and Petroleum 2013, *Tailings storage facilities in Western Australia - code of practice*, Resources Safety and Environment Divisions, Department of Mines and Petroleum, western Australia

Ref No.	Title
B17.	Department of Mines and Petroleum 2015, *Guide to the preparation of a design report for tailings storage facilities (TSFs)*, Resources Safety and Environment Divisions, Department of Mines and Petroleum, western Australia
B18.	Department of Sustainability, Environment, Water, Population and Communities - National Pollutant Inventory Emission Estimation Technique Manual for Mining Version 3.1, 2012
B19.	Invasive Plants and Animals Committee - Australian Weeds Strategy 2017 - 2027
B20.	Friebel, E and Nadebaum, P (2011). Health screening levels for petroleum hydrocarbons in soil and Groundwater. Summary for NEPC. Technical Report no. 10, CRC for Contamination Assessment and Remediation of the Environment, Adelaide, Australia
B21.	Globally Harmonized System of Classification and Labelling of Chemicals (GHS) Rev.7, 2017, UNECE
B22.	http://www.agriculture.gov.au/water/policy/nwi/nonurban-water-metering-framework
B23.	Model Code of Practice: Labelling of Workplace Hazardous Substances, Safe Work Australia, October 2018
B24.	Model Code of Practice: Managing Risks of Hazardous Chemicals in the Workplace, Safe Work Australia, May 2018
B25.	National Environmental Protection Council (NEPC), National Environment Protection (Assessment of Site Contamination) Measure (NEPM), 1999 as amended in 2013
B26.	National Framework for Nonurban Water Metering: Policy paper, Department of Agriculture and Water Resources, Canberra, 2009.
B27.	National Recovery Plan for the Greater Bilby (Macrotis lagotis)
B28.	NHMRC, NRMMC (2011), Australian Drinking Water Guidelines Paper 6, National Water Quality Management Strategy.
B29.	Northern Territory Survey Methods for Flora and Fauna Surveys Used for Standard Biodiversity Unit Survey Sites
B30.	NSW Environment Protection Authority - Approved methods for the modelling and assessment of air pollutants in NSW
B31.	NT Dept of Infrastructure, Planning and Logistics - Standard Specification for Environmental Management (2013/14)
B32.	NT Dept of Land Resource Management - Buffel Grass Management Guide for Central Australia
B33.	NT Dept of Natural Resources, Environment, The Arts and Sport - Guidelines for Weed Data Collection in the Northern Territory
B34.	NT Dept of Natural Resources, Environment, The Arts and Sport - Northern Territory Weed Management Handbook

Ref No.	Title
B35.	NT EPA 2013, Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites
B36.	NT EPA 2021, Referring a Proposal to the NT EPA: Environmental Impact assessment, Guidance for proponents (version 1.0)
B37.	Recovery Plan for Five Species of Rock Wallabies 2012-2022.
B38.	Recovery Plan for the Great Desert Skink (Egernia kintorei)
B39.	Survey Guidelines for Australia's Threatened Mammals: Guidelines for Detecting Mammals Listed as Threatened Under the EPBC Act
B40.	Survey Guidelines for Australia's Threatened Reptiles: Guidelines for Detecting Reptiles Listed as Threatened Under the EPBC Act
B41.	The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013
B42.	Threat Abatement Plan for Competition and Land Degradation by Rabbits
B43.	Threat Abatement Plan for Predation by Feral Cats
B44.	Threat Abatement Plan for Predation by the European Red Fox
B45.	Threat Abatement Plan to reduce the Impacts on Northern Australia's Biodiversity by the Five Listed Grasses
B46.	Victoria Environment Protection Authority - Environmental Guidelines for Major Construction Sites
B47.	Victoria Environment Protection Authority - Mining and Extractive Industries Protocol for Environmental Management. Criteria for PM2.5 and PM10
B48.	Victoria Environment Protection Authority - Victorian State Environment Protection Policy (Air Quality Management)
B49.	Western Australia, Department of Mines, Industry Regulation and Safety "Mine Closure Plan Guidance Version 3.0 March 2020: https://www.dmp.wa.gov.au/Documents/Environment/REC-EC-112D.pdf

9.3 Third Party Documents

Ref No.	Title
C1.	Archaeological & Heritage Management Solutions Pty Ltd 2015, *Nolans Rare Earth Project, Nolans Bore, Northern Territory: Indigenous and Historic Cultural Heritage Assessment*, GHD on behalf of Arafura Resources Pty Ltd
C2.	Aquatic Ecology Services, 2020, *Nolans Bore Rare Earth Mine Southern Borefield Stygofauna Pilot Study*
C3.	CDM Smith, 2024, *Environmental Impact Self-Assessment, Nolans Bore - Explosives Magazine and Gravel Pits*

Ref No.	Title
C4.	Desert Wildlife Services, 2016, *Nolans Project Appendix 9: Vegetation of Day Creek and Associated Floodplain*, Supplement Report October 2016
C5.	Earthsea Pty Ltd, 2012, *Archaeological survey of parts of EL28473, Nolan's Bore 2011-2012*, GHD and Arafura Resources Pty Ltd
C6.	Earthsea Pty Ltd, 2010, *Archaeological Survey of the proposed Haul Road Corridor, Nolan's Bore Rare Earths Project*, GHD on behalf of Arafura Resources Pty Ltd
C7.	EcOz Pty Ltd, 2024 *Threatened species assessment of Gravel, Explosives Magazine and Access tenure*, 23-25 February 2024, Nolan Project
C8.	GHD, 2016, *Nolans Project Environmental Impact Statement (EIS)*, Arafura Resource Pty Ltd
C9.	GHD, 2016, *Arafura Resources Nolans Environmental Impact Statement Volume 1, Chapter 9 Biodiversity,* Report
C10.	GHD, 2016, Arafura Resources *Nolans Environmental Impact Statement Volume 3, Appendix M Biodiversity: Flora and Vegetation,* Report
C11.	GHD, 2016, *Arafura Resources Nolans Environmental Impact Statement Volume 3: Appendix N: Biodiversity: Fauna and Threatened Species,* Report
C12.	GHD, 2011, *Arafura Resources, Nolans Mine EIS Appendix 15: Stygofauna Pilot Survey*, Supplement Report February 2011
C13.	GHD, 2016, *Nolans Environmental Impact Statement Volume 1, Chapter 15 Socio-economics,* Report
C14.	GHD, 2016, *Nolans Environmental Impact Statement Volume 2, Appendix G: Risk Register (Social),* Supplement Report
C15.	GHD, 2016, *Nolans Environmental Impact Statement Volume 2, Appendix H: Community Consultation Report,* Supplement Report
C16.	GHD, 2016, *Nolans Environmental Impact Statement Volume 2, Appendix L: Acid, Metalliferous Drainage Report,* Supplement Report
C17.	GHD, 2016, *Nolans Environmental Impact Statement Volume 1, Chapter 6 Consultation,* Report
C18.	GHD, 2016, *Nolans Environmental Impact Statement Volume 1, Chapter 8 Groundwater,* Report
C19.	GHD 2017, *Nolans Project Environmental Impact Statement (EIS) - Supplementary Report,* Arafura Resources Pty Ltd
C20.	GHD, 2018, *Southern Basins Borefield DFS Inputs (including GHD, 2018a to GHD, 2018h).*
C21.	GHD, 2018, *Southern Basins Borefield DFS Inputs Extended.*
C22.	GHD, 2019, *Nolans Project Section 14A Notification*, Arafura Resources Pty Ltd
C23.	GHD, 2019, Draft *Water Abstraction Management Plan (WAMP)*, Arafura Resources Pty Ltd Rev0

Ref No.	Title
C24.	GHD, 2021, *Water Abstraction Management Plan (WAMP)*, Arafura Resources Pty Ltd Rev1
C25.	GHD, 2024, *Nolans Borefield Monitoring Program*, Arafura 06 August 2024, Rev 3
C26.	GHD, 2024, *Nolans Reaphook Palaeovalley Adaptive Management Plan*, Arafura Nolans Project, 02 August 2024, Rev 3.
C27.	Gunn, R, 2006, *Nolans Bore Prospect Aileron, Central Australia: Archaeological Survey*, Arafura Resources Pty Ltd
C28.	Knight Piesold, 2018, *Residue Storage Facility Operating and Monitoring Manual*, prepared for Arafura Resources Pty Ltd
C29.	Knight Piesold, 2018, *Nolans – Mining Area Surface Water Management – Design Summary*, prepared for Arafura Resources Pty Ltd, November 2018, Document Reference PE801-00140/07
C30.	Knight Piesold, 2019, *Residue Storage Facility, Definitive Feasibility Study Design Report*, prepared for Arafura Resources Pty Ltd
C31.	Knight Piesold, 2019, *Tailings Testing Report – Blend Tailings*, prepared for Arafura Resources Pty Ltd
C32.	Knight Piesold, 2019, *Tailings Testing Report – Water Leach Residue*, prepared for Arafura Resources Pty Ltd
C33.	Landloch, 2021a, *Baseline Soil Assessment: Nolans Project*
C34.	Landloch, 2021b, *Strategic Guidance For Rehabilitated Waste Landforms: Nolans Rare Earth Project*
C35.	Michels Warren Munday, 2016, *Arafura Resources Nolans Project, Appendix K: Social Impact Management Plan,* Supplementary Report
C36.	Commonwealth of Australia, 2018, *2018 National Waste Policy: Less waste more resources*.

10.0 ABBREVIATIONS

Abbreviation	Meaning
ARI	Average Reoccurrence Interval
AEP	Annual exceedance probability
Arafura / ARU	Arafura Resources Limited
AMD	Acid and metalliferous drainage
ANESA	Ammonium nitrate explosives storage area
CLC	Central Land Corporation
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ESMS	Environmental and Social Management System
Extractive MP	Extractive Mineral Permit
GDE	Groundwater dependent ecosystem
HDPE	High density polyethylene
IBC	Intermediate bulk container
ILUA	Indigenous land use agreement
LOM	Life of mine
LV MCC	Low voltage motor control centre
MAR	Mine Access Road
ML	Mineral lease
MMP	Mine Management Plan
MIA	Mine infrastructure area
NTA	Native title agreement
NTG	Northern Territory Government
NORM	Naturally occurring radioactive material
NPI	Non-process infrastructure
PMP	Probable maximum precipitation
RL	Relative level
RO	Reverse osmosis
ROM	Run of Mine
RSF	Residue storage facility
SAP	Sulphuric acid plant

Abbreviation	Meaning
SAR	Site Access Road
SEG/HRE	Samarium, Europium, Gadolinium (Middle Rare Earths)/Heavy Rare Earths
SPC	Soil profile class
TARP	Trigger, Action and Response Plan
WAMP	Water Abstraction Management Plan
WRD	Waste rock dump
WWTP	Waste water treatment plant

APPENDIX A	**ARMS-0000-H-PLN-N-0009 WEED MANAGEMENT PLAN**
APPENDIX B	**ARMS-0000-H-PLN-N-0002 BIODIVERSITY MANAGEMENT PLAN**
APPENDIX C	**ARMS-0000-H-PLN-N-0001 AIR QUALITY AND DUST MANAGEMENT PLAN**
APPENDIX D	**ARMS-0000-H-PLN-N-0007 WASTE MANAGEMENT PLAN**
APPENDIX E	**ARMS-0000-H-PLN-H-0002 HAZARDOUS MATERIALS MANAGEMENT PLAN**
APPENDIX F	**ARMS-0000-H-PLN-H-0012 EROSION AND SEDIMENT CONTROL MANAGEMENT PLAN**
APPENDIX G	**ARMS-0000-H-PLN-I-0001 CULTURAL HERITAGE MANAGEMENT PLAN**
APPENDIX H	**ARMS-0000-H-PLN-W-0001 SOCIAL IMPACT MANAGEMENT PLAN**
APPENDIX I	**ARMS-0000-H-PLN-H-0001 EMERGENCY RESPONSE MANAGEMENT PLAN**
APPENDIX J	**ARMS-0000-H-PLN-H-0003 NOISE, VIBRATION AND LIGHT MANAGEMENT PLAN**
APPENDIX K	**NRE-0000-H-PLN-H-0004 RADIATION PROTECTION AND RADIOACTIVE WASTE MANAGEMENT PLAN**
APPENDIX L	**ARMS-0000-H-PLN-N-0008 WASTE ROCK MANAGEMENT PLAN**
APPENDIX M	**NRE-0000-H-PRO-N-0003 GROUNDWATER SAMPLING AND DATA COLLECTION PROCEDURE**
APPENDIX N	**ARMS-0000-H-PRO-N-0002 SURFACE WATER SAMPLING PROCEDURE**
APPENDIX O	**ARMS-0000-H-PRO-N-0003 SEDIMENT SAMPLING PROCEDURE**
APPENDIX P	**ARMS-0000-H-PLN-N-0003 KEROSENE CAMP CREEK MANAGEMENT PLAN**
APPENDIX Q	**ARMS-0000-H-PLN-N-0006 RESIDUE STORAGE FACILITY MANAGEMENT PLAN**
APPENDIX R	**ARMS-0000-H-PLN-N-0013 WATER MANAGEMENT PLAN**
APPENDIX S	**ARMS-0000-O-PLN-O-0002 MINE CLOSURE PLAN**
APPENDIX T	**INCIDENT/ACCIDENT REPORT FORM**
APPENDIX U	**STAKEHOLDER CONSULTATION AND ISSUES REGISTER**
APPENDIX V	**NRE-0000-H-APP-N-0020 RISK REGISTER (ENVIRONMENTAL)**
APPENDIX W	**NRE-0000-A-PLN-G-0001 TERRITORY BENEFIT PLAN**
APPENDIX X	**NRE-0000-H-SRG-I-0001 INDIGENOUS ENGAGEMENT STRATEGY**
APPENDIX Y	**NRE-0000-E-RPT-Y-0001 BASELINE SOIL ASSESSMENT**
APPENDIX Z	**NRE-0000-E-RPT-Y-0002 STRATEGIC GUIDANCE FOR REHABILITATED WASTE LANDFORMS**
APPENDIX AA	**ARMS-0000-H-PLN-N-0005 TOPSOIL MANAGEMENT PLAN**
APPENDIX BB	**KEROSENE CAMP CREEK DIVERSION AND MINE SURFACE WATER MANAGEMENT DESIGN**
APPENDIX CC	**SECURITY CALCULATION**
APPENDIX DD	**THREATENED SPECIES ASSESSMENT OF GRAVEL, MAGAZINE AND ACCESS TENURE**
APPENDIX EE	**ENVIRONMENTAL IMPACT SELF-ASSESSMENT, EXPLOSIVES MAGAZINE AND GRAVEL PITS**

NORTHERN TERRITORY GOVERNMENT

DEPARTMENT OF LANDS,PLANNING AND ENVIRONMENT

AT3-010		last review: June 2009

DLPE Security Calculation Form

Security Calculation Summary

Details	Nolans Rare Earth Project Total - Stages 1 - 12		
Assessment Date	13/08/2025	**Environmental Mining Officer**	Roojan Bista
Project	Nolans Rare Earths Project	**Authorisation #**	1127-01
Operator	Arafura Nolans Project Pty Ltd	**Operator Contact**	Yemaya McGuinness
MMP reference	42-D25-31226 (Rev 5.1) submitted on 13 Aug 2025	**Shapefile - 42-D25-20088 (dept record)**	

Calculation Trigger

New Authorisation	MMP Renewal/amendment	Audit Finding	Client Request
	☒		

Domains	Total Calculated Cost	Stage 1 Calculated Cost Early Works	Stage 2 Calculated Cost Bulk Earthworks (BEW), Temporary Facilities, Comms	Stage 3 Calculated Cost Process Plant Concrete & Camp Construction	Stage 4 Calculated Cost Hydromet Construction	Stage 5 Calculated Cost Beneficiation Construction	Stage 6 Calculated Cost Sulfuric Acid Plant (SAP) Construction	Stage 7 Calculated Cost Non-process Infrastructure (NPI)	Stage 8 Calculated Cost Power Station	Stage 9 Calculated Cost Residue Storage Facility (RSF)	Stage 10 Calculated Cost Mine Facilities, Surface Water Management (SWM)	Stage 11 Calculated Cost Mining Campaign 1	Stage 12 Calculated Cost Mining Campaign 2	
1: Site Infrastructure	$18,468,013.60	$1,176,058.50	$989,159.68	$1,830,868.90	$10,971,216.72	$520,496.00	$586,078.00	$1,102,545.80	$423,470.00	$616,500.00	$120,170.00	$68,750.00	$62,700.00	
2: Extractive Workings - Sand, Clay & Gravel	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	
3: Hard Rock Pits & Quarries	$159,620.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$58,260.00	$101,360.00	
4: Underground Workings	$0.00	$0.00	$0.00		$0.00	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00	$0.00	
5: Tailings Storage Facilities and Dams	$6,533,213.32	$32,953.50	$1,756,685.00	$0.00	$0.00	$40,862.50	$0.00	$0.00	$0.00	$4,567,469.82	$80,242.50	$55,000.00	$0.00	
6: Stockpiles & Waste Rock Dumps	$4,182,450.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,264,950.00	$2,917,500.00	
7: Exploration	$0.00	$0.00	$0.00		$0.00	$0.00	$0.00		$0.00	$0.00	$0.00	$0.00	$0.00	
8: Access and Haul Roads	$968,471.00	$660,060.00	$91,360.00	$0.00	$0.00	$0.00	$0.00	$113,487.00	$0.00	$12,084.00	$81,220.00	$10,260.00	$0.00	
9: River Diversions	$1,240,146.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,240,146.00	$0.00	$0.00	
Decommissioning & Post Closure Management	$2,848,831.25	$414,544.00	$785,456.00	$0.00	$0.00	$0.00	$0.00	$36,750.00	$0.00	$191,085.00	$94,550.00	$517,923.75	$808,522.50	
Sub-Total - All Domains	$34,400,745.17	$2,283,616.00	$3,622,660.68	$1,830,868.90	$10,971,216.72	$561,358.50	$586,078.00	$1,252,782.80	$423,470.00	$5,387,138.82	$1,616,328.50	$1,975,143.75	$3,890,082.50	
CONTINGENCY @15%	$5,160,111.78	$342,542.40	$543,399.10	$274,630.34	$1,645,682.51	$84,203.78	$87,911.70	$187,917.42	$63,520.50	$808,070.82	$242,449.28	$296,271.56	$583,512.38	
TOTAL COST	$39,560,856.94	$2,626,158.40	$4,166,059.78	$2,105,499.24	$12,616,899.23	$645,562.28	$673,989.70	$1,440,700.22	$486,990.50	$6,195,209.64	$1,858,777.78	$2,271,415.31	$4,473,594.88	
Operator Assessment (to nearest $)	$39,560,857	$2,626,158	$4,166,060	$2,105,499	$12,616,899	$645,562	$673,990	$1,440,700	$486,991	$6,195,210	$1,858,778	$2,271,415	$4,473,595	
10% Discount	$3,956,086	$262,616	$416,606	$210,550	$1,261,690	$64,556	$67,399	$144,070	$48,699	$619,521	$185,878	$227,142	$447,359	
Amended amount	$35,604,771	$2,363,543	$3,749,454	$1,894,949	$11,355,209	$581,006	$606,591	$1,296,630	$438,291	$5,575,689	$1,672,900	$2,044,274	$4,026,235	$35,604,771
1% levy	$356,048	$23,635	$37,495	$18,949	$113,552	$5,810	$6,066	$12,966	$4,383	$55,757	$16,729	$20,443	$40,262	
Operator Assessment (as per security calculation)	$35,346,178.00	$2,363,549	$2,707,823	$2,863,968	$11,355,209	$581,006	$606,591	$1,311,941	$438,291	$5,570,359	$1,583,153	$2,102,163	$3,862,126	

	DISTURBANCE AREA INVENTORY																
			Early Works	BEW, Temp, Comms	Process Plant, Camp	Hydromet	Beneficiation	SAP	NPI	Power Station	RSF	Mine Facilities, SWM	Campaign 1	Campaign 2			
	Whole of site summary	**Total Area (ha)**	**Stage 1 (ha)**	**Stage 2 (ha)**	**Stage 3 (ha)**	**Stage 4 (ha)**	**Stage 5 (ha)**	**Stage 6 (ha)**	**Stage 7 (ha)**	**Stage 8 (ha)**	**Stage 9 (ha)**	**Stage 10 (ha)**	**Stage 11 (ha)**	**Stage 12 (ha)**	**Progressive Rehab Area (ha)**	**Remaining area (ha)**	Operator's Comments	Dept. Comments
	Lease surface area	3139																
	Disturbed operational area	182.50																
	Above grade landforms																	
1	Waste rock dump	115.00											27.00	88.00		115.00		
2	ROM	49.50											20.30	29.20		49.50		
3	Mine Topsoil Stockpiles	40.00											8.30	31.70		40.00		
4	Tailings Dam (RSF cell) #1	69.00									69.00					69.00	RSF cell 1 + containment corridor, access and laydown area	
5	Pit #1	11.70											11.70			11.70	Pit 1	
6	Pit #2	10.10												10.10		10.10	Pit 2	
7	Pit #3	7.50												7.50		7.50	Pit 3	
8	Mine Surface Water Management	16.20										16.20				16.20	Drains, bunds and dams	
9	River diversion and bunds	10.40										10.40				10.40	River diversion	
10	Mine haul roads	13.10										13.10				13.10		
11	access roads/tracks	155.60	120.30	11.40				20.00			2.10		1.80			155.60	The stage 1 amount includes access roads and tracks	
12	water ponds/dams	36.05									36.05					36.05	Stage 2: 35.8 ha evaporation pond + 0.25 ha event pond at RSF	
13	Hydromet Process Plant	100.33	29.33	71.00												100.33		
	Sulphuric Acid Plant	-														-	Included in Hydromet Process Plant	
	Beneficiation Plant	-														-	Included in Hydromet Process Plant	
	Power Station	-														-	Included in Hydromet Process Plant	
	Operations Complex (Admin Building	-														-	Included in Hydromet Process Plant	
14	Communication infrastructure	1.00		1.00													located within ML32414 - 1 ha total	15.99ha target area footprint in shapefile but only 1ha disturbance proposed
15	Mine Infra. Area (Mine Ops Complex)	10.40		10.40												10.40		
16	Explosive Storage Area	5.20		5.20												5.20		
17	Accommodation village	27.00	27.00													27.00		
	Water and Waste treatment Plants	-														-	Included in accommodation village	
18	Borefield and pipelines	10.37	5.87					4.50								10.37	Stage 7: 1.5 ha allowed for each new bore field area (3 in total)	43.96ha target area footprint in shapefile but only 4.5ha disturbance proposed
20	Landfill	3.00		3.00												3.00	Landfill at process area - 3 ha	
	TOTAL	**691.45**	**182.50**	**102.00**	**-**	**-**	**-**	**24.50**	**-**	**-**	**107.15**	**39.70**	**69.10**	**166.50**	**-**	691.45		

Domain 1: Infrastructure

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Stage 1 Early Works	Stage 2 BEW, Temp, Comms	Stage 3 Process Plant, Camp	Stage 4 Hydromet	Stage 5 Beneficiation	Stage 6 SAP	Stage 7 NPI	Stage 8 Power Station	Stage 9 RSF	Stage 10 Mine Facilities, SWM	Stage 11 Campaign 1	Stage 12 Campaign 2	Operator's Comments	Dept.Comments
1	Process Plant, Mill, Crusher area	disconnect and terminate services	@	10000-27500	10000.00	5.00	$50,000.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.				1	1	1	1	1							
2		demolish and remove small buildings	m^2	70-90	70.00	3864.00	$270,480.00	enter the total area of small buildings and offices in the area, including demountables. It does not include workshops.				3317				547						Operator's estimated quantity used
3		demolish and remove industrial workshops and sheds	m^2	160-210	210.00	0.00	$0.00	enter the total area of workshop facilities in the area.				0										
4		demolish remove conveyor system	m	100-250	100.00	656.96	$65,696.00	Enter the total length of conveyors				288	304	64.5								Operator's estimated quantity used
5		demolish/remove crusher, process plant and mills	m^2	160-210	160.00	33730.45	$5,396,872.00	enter the total surface area of process plant and mills etc. If multi-story the area should be the sum of the surface area of all floors.				27799	1549.2	2714.8		1667						Operator's estimated quantity used
6		remove concrete pads and footings <300mm thick	m^2	10-30	10.00	59602.49	$596,024.90	enter the total area of buildings, workshops etc. Cost dependent on thickness. Assume $10/m2 for <300mm thick, $30/m2 for >300mm thick. (default $15 if unknown)				46796		4924.4	7526	356						Operator's estimated quantity used
7		remove concrete pads and footings >300mm thick	m^2	10-30	30.00	22227.80	$666,834.00	enter the total area of buildings, workshops etc. Cost dependent on thickness. Assume $10/m2 for <300mm thick, $30/m2 for >300mm thick. (default $15 if unknown)				20518		426		1284						Operator's estimated quantity used
8		remove mobile plant	hr	140-300	140.00	16.00	$2,240.00	consider distance to remove all mobile plant to the nearest centre or to Darwin.		4		12										Stage 2 -Mobile concrete batch plant. Stage 4 - Operator's estimated quantity used
9		remove contaminated material	m^3	3.00-5.00	3.00	25731.24	$77,193.72	enter volume of spillage and other contamination for removal to pit or WRD.				25731										
10		deconstruct and remove large tanks - e.g. leach	@	35000-165000	35000.00	114.00	$3,990,000.00	enter the number of tanks				112	2									
11		deconstruct and remove small tanks	@	10000-30000	10000.00	208.00	$2,080,000.00	enter the number of tanks				192	10	6								Operator's estimated quantity used
12		tank removal - large hydrocarbon (>5000L)	@	48000-82500	48000.00	0.00	$0.00	removal of tank and all pipework, bunds and any contamination							0							
13		tank removal - small hydrocarbon (up to 5000L)	@	20000-21000	20000.00	0.00	$0.00	removal of tank and all pipework, bunds and any contamination														
14		above ground tank removal - hydrocarbon	@	200.00	200.00	14.00	$2,800.00	enter number of tanks		5	2	0	1	0		5		1				14 Tanks proposed in MMP Rev 5.1
15		remove hydrocarbon contamination	m^3	3.00-5.00	3.00	2160.49	$6,481.46	enter the volume to be removed to pit void for appropriate rehabilitation. If the volume is not known assume a volume of 3000m3 per fuel storage facility.		2160.486												8 fuel facilities (14 tanks) Section 4.9.3.1.2 (page 81) of the MMP (Rev 5.1). Operator's estimated quantity used.
16		remediation on site of hydrocarbon contamination	m^3	30-55	30.00	2160.49	$64,814.58	enter the volume of material requiring onsite remediation. If the volume is not known assume a volume of 3000m3 per fuel storage facility.		2160.486												8 fuel facilities (14 tanks) Section 4.9.3.1.2 (page 81) of the MMP (Rev 5.1) Operator's estimated quantity used.
							$13,269,436.66															
17	Main Workshop and Stores area	disconnect and terminate services	@	5000-5500	5000.00	3.00	$15,000.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.		1					1.00			1				Stage 2 - 2 strucutres (MIA+ESA); Stage 7 - 2 Structures; Stage 10 - 2 workshops
18		demolish and remove small buildings	m^2	70-90	70.00	1425.00	$99,750.00	enter the total area of small buildings and offices in the area, including demountables. It does not include workshops.							1425							Operator's estimated quantity used
19		demolish and remove industrial workshops and sheds	m^2	160-210	160.00	2006.00	$320,960.00	enter the total area of workshop facilities in the area. Are there any remote or field based workshops to include							2006							Operator's estimated quantity used
20		remove concrete pads and footings	m^2	10-30	15.00	3613.00	$54,195.00	enter the total area of workshops and buildings. Include any areas of carpark and washdown pads, bulk fuel bunding and refuelling areas.							3613							Operator's estimated quantity used
21		remove contaminated material	m^3	3.00-5.00	3.00	550.00	$1,650.00	enter volume of spillage and other contamination for removal to pit or WRD.							550							Operator's estimated quantity used
22		underground tank removal - large hydrocarbon (>5000L)	@	48000-82500	60000.00	0.00	$0.00	removal of underground tank and all pipework, bunds and any contamination														
23		underground tank removal - small hydrocarbon (up to 5000L)	@	20000-21000	20000.00	0.00	$0.00	removal of underground tank and all pipework, bunds and any contamination														
24		above ground tank removal - hydrocarbon	@	200.00	200.00	14.00	$2,800.00	enter number of tanks	3.00						11							Operator's estimated quantity used
25		remove hydrocarbon contamination	m^3	3.00-5.00	3.00	0.00	$0.00	enter the volume to be removed to pit void for appropriate rehabilitation. If the volume is not known assume a volume of 3000m3 per fuel storage facility.														Captured in Process Plant section - 8 fuel facilities
26		remediation on site of hydrocarbon contamination	m^3	30-55	55.00	0.00	$0.00	enter the volume of material requiring onsite remediation. If the volume is not known assume a volume of 3000m3 per fuel storage facility.														Captured in Process Plant section - 8 fuel facilities
							$494,355.00															
27	Administration	disconnect and terminate services	item	5000-5500	5000.00	6.00	$30,000.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.		2					2		1	1				Stage 2 - 2 x areas (Construction offices + Concrete batch plant); Stage 4 - 2x areas; Stage 9 - Admin buildings ;Stage 10- Admin buildings These are all different areas witin the site.
28		demolish and remove small buildings	m^2	70-90	70.00	13947.20	$976,304.00	enter the total area of small buildings and offices in the area, including demountables. It does not include workshops.		3607					4824		4000	1516				Operator's estimated quantity used
29		demolish and remove industrial workshops and sheds	m^2	160-210	160.00	2380.00	$380,800.00	enter the total area of workshop facilities in the area.							380		2000					Operator's estimated quantity used
30		remove bitumen from sealed carparks etc	m^2	12.00-17.00	12.00	48.00	$576.00	enter total area of carparks. Includes removal offsite to appropriate facility							48							Operator's estimated quantity used
31		remove concrete pads, footings	m^2	10-30	15.00	470.00	$7,050.00	enter the total area of workshops and buildings. (concrete <300mm @ $10/m2, concrete >300mm @ $30/m2)							380			90				Operator's estimated quantity used
32		remove contaminated material	m^3	3.00-5.00	3.00	500.00	$1,500.00	assumes removal offsite to a waste disposal facility. Adjust if disposing at onsite facility							500							Operator's estimated quantity used
33		waste disposal offsite	@	650	650.00	10.00	$6,500.00	assumes removal offsite to a waste disposal facility. Adjust if disposing at onsite facility									10					Operator's estimated quantity used
							$1,402,730.00															
34	Sewerage/Water treatment plant	disconnect and terminate services	item	2500-5000	2500.00	3.00	$7,500.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.	1			1						1				Stage 4 - Operator's estimated quntity used. Stage 10 - Ablutions and crib facilities
35		remove concrete pads, footings	m^2	10-30	15.00	3950.80	$59,262.00	enter the total area of workshops and buildings. (concrete <300mm @ $10/m2, concrete >300mm @ $30/m2)	807.8			3143										Operator's estimated quantity used
36		demolish and remove small buildings	m^2	70-90	70.00	1125.00	$78,750.00	enter the total area of small buildings and tanks.	0			1125										Operator's estimated quantity used
37		deconstruct and remove large tanks - e.g. leach	@	35000-165000	35000.00	6.00	$210,000.00	enter the number of tanks	1			5										Operator's estimated quantity used
38		deconstruct and remove small tanks	@	10000-30000	10000.00	11.00	$110,000.00	enter the number of tanks	8			3										Operator's estimated quantity used
39		remove contaminated soil	m^3	3.00-5.00	5.00	0.00	$0.00	removal to pit void for appropriate rehabilitation	0													
							$465,512.00															

Domain 1: Infrastructure

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Stage 1 Early Works	Stage 2 BEW, Temp, Comms	Stage 3 Process Plant, Camp	Stage 4 Hydromet	Stage 5 Beneficiation	Stage 6 SAP	Stage 7 NPI	Stage 8 Power Station	Stage 9 RSF	Stage 10 Mine Facilities, SWM	Stage 11 Campaign 1	Stage 12 Campaign 2	Operator's Comments	Dept.Comments
40	Accommodation Camp	disconnect and terminate services	item	5000-5500	5000.00	2.00	$10,000.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.	1								1					Operator's estimated quantity used
41		deconstruct and remove small tanks	@	10000-30000	10000.00	7.00	$70,000.00	enter the number of tanks	7													Exisiting disturbance
42		deconstruct and remove large tanks - e.g. leach	@	35000-165000	35000.00	2.00	$70,000.00	enter the number of tanks	0		2											Operator's estimated quantity used
43		demolish and remove small buildings	m^2	70-90	70.00	16762.20	$1,173,354.00	enter the total area of small buildings and tanks.	8306		8456.2											Operator's estimated quantity used
44		demolish and remove industrial workshops and sheds	m^2	160-210	160.00	216.00	$34,560.00				216											Operator's estimated quantity used
45		remove bitumen from sealed carparks etc	m^2	12.00-17.00	12.00	510.00	$6,120.00	Assumed for Sport Court			510											Operator's estimated quantity used
		remove hydrocarbon contamination	m3	3.00-5.00	5.00	0.00	$0.00															Captured in Process Plant section - 8 fuel facilities
		remediation on site of hydrocarbon contamination	m3	30-55	55.00	0.00	$0.00															Captured in Process Plant section - 8 fuel facilities
46		remove concrete pads, footings	m^2	10-30	10.00	4436.00	$44,360.00				4436											Operator's estimated quantity used
							$1,408,394.00															
47	Airstrip, borefields, other	remove concrete pads footings and bitumen	m^2	10-30	10.00	228.00	$2,280.00	enter total area (concrete <300mm @ $10/m2, concrete >300mm @ $30/m2)	40						138				30	20		Operator's estimated quantity used
48		deconstruct and remove small tanks	@	10000-30000	10000.00	12.00	$120,000.00	enter the number of tanks	2						9				1			Operator's estimated quantity used
49		deconstruct and remove large tanks - e.g. leach	@	35000-165000	35000.00	1.00	$35,000.00	enter the number of tanks	1													Operator's estimated quantity used
50		above ground tank removal - hydrocarbon	@	200.00	200.00	4.00	$800.00	enter number of tanks	0						3				1			Operator's estimated quantity used
51		Deep rip	ha	550-1100	550.00	2.13	$1,171.50	Enter all areas disturbed by infrastructure from above, including laydown areas Assume highly disturbed and compacted areas - see assumptions.	2.13														
52		demolish and remove sheds and storage tanks	m^2	70-90	70.00	10.00	$700.00	enter area of sheds and tanks	0						10							
53		production/dewatering bore closure	@	2000-3300	2000.00	13.00	$26,000.00	sealing and rehabilitation	2						9				1	1		Operator's estimated quantity used
54		remove hydrocarbon contamination	m3	3.00-5.00	5.00	0.00	$0.00															Captured in Process Plant section - 8 fuel facilities
55		remediation on site of hydrocarbon contamination	m3	30-55	55.00	0.00	$0.00															Captured in Process Plant section - 8 fuel facilities
56		observation bore closure	@	500	500.00	60.00	$30,000.00	includes sealing and rehabilitation to make safe.	45						11				2	2		
57		deconstruct and remove small Tower (Comms)	@	10000-30000	10000.00	0.00	$0.00								0							
58		deconstruct and remove large Tower (Comms)	@	35000-165000	35000.00	3.00	$105,000.00			3					0							Stage 2 - 3 x Commns tower - Mine, accommodation and borefield F (ML32414)
59							$320,951.50															
60	Revegetation Activities - all infrastructure areas	Deep rip	ha	550-1100	550.00	217.12	$119,414.66	Enter all areas disturbed by infrastructure from above, including laydown areas Assume highly disturbed and compacted areas - see assumptions. Covers rehabilitation MINING topsoil stockpiles	62	128									13.00	14.00		Stage 11 - 8.29 ha of top soil stockpile Stage 12- 31.72 ha of top soil stockpile
61		source cart and spread topsoil	m^3	2.50-5.50	2.50	217117.56	$542,793.91	assume minimum of 10cm depth	62200	127918									13000	14000		Operator's estimated quantity used
62		revegetation by tubestock	ha	6000/ha (or 5/ea.)	6000.00	0.00	$0.00	enter total area for revegetation by tubestock. (or enter quantity of tubestock required (<15cm), and density/ha)	0													
63		revegetation by direct seeding	ha	1200-2000	1200.00	217.12	$260,541.08	this rate includes acquiring a mix of native tree and shrub species appropriate for the area, mixing and treating the seed and applying by hand at a rate of 4-10kg/ha	62	128									13.00	14.0		Operator's estimated quantity used
64		fertiliser application	ha	140-744	140.00	0.00	$0.00	includes a single application of fertiliser during the initial seeding program - see assumptions														
65	Sediment Management	sediment traps/dams	m^3	2.50-2.90	2.90	0.00	$0.00	enter volume of dam required for sediment traps		0												
66		Rocks or coarse material lined sediment trap	m^3	1.00-5.00	5.00	30.00	$150.00	consider distance to cart material		30												
67							$922,899.64															
68	Other	remove powerlines	km	9800-15000	9800.00	6.50	$63,700.00	include dismantling and removal of lines and poles from the site	0						0	6.5						Operator's estimated quantity used
69		remove pipelines	km	1400-1800	1400.00	80.26	$112,359.80	remove polypipe >300mm diameter. Assumes removal by 3 persons via truck to nearest location.	30						49.057	1.2						Stages 7 & 9 -Operator's estimated quantity used
70		remove fencing	km	500	500.00	15.35	$7,675.00	remove polypipe >300mm diameter. Assumes removal by 3 persons via truck to nearest location.							15.35							Stage 7 -Operator's estimated quantity used.
							$183,734.80															
		DOMAIN 1 TOTAL					$18,468,013.60															

COVERED UNDER EXTRACTIVE MINERALS PERMIT MMP - MA1083

Domain 2: Extractive Workings - Sand, Clay & Gravel

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)		Early Works	BEW	Hydromet Conc. & Camp	Hydromet	Bene	SAP	NPI Buildings	Power Stations (PS)	RSF (Tailings)	Mining	Campaign 1	Campaign 2	Technique Notes
71	Pits	Scaling, battering for stabilisation	m^2	1.21-3.00	1.21	0.00	$0.00	TRUE													this includes the area requiring reshaping for stabilisation and preparation for revegetation
72		backfilling of pits	m^3	4.00-5.00	4.00	0.00	$0.00	TRUE													enter volume of material to be backfilled into pit
73		abandonment bund and pit access closed	m	20.00-63.25	20.00	0.00	$0.00	TRUE													required where final pit includes steep faces. Includes bund around pit and closure of ramp. Bund assumed to be 2m high and 5m wide at base
74		structural works for drainage	ha	700-1500	700.00	0.00	$0.00	TRUE													earthworks for banks and drains to manage surface water .
75		source cart and spread topsoil or growth medium	m^3	2.50-5.50	2.50	0.00	$0.00	TRUE													required if it has not been demonstrated that pit material is suitable as a growth medium
76		final trim, deep rip	ha	550-1600	550.00	0.00	$0.00	TRUE													to enhance vegetation program as required, dependent on material to be ripped eg sand, gravel, clay. Assume low to medium level disturbance - see assumtpions
77		revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00	0.00	$0.00	TRUE													includes acquisition of tubestock, fertiliser and guarding as necessary
78		revegetation by direct seeding	ha	1200-2000	1200.00	0.00	$0.00	TRUE													includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
79		fertiliser application	ha	140-744	140.00	0.00	$0.00	TRUE													includes a single application of fertiliser during the initial seeding program - see assumptions
80		signage	@	50	50	0.00	$0.00	TRUE													enter number of warning signs as approriate
							$0.00		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	
81	Sediment Management	sediment traps/dams	m^3	2.50-2.90	2.50	0.00	$0.00	TRUE													enter volume of dam required for sediment traps
82		Rocks or coarse material lined sediment trap	m^3	1.00-5.00	1.00	0.00	$0.00	TRUE													condsider distance to cart material
83	Other						$0.00	TRUE													
							$0.00		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	
	DOMAIN 2 TOTAL						$0.00		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	

Domain 3: Hard Rock Pits and Quarries

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Early Works	BEW, Temp, Comms	Process Plant, Camp	Hydromet	Beneficiation	SAP	NPI	Power Station	RSF	Mine Facilities, SWM	Campaign 1	Campaign 2	Technique Notes
84	Stabilisation of Pits	Drill and blast faces to make safe OR	m^3	1.20-1.60	1.60	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	Volume is worked out be multiplying length of bench by width and height to reduce angle to make it safe.
85		scaling, battering, pushing walls	m^3	1.21-3.00	3.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	volume requiring reshaping
86		abandonment bund and pit access closed	m	19.00-63.25	19.00	4080.00	$77,520.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$28,310	$49,210	required where final pit includes steep faces (>18o). Includes bund (2m high , 5m base) around pit and closure of ramp
87		final trim, deep rip	ha	550-1600	1600.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	to enhance vegetation program around pit and pit floors as required
88		structural works for drainage	ha	700-1540	1200.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	earthworks for banks and drains to manage surface water .
89		source cart and spread topsoil if appropriate	m^3	2.50-5.50	5.50	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes min of 10cm of topsoil to assist revegetation program.
90		revegetation by tube stock	ha	6000/ha (or 5/ea.)	6000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes acquisition of tubestock, fertiliser and guarding as necessary
91		revegetation by direct seeding	ha	1200-2000	2000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
92		fertiliser application	ha	140-744	140.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes a single application of fertiliser during the initial seeding program
93		fencing	m	10.0-30.0	20.00	4080.00	$81,600.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$29,800	$51,800	construct a standard stock fence around the site
94		signage	@	50	50	10.00	$500.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$150	$350	enter number of warning signs as appropriate
							$159,620	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$58,260	$101,360	
95	Infill of pits	infill with tailings or waste rock	m^3	2.00-4.00	4.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	haul and dump of waste rock or tailings. Distance needs to be considered.
96		shaping or levelling	ha	550-1100	700.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	area requiring minor reshaping prior to deep ripping
97		source cart and spread suitable material for growth medium	m^3	2.00-5.00	5.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	required if it has not been demonstrated that infill material is suitable as a growth medium and only if does not require engineered capping design for ARD/metals mitigation. Assume min thickness of 0.5m
98		source cart and spread topsoil if appropriate	m^3	2.50-5.50	5.50	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes min of 10cm of topsoil to assist revegetation program.
99		final trim, deep rip	ha	550-1600	1600.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	to enhance vegetation program over infilled pit as required
100		structural works for drainage	ha	700-1540	1200.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	earthworks for banks and drains to manage surface water on top of capped pit area if required.
101		revegetation by tube stock	ha	6000/ha (or 5/ea.)	6000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes acquisition of tubestock, fertiliser and guarding as necessary
102		revegetation by direct seeding	ha	1200-2000	2000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
103		fertiliser application	ha	140-744	140.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes a single application of fertiliser during the initial seeding program - see assumptions
							$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
104	Sediment Management	sediment traps/dams	m^3	2.5-2.9	2.50	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	enter volume of dam required for sediment traps
105		Rocks or coarse material lined sediment trap	m^3	1.00-5.00	2.50	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	consider distance to cart material
106	Other					0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
							$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
	DOMAIN 3 TOTAL						$159,620.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$58,260.00	$101,360.00	

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8	Stage 9	Stage 10	Stage 11	Stage 12		
	Early Works	BEW, Temp, Comms	Process Plant, Camp	Hydromet	Beneficiation	SAP	NPI	Power Station	RSF	Mine Facilities, SWM	Campaign 1	Campaign 2	Operator's Comments	Dept.Comments
84														
85														
86											1490	2590		Operator's estimated quantity used
87														
88														
89														
90														
91														
92														
93											1490	2590		Pastoral property requires fence
94											3	7		Operator's estimated quantity used
95														
96														
97														
98														
99														
100														
101														
102														
103														
104														
105														
106														

NOT APPLICABLE

Domain 4: Underground Workings

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes
107	Portals, Declines and Shafts	barricading portal/declines/adits	@	1500-2500	1500.00		0.00	barricading of portal with steel grill to make safe and ensure access cnnot be gained but will allow movement of bats
108		sealing portal/decline	@	15000-25000	15000.00		0.00	OR sealing portal with concrete and backfill to make safe and ensure access cannot be gained
109		capping/sealing shafts	@	10000-25000	10000.00		0.00	cap shafts using reinforced concrete slab. Dependent on size
110		shaft infilling	m^3	8.00-20.0	8.00		0.00	filling of shafts using onsite material
111		seal ventilation fans	@	27500	27500.00		0.00	seal and rehab ventilation fans to make safe.
112		final trim, deep rip	ha	550-1600	550.00		0.00	to enhance vegetation program in area as required
113		revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary
114		revegetation by direct seeding	ha	1200-2000	1200.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
115		fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program - see assumptions
							0.00	
	DOMAIN 4 TOTAL						$0.00	

Domain 5: Tailings Storage Facilities and Dams

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Early Works	BEW, Temp, Comms	Process Plant, Camp	Hydromet	Beneficiation	SAP	NPI	Power Station	RSF	Mine Facilities, SWM	Campaign 1	Campaign 2	Technique Notes
116	Water Dams, Ponds	clean water dams - stabilise and make safe	@	2000-2200	2200.00	1.00	$2,200.00	$2,200	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	minor earthworks
117		or backfill to natural surface	m^3	2.00-5.00	2.00	83600.00	$167,200.00	$30,000	$72,200	$0	$0	$10,000	$0	$0	$0	$0	$55,000	$0	$0	backfilled with onsite material. Haul distance sliding scale from $2/m3 for up to 1km, up to $5/m3 for up to 5km or greater.
118		dirty water dams - drain and remove sediment	m^3	5.00-7.50	5.00	193750.00	$968,750.00	$0	$901,250	$0	$0	$18,750	$0	$0	$0	$0	$48,750	$0	$0	includes draining the dam to the pit or other appropriate place, removing 500mm of potentially contaminated sediments to be buried in the pit or other disposal area. Must consider the distance from dam to disposal area.
119		shaping or levelling	ha	550-1100	550.00	37.42	$20,581.00	$754	$19,828	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	area requiring minor reshaping prior to deep ripping
120		source cart and spread suitable material for capping/growth medium	m^3	2.00-5.00	3.23	193750.00	$625,812.50	$0	$582,208	$0	$0	$12,113	$0	$0	$0	$0	$31,493	$0	$0	required if it has not been demonstrated that infill material is suitable as a growth medium Assume min thickness of 0.5m
121		source cart and spread topsoil if appropriate	m^3	2.50-5.50	2.50	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes min of 10cm of topsoil to assist revegetation program.
122		final trim, deep rip	ha	550-1600	550.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	to enhance vegetation program as required
123		structural works for drainage	ha	700-1540	1500.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	earthworks for banks and drains to manage surface water on top of capped dam area if required.
124		revegetation by tubestock	ha	6000/ha (or $/ea.)	6000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes acquisition of tubestock, fertiliser and guarding as necessary
125		revegetation by direct seeding	ha	1200-2000	1200.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
126		fertiliser application	ha	140-744	140.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes a single application of fertiliser during the initial seeding program
							$1,784,543.50	$32,953.50	$1,575,485.00	$0.00	$0.00	$40,862.50	$0.00	$0.00	$0.00	$0.00	$80,242.50	$55,000.00	$0.00	
127	Tailings Dams	source cart and spread suitable material for capping	m^3	2.00-5.00	3.23	1320000.00	$4,263,600.00	$0	$0	$0	$0		$0	$0	$0	$4,263,600	$0	$0	$0	volume of suitable material for capping the TSF. Must have appropriate chemical and physical properties. Required whether for engineered design or growth medium. *Calculated for 2 m capping material*
128		apply capping design treatment as required e.g. 'store and release'	ha	25000-49500	36500.00	0.00	$0.00	$0	$0	$0	$0		$0	$0	$0	$0	$0	$0	$0	required to manage AMD or metals leachate from TSF. Capping layer assumed to be no less than 2m thick.
129		source cart and spread topsoil if appropriate	m^3	2.50-5.50	2.50	69020.00	$172,550.00	$0	$0	$0	$0		$0	$0	$0	$172,550	$0	$0	$0	includes min of 10cm of topsoil to assist revegetation program.
130		reshape walls and surrounds	ha	1400-5500	1400.00	5.31	$7,429.82	$0	$0	$0	$0		$0	$0	$0	$7,430	$0	$0	$0	area requiring stabilisation and reshaping works around the walls of the emplacement
131		final trim, deep rip	ha	550-1600	550.00	69.02	$37,961.00	$0	$0	$0	$0		$0	$0	$0	$37,961	$0	$0	$0	to enhance vegetation program as required
132		structural works for drainage	ha	700-1540	1500.00	2.07	$3,105.00	$0	$0	$0	$0		$0	$0	$0	$3,105	$0	$0	$0	earthworks for banks and drains to manage surface water on top of capped dam area if required.
133		revegetation by tubestock	ha	6000/ha (or $/ea.)	6000.00	0.00	$0.00	$0	$0	$0	$0		$0	$0	$0	$0	$0	$0	$0	includes acquisition of tubestock, fertiliser and guarding as necessary
134		revegetation be direct seeding	ha	1200-2000	1200.00	69.02	$82,824.00	$0	$0	$0	$0		$0	$0	$0	$82,824	$0	$0	$0	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
135		fertiliser application	ha	140-744	140.00	0.00	$0.00	$0	$0	$0	$0		$0	$0	$0	$0	$0	$0	$0	includes a single application of fertiliser during the initial seeding program - see assumptions
136		seepage management - recovery and treatment	@	20000-200000	20000.00	0.00	$0.00	$0	$0	$0	$0		$0	$0	$0	$0	$0	$0	$0	where seepage is at unacceptable levels and no wetland filter is in place and company has committed to recovery and treatment of seepage. Depends on size.
137		seepage management - wetland filter	ha	5500	5500.00	0.00	$0.00	$0	$0	$0	$0		$0	$0	$0	$0	$0	$0	$0	assumes wetland filter is in place and functioning
	Other - Landfill	Backfill to natural surface	m3	2.00-5.00	2.00	60000.00	$120,000.00	$0	$120,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	backfilled with onsite material. Haul distance sliding scale from $2/m3 for up to 1km, up to $5/m3 for up to 5km or greater.
		Landfill - source cart and spread suitable material for capping	m3	2.00-5.00	3.23	15000.00	$48,450.00	$0	$48,450	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	required if it has not been demonstrated that infill material is suitable as a growth medium Assume min thickness of 0.5m
		Landfill - source cart and spread topsoil if appropriate	m3	2.50-5.50	2.50	3000.00	$7,500.00	$0	$7,500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes min of 10cm of topsoil to assist revegetation program.
		Landfill - final trim, deep rip	ha	550-1600	550.00	3.00	$1,650.00	$0	$1,650	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	to enhance vegetation program as required
		Landfill - revegetation by direct se	ha	1200-2000	1200.00	3.00	$3,600.00	$0	$3,600	$0	$0		$0	$0	$0	$0	$0	$0	$0	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
							$4,748,669.82	$0.00	$181,200.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4,567,469.82	$0.00	$0.00	$0.00	
		DOMAIN 5 TOTAL					$6,533,213.32	$32,953.50	$1,756,685.00	$0.00	$0.00	$40,862.50	$0.00	$0.00	$0.00	$4,567,469.82	$80,242.50	$55,000.00	$0.00	

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8	Stage 9	Stage 10	Stage 11	itage 12		
	Early Works	BEW, Temp, Comms	Process Plant, Camp	Hydromet	Beneficiation	SAP	NPI	Power Station	RSF	Mine Facilities, SWM	Campaign 1	Campa ign 2	Operator's Comments	Dept Comments
116	1													
117	15000	36,100.0			5000.00						27,500.0		capacity of beneficiation process water pond	
118		180,250.0			3750.00					9750.00			Dirty: RSF Stage 2 (1 x evaporation pond 35.8 ha, 1 x event pond 0.25 ha); BENEFICIATION Stage 5 (1 x beneficiation process water pond 0.75 ha); PROCESS PLANT Stage 11 (2 x mixed acid storage ponds 0.75 ha each and 1 x cerium raffinate pond 0.45 ha). Only 100 mm sediment build up will be allowed within ponds during operations.	Operator's estimated quantity used
119	1.37	36.1											As backfill to natural surface is now covered above. That will adequately shape/level the areas ready for deep rip, hence this item is not required in addition.	Operator's estimated quantity used. This is required since backfilling doesn't cover shaping or levelling.
120		180,250.0			3750.00					9,750.0			Stage 2: 35.8 ha evaporation pond + 0.25 ha event pond at RSF	Operator's estimated quantity used
121														Captured under infrastructure tab
122														Captured under infrastructure tab
123														
124														
125														Captured under infrastructure tab
126														
127									1,320,000.0				66 ha RSF	Operator's estimated quantity used
128														
129									69,020.0				66 ha RSF + 3 ha containment corridor, acess and laydown area	Operator's estimated quantity used
130									5.3					Operator's estimated quantity used
131									69.0				66 ha RSF + 3 ha containment corridor, acess and laydown area	Operator's estimated quantity used
132									2.1					Operator's estimated quantity used
133														Operator's estimated quantity used
134									69.0				66 ha RSF + 3 ha containment corridor, acess and laydown area	Operator's estimated quantity used
135									-					
136									-					
137									-					
		60,000.0												Operator's estimated quantity used
		15,000.0											3 ha Landfill adjacent to RSF area	Operator's estimated quantity used
		3,000.0												Operator's estimated quantity used
		3.0												Operator's estimated quantity used
		3.0												Operator's estimated quantity used

Domain 6: Stockpiles & Waste Rock Dumps

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Early Works	BEW, Temp, Comms	Process Plant, Camp	Hydromet	Beneficiation	SAP	NPI	Power Station	RSF	Mine Facilities, SWM	Campaign 1	Campaign 2	Technique Notes
1	Oxide waste rock dumps and extractive product stockpiles	Recontouring/battering for stabilisation	m^2	2.00-3.60	2.14	1555000.00	$3,327,700.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,012,220	$2,315,480	this includes the area requiring reshaping for stabilisation and preparation for revegetation
2		unshaped requiring minor earthworks, trim and deep rip (WRD)	ha	550-1600	1600.00	20.00	$32,000.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,880	$29,120	enter the area requiring minor reshaping to 12-18° slopes and deep ripping to enhance revegetation
3		unshaped requiring major earthworks, trim and deep rip	m^3	1.21-4.00	4.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	include volume of material requiring major reshaping to achieve appropriate grades (<18° Or as specified in MMP) and deep ripping
4		structural works for drainage	ha	700-1540	1500.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	earthworks for banks and drains to manage surface water on top of WRD.
5		source cart and spread topsoil or growth medium	m^3	2.50-5.50	2.50	155500.00	$388,750.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$118,250	$270,500	required if it has not been demonstrated that WRD material is suitable as a growth medium
6		or removal of stockpiles	m3/bcm	3.00-5.00	5.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	carting of stockpiles offsite or WRD to pit. Consider carting distance
7		trim, deep rip if required	ha	550-1600	1600.00	155.00	$248,000.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$75,200	$172,800	ripping stockpiles or surrounds if required. Assume ripping of waste rock dumps undertaken during reshaping.
8		revegetation by tube stock	ha	6000/ha (or 5/ea.)	6000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes acquisition of tubestock, fertiliser and guarding as necessary
9		revegetation by direct seeding	ha	1200-2000	1200.00	155.00	$186,000.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$56,400	$129,600	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
10		fertiliser application	ha	140-744	140.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes a single application of fertiliser during the initial seeding program - see assumptions
							$4,182,450.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,264,950.00	$2,917,500.00	
11	Waste rock dumps with AMD or metals	unshaped requiring major earthworks, trim and deep rip	m^3	4.00-6.00	4.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	include volume of material requiring major reshaping to achieve appropriate grades (<18° or as specified in MMP) and deep ripping
12		unshaped requiring minor earthworks, trim and deep rip	ha	550-1600	1600.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	enter the are requiring minor reshaping and deep ripping to enhance revegetation
13		source cart and spread suitable material for capping	m^3	2.00-5.00	5.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	volume of suitable material for capping the WRD. Must have appropriate chemical and physical properties.
14		apply capping design treatment e.g. 'store and release'	ha	25000-49500	36500.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	required to manage AMD or metals leachate from WRD. Capping layer assumed to be no less than 2m thick.
15		or removal of stockpiles	m3/bcm	3.00-5.00	5.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	removal to pit. Haulage distance needs to be considered at an additional $1/km
16		source cart and spread topsoil if appropriate	m^3	2.50-5.50	5.50	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	required if it has not been demonstrated that capping material is suitable as a growth medium
17		final trim, deep rip	ha	550-1600	1600.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	to enhance vegetation program over WRD as required. Assume ripping may be undertaken during capping.
18		structural works for drainage	ha	700-1540	700.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	earthworks for banks and drains to manage surface water on top of WRD area if required.
19		revegetation by tube stock	ha	6000/ha (or 5/ea.)	6000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes acquisition of tubestock, fertiliser and guarding as necessary
20		revegetation by direct seeding	ha	1200-2000	2000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
21		fertiliser application	ha	140-744	140.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes a single application of fertiliser during the initial seeding program - see assumptions
							$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	
22	Leachate and sediment management	Active recovery treatment of problem leachate	item	20000-200000	20000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	where seepage is at unacceptable levels and no wetland filter is in place and company has committed to recovery and treatment of seepage. Depends on size.
23		Wetland filter	ha	5500	5500.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	assumes wetland filter is in place and functioning
24		dams for sediment control	m^3	2.50-2.90	2.90	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	enter volume of dam required for sediment traps
25		Rocks or coarse material lined sediment trap	m^3	1.00-5.00	5.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	consider distance to cart material
26	Other					0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
							$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	
	DOMAIN 6 TOTAL						$4,182,450.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,264,950.00	$2,917,500.00	

Stage 1 Stag Stage Stag Stag Stag Stag Stag Stag Stag Stage 11 Stage 12

Early Works	BEW, Tem	Proces Plant,	Hydro met	Benef iciatio n	SAP	NPI	Powe r Statio	RSF	Mine Facili ties, SWM	Campaign 1	Campaign 2	Operators Comments (*from security submitted on 6 Nov 2024*)	Dept.Comments
										473000.00	1082000.00	27 ha WRD + 20.3 ha ROM - Campaign 1 79 ha WRD + 29.2 ha ROM - Campaign 2	27 ha WRD + 20.3 ha ROM - Stage 11 79 ha WRD + 29.2 ha ROM -Stage 12
										1.80	18.20	Accounts for slopes where this is required	Operator's estimated quanity used. Cost is higher for WRD compared to Dams and Ponds
										47300.00	108200.00	27 ha WRD + 20.3 ha ROM for 100mm topsoil 79 ha WRD + 29.2 ha ROM for 100mm topsoil	27 ha WRD + 20.3 ha ROM - Stage 11 79 ha WRD + 29.2 ha ROM -Stage 12
										47.00	108.00	27 ha WRD + 20.3 ha ROM - Campaign 1 79 ha WRD + 29.2 ha ROM - Campaign 2	27 ha WRD + 20.3 ha ROM - Stage 11 79 ha WRD + 29.2 ha ROM -Stage 12
										47.00	108.00	27 ha WRD + 20.3 ha ROM - Campaign 1 79 ha WRD + 29.2 ha ROM - Campaign 2	27 ha WRD + 20.3 ha ROM - Stage 11 79 ha WRD + 29.2 ha ROM -Stage 12
												This section has been covered within Domain 9: River Diversion, which includes WRD drain management.	

NOT APPLICABLE

Domain 7: Exploration

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes
27	Drillholes, Pads, sumps, costeans	capping drillholes 30cm below ground	@	80-275	80.00		0.00	Cut collar, insert plug and backfill. Assume using, concrete or plastic cone plugs or bridge (no 'occy' plugs) Depends on number of holes
28		grout with concrete	@	1250	1250.00		0.00	Assume total grouting of drillhole
29		empty and remove plastic sample bags	hole	25-235	25.00		0.00	return cuttings to hole and remove plastic bags to a waste disposal facility. Bags cannot be disposed of on site.
30		ripping/scarifying pads	ha	440-2500	440.00		0.00	Minor ripping/scarifying of pads to depth of 0.3m to assist vegetation in areas of flat/gentle terrain, includes sump infilling. Sumps should not remain open for extended periods of time.
31		reshape drill pads	@	320	320.00		0.00	Required in steep terrain where earthworks required with excavator/dozer to return pad to slope and establish erosion control, includes sump infilling. Using PC650 excavator or equivalent assumes one pad per hour @$320/hr.
32		infilling costeans	m^3	2.00-3.00	2.00		0.00	Backfilling of all costeans/trenches. Assumes material does not have to be carted.
33		bulk sample pits	m^3	2.00-8.00	2.00		0.00	dependent on depth of pit and if battering of walls required to form to 18° slope
34		contouring for erosion control	ha	700-1540	700.00		0.00	minor pushing to construct water management structures such as contour banks and diversion drains as required.
35		topsoil replacement if applicable	m^3	2.50-5.50	2.50		0.00	includes min of 10cm of topsoil to assist revegetation program. **this may be carried out when reshaping pads
36		revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary
37		revegetation by direct seeding	ha	1200-2000	1200.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha if required. Required where area of disturbance is significant.
38		fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program
							0.00	
39	Tracks and Gridlines	ripping/scarifying minor tracks and gridlines	km	120-500	120.00		0.00	assume using grader or equivalent to rip to 0.3m and no windrows, establishing erosion control measures (eg bunds) as required
40		ripping major tracks and roads	km	550-1000	550.00		0.00	pushing in windrows and ripping track and establishing erosion control measures (ie bunds) across tracks as required
41		removal of gridpegs	item	1500	1500.00		0.00	includes removal offsite of all grid pegs in exploration area
42		topsoil replacement if applicable	m^3	2.50-5.50	2.50		0.00	includes min of 10cm of topsoil to assist revegetation program if required
43		revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary
44		revegetation by direct seeding	ha	1200-2000	1200.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.
45		fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program
							0.00	
	DOMAIN 7 TOTAL						$0.00	

Domain 8: Access and Haul Roads

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Stage 1 Early Works	Stage 2 BEW, Temp, Comms	Stage 3 Process Plant, Camp	Stage 4 Hydromet	Stage 5 Beneficiation	Stage 6 SAP	Stage 7 NPI	Stage 8 Power Station	Stage 9 RSF	Stage 10 Mine Facilities, SWM	Stage 11 Campaign 1	Stage 12 Campaign 2	Operator's Comments	Dept.Comments
46	Haul Roads	remove ARD material from road	m3/bcm	2.50-5.50	5.50	0.00	$0.00	where haul road have been constructed with waste rock material that is leaching ARD removal and disposal in pit or similar will be required		-												
47		reshape and deep rip	ha	2000-5000	2500.00	13.10	$32,750.00	windrows are pulled back and edges battered, area is deep ripped (road 12mwide)										13.10			area shown in shapefile is indicative of the location. May shift w	Operator's estimated quantity used
48		structural works for drainage	ha	700-1540	1500.00	0.00	$0.00	pushing to construct water management structures such as contour banks and diversion drains as required. Diversion drains assumed to be every 100m and are ~10mx40m each.		-												
							$32,750.00															
49	Access Roads	breaking and removal of bitumen	m3	12.00-17.00	12.00	20.00	$240.00	Includes area of bitumen in roads car parks etc which needs to be removed and disposed of appropriately		20.0											area of bitumen is for the initial sealing of the frst 100 m of the S	Operator's estimated quantity used
50		reshape and deep rip	ha	2000-5000	2000.00	155.59	$311,180.00	windrows are pulled back and edges battered, area is deep ripped	115.8	16.0					19.9		2.1		1.80			Operator's estimated quantity used. 4.50 ha of tracks added from Stage 1.
51		structural works for drainage	ha	700-1540	1500.00	0.00	$0.00	pushing to construct water management structures such as contour banks and diversion drains as required. Diversion drains assumed to be every 100m and are ~10mx40m each.														
							$311,420.00															
52	Revegetation activities - all roads	source cart and spread topsoil	m^3	2.50-5.50	2.50	168730.00	$421,825.00	assume minimum of 10cm depth	115800	16,000.0					19,910.0		2,120.0	13,100.0	1800		area shown in shapefile is indicative of the location. May shift within ML based on survey.	Area multiplied by 10cm
53		revegetation by tubestock	ha	6000/ha (or 5/ea.)	6000.00	0.00	$0.00	enter total area for revegetation by tubestock. (or enter quantity of tubestock required (<15cm), and density/ha)														
54		revegetation by direct seeding	ha	1200-2000	1200.00	168.73	$202,476.00	this rate includes acquiring a mix of native tree and shrub species appropriate for the area, mixing and treating the seed and applying by hand at a rate of 4-10kg/ha	115.8	16.0					19.9		2.1	13.1	1.80		area shown in shapefile is indicative of the location. May shift within ML based on survey.	
55		fertiliser application	ha	140-744	140.00	0.00	$0.00	includes a single application of fertiliser during the initial seeding program - see assumptions														
							$624,301.00															
	DOMAIN 8 TOTAL						$968,471.00															

Domain 9: River Diversions

	Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Early Works	BEW, Temp, Comms	Process Plant, Camp	Hydromet	Beneficiation	SAP	NPI	Power Station	RSF	Mine Facilities, SWM	Campaign 1	Campaign 2	Technique Notes
56	Creek/River	channel maintenance	m	165.00	165.00	2890.70	$476,965.50	$0	$0	$0	$0	$0	$0	$0	$0	$0	$476,966	$0	$0	Includes earthwork repairs and stabilisation following flow events.
57		vegetation by tubestock	ha	6000/ha (or 5/ea.)	6000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	enter total area for revegetation by tubestock. (or enter quantity of tubestock required (<15cm), and density/ha)
58		vegetation by direct seeding	ha	1200-2000	1200.00	10.40	$12,480.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12,480	$0	$0	this rate includes acquiring a mix of native tree and shrub species appropriate for the area, mixing and treating the seed and applying by hand at a rate of 4-10kg/ha
59		vegetation maintenance	ha	140-744	140.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes a single application of fertiliser during the initial seeding program
							$489,445.50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$489,445.50	$0.00	$0.00	
60	Creek/River Bunds	bund maintenance	m	165.00	165.00	4453.70	$734,860.50	$0	$0	$0	$0	$0	$0	$0	$0	$0	$734,861	$0	$0	Includes earthwork repairs and stabilisation following flow events.
61		vegetation by tubestock	ha	6000/ha (or 5/ea.)	6000.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	enter total area for revegetation by tubestock. (or enter quantity of tubestock required (<15cm), and density/ha)
62		vegetation by direct seeding	ha	1200-2000	1200.00	13.20	$15,840.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15,840	$0	$0	this rate includes acquiring a mix of native tree and shrub species appropriate for the area, mixing and treating the seed and applying by hand at a rate of 4-10kg/ha
63		vegetation maintenance	ha	140-744	140.00	0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	includes a single application of fertiliser during the initial seeding program
							$750,700.50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$750,700.50	$0.00	$0.00	
	DOMAIN 9 TOTAL						$1,240,146.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,240,146.00	$0.00	$0.00	

Stage Early Works	Stage BEW, Temp, Comms	Stage Process Plant, Camp	Stage Hydromet	Stage Beneficiation	Stage SAP	Stage NPI	Stage Power Station	Stage RSF	Stage 10 Mine Facilities, SWM	Stage Campaign 1	Stage 12 Campaign 2	Operator's Comments	Dept.Comments
									2890.70			length of diversion channel	Operator's estimated quantity used
									10.40			area of diversion channel	Operator's estimated quantity used
									4453.70			length of bunds	Operator's estimated quantity used
									13.20			area of bunds	Operator's estimated quantity used

Decommissioning & Post Closure Management

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Early Works	BEW, Temp, Comms	Process Plant, Camp	Hydromet	Beneficiation	SAP	NPI	Power Station	RSF	Mine Facilities, SWM	Campaign 1	Campaign 2	Technique Notes
Decommissioning and Closure	mobilisation/demobilisation	km	10.00-15.00	15.00	270.00	20,250.00	$20,250	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	determined based on distance to the mine and machinery used ($/km) Assume mob/demob from largest centre unless otherwise stipulated & supported by the operator. Calculation assumes 5 pieces of machinery required per site. Adjust formula if necessary.
	Contaminated site assessment	@	35000	35000.00	3.00	105,000.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$35,000	$35,000	$35,000	has a contaminated site assessment been undertaken? If not this should be included for large metalliferous mines.
	Pest and weed management, monitoring & assessment	ha	200 - 250	200.00	691.45	276,579.00	$72,998.4	$40,806	$0	$0	$0	$0	$9,800	$0	$42,860	$15,880	$27,639	$66,600	Include total disturbed area , consider for minimum of 2 years during closure for larger sites only. Entry automated form 'Key Information' tab.
	Contractor accommodation, messing and travel costs	man day	210-320	320.00	380.00	121,600.00	$6,400	$57,600	$0	$0	$0	$0	$0	$0	$0	$0	$22,400	$35,200	Assume 5-9 people required for 2-10 weeks (or more) depending on size of site *quantity = number of days X number of people (e.g. 9 persons for 50 days = 450 man days)
	Closure management	yr	110,000 - 300,000	110000.00	6.50	715,000.00	$55,000	$220,000	$0	$0	$0	$0	$0	$0	$0	$0	$220,000	$220,000	This includes project management team assuming 1 - 3 persons based on the magnitude of the process salaries, oncosts, tender preparation and closure report and coordination of works. Consider part of year only for small sites.
Post Closure	mobilisation/demobilisation	km	10.00-15.00	15.00	270.00	4,050.00	$4,050	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	Determined based on distance to the mine and machinery used ($/km) Assume mob/demob from largest centre unless otherwise stipulated & supported by the operator. Calculation assumes 1 piece of machinery required per site.
	Post closure water monitoring	yr	adjust post closure worksheet - no entry required		0.00	552,800.00	$35,100	$258,850	$0	$0	$0	$0	$0	$0	$0	$0	$90,598	$168,253	Monitoring and measurement requirements that may be needed following the closure of the project - use the 'post closure worksheet' Estimated quantity refers to number of years required post closure
	Pest and weed management, monitoring & assessment	ha	200 - 250	200.00	691.45	414,868.50	$109,498	$61,200	$0	$0	$0	$0	$14,700	$0	$64,290	$23,820	$41,459	$99,900	Include total rehabilitated area , assumed for minimum of 3 years post closure Entry automated form 'Key Information' tab.
	Earthwork maintenance	ha	1,100	1100.00	36.80	80,960.00	$0	$0	$0	$0	$0	$0	$0	$0	$30,360	$0	$11,880	$38,720	Assume 20% failure rate for the total areas of constructed landforms (e.g. WRDS, TSF etc) for a period of 2 years (if not stipulated otherwise) Entry automated form 'Key Information' tab.
	Revegetation maintenance, monitoring & assessment	ha	1,250 - 2,500	1250.00	138.29	345,723.75	$91,248	$51,000	$0	$0	$0	$0	$12,250	$0	$53,575	$19,850	$34,549	$83,250	Assume a 20% failure rate for all disturbed areas for a period of 2 years. (if not stipulated otherwise) Entry automated form 'Key Information' tab.
	Project management	yr	20,000	20000.00	7.00	140,000.00	$20,000	$60,000	$0	$0	$0	$0	$0	$0	$0	$0	$20,000	$40,000	This includes tender preparation, financial reporting procurement, contractor management etc. Time frame assumed is 1-10 years depending upon the site & the complexity of the issues present
	fire break maintenance	km	50-75	72.00	1000.00	72,000.00	$0	$36,000	$0	$0	$0	$0	$0	$0	$0	$0	$14,400	$21,600	Grading of firebreaks during and after closure for a period of 1-10 years depending on site size *quantity = number km x number years
						$ 2,848,831.25	$414,544	$ 785,456.00	$ -	$ -	$ -	$ -	$ 36,750.00	$ -	$ 191,085.00	$ 94,550.00	$ 517,923.75	$ 808,522.50	
	POST CLOSURE TOTAL					$ 2,848,831.25	$414,544	$ 785,456.00	$ -	$ -	$ -	$ -	$ 36,750.00	$ -	$ 191,085.00	$ 94,550.00	$ 517,923.75	$ 808,522.50	

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8	Stage 9	Stage 10	Stage 11	Stage 12			
Early Works	BEW, Temp, Comms	Process Plant, Camp	Hydromet	Beneficiation	SAP	NPI	Power Station	RSF	Mine Facilities, SWM	Campaign 1	Campaign 2	TOTAL	Operators Comments (*from security submitted on 6 Nov 2024*)	Dept.Comments
270												270.0	Return km to Alice Springs	Captured in Stage 1 calculation
									1.0	1.0	1.0	3.0		
182.50	102.0					24.5		107.2	39.7	69.1	166.5	691.4		
20	180.0									70.0	110.0	380.0		Operato's estimated quantity used
0.5	2.0									2.0	2.0	6.5		Stages 2,11 & 12 - 2 persons
270												270.0		Captured in Stage 1 calculation
												-		
182.50	102.0					24.5		107.2	39.7	69.1	166.5	691.4		
								13.8		5.4	17.6	36.8		
36.50	20.4					4.9		21.4	7.9	13.8	33.3	138.3		
1	3.0									1.0	2.0	7.0		
	500.0									200.0	300.0	1,000.0		

POST CLOSURE WATER QUALITY MONITORING WORKSHEET

NOTE:
Mining Officers must adjust the numbers in the blue boxes only, to the appropriate timeframes and reflecting the structures present on individual sites.

SUMMARY

Item	Component	Cost ($)
1	Groundwater monitoring - Analytical	$212,500
2	Surface water monitoring - Analytical	$82,500
3	Field sampling and Expenses	$52,800
4	Water quality interpretation & reporting	$205,000
	TOTAL	**$552,800**

1 GROUNDWATER MONITORING - ANALYTICAL

Analytical & consumables
Assumptions: ICPMS, fields & laboratory consumables @ $250/sample

STAGE 1

Mine site structures	Size (ha)	Enter the number of structures	Sampling points	Sampling per year	Enter the number of years 0-10	Subtotal cost ($)
Whole of site	All		3	2	*10*	0
Extraction bores for use after closure			1	2	*10*	0
Discrete infrastructure areas			3	2	*10*	0
Underground fuel storage areas			1	2	*10*	0
Pit voids/declines	All		3	2	*10*	0
Waste rock dump - oxide	<5		2	1	*10*	0
	5 - 20		3	2	*10*	0
	>20		4	2	*10*	0
Waste rock dump - mixed or sulfide	<5		2	2	*10*	0
	5 - 20		4	2	*10*	0
	>20		6	2	*10*	0
Tailings dam / residue disposal ponds	0 -20		3	2	*10*	0
	21 - 100		4	2	*10*	0
	100 - 150		6	2	*10*	0
	>150		10	2	*10*	0
Heap leach pad	<10		3	2	*10*	0
	>10		5	2	*10*	0
Water containment/retention ponds (water not suitable for passive release)	<10		2	1	*10*	0
	10 - 20		3	2	*10*	0
	>20		4	2	*10*	0
Waste disposal areas			2	1	*10*	0
Other		*3*	170	3	*15*	212,500
Other						0
Other						0
					sub total	***$212,500***

STAGE 2-10

Mine site structures	Size (ha)	Enter the number of structures	Sampling points	Sampling per year	Enter the number of years 0-10	Subtotal cost ($)
Whole of site	All		3	2	*10*	0
Extraction bores for use after closure			1	2	*10*	0
Discrete infrastructure areas			3	2	*10*	0
Underground fuel storage areas			1	2	*10*	0
Pit voids/declines	All		3	2	*10*	0
Waste rock dump - oxide	<5		2	1	*10*	0
	5 - 20		3	2	*10*	0
	>20		4	2	*10*	0
Waste rock dump - mixed or sulfide	<5		2	2	*10*	0
	5 - 20		4	2	*10*	0
	>20		6	2	*10*	0
Tailings dam / residue disposal ponds	0 -20		3	2	*10*	0
	21 - 100		4	2	*10*	0
	100 - 150		6	2	*10*	0
	>150		10	2	*10*	0
Heap leach pad	<10		3	2	*10*	0
	>10		5	2	*10*	0
Water containment/retention ponds (water not suitable for passive release)	<10		2	1	*10*	0
	10 - 20		3	2	*10*	0
	>20		4	2	*10*	0
Waste disposal areas			2	1	*10*	0
Other		*1*	10	1	*5*	12,500
Other						0
Other						0
					sub total	***$12,500***

STAGE 11-12

Mine site structures	Size (ha)	Enter the number of structures	Sampling points	Sampling per year	Enter the number of years 0-10	Subtotal cost ($)
Whole of site	All		3	2	*10*	0
Extraction bores for use after closure			1	2	*10*	0
Discrete infrastructure areas			3	2	*10*	0
Underground fuel storage areas			1	2	*10*	0
Pit voids/declines	All		3	2	*10*	0
Waste rock dump - oxide	<5		2	1	*10*	0
	5 - 20		3	2	*10*	0
	>20		4	2	*10*	0
Waste rock dump - mixed or sulfide	<5		2	2	*10*	0
	5 - 20		4	2	*10*	0
	>20		6	2	*10*	0
Tailings dam / residue disposal ponds	0 -20		3	2	*10*	0
	21 - 100		4	2	*10*	0
	100 - 150		6	2	*10*	0
	>150		10	2	*10*	0
Heap leach pad	<10		3	2	*10*	0
	>10		5	2	*10*	0
Water containment/retention ponds (water not suitable for passive release)	<10		2	1	*10*	0
	10 - 20		3	2	*10*	0
	>20		4	2	*10*	0
Waste disposal areas			2	1	*10*	0
Other		*1*	80	1	*5*	100,000
Other						0
Other						0
					sub total	***$100,000***

2 SURFACE WATER MONITORING - ANALYTICAL

Analytical & consumables
Assumptions: ICPMS, fields & laboratory consumables @ $250/sample

STAGE 1

Mine site features	Number of features	Sampling points	Sampling per year	Enter No. of years 1-10	Subtotal cost ($)
Water retaining structures with no discharge	*18*	3	1	*10*	22,500
Water retaining structures with possible discharge	*0*	3	2	*10*	0
Bioremediation structures	*0*	3	1	*10*	0

PLUS

Mine site features	Number of features	Sampling points	Sampling per year	Enter No. of years 0-10	Subtotal cost ($)
Perenial streams discharging from site	*0*	6	4	*10*	0
Ephemeral streams discharging from site	*12*	6	2	*10*	60,000

OR Please note: Fill out either the streams or the site operational complexity, size and climate section, but not both

Site operation complexity & size and climate	Default sampling sites	Sampling per year	Enter No. of years 0-10	Subtotal cost ($)
Arid zone site - small to medium	5	3	*0*	0
Arid zone site - large	10	6	*0*	0
Wet/dry tropics site - small size, simple issues	10	6	*0*	0
Wet/dry tropics site - small size, moderate -complex issues	10	12	*0*	0
Wet/dry tropics site - medium size, simple issues	15	6	*0*	0
Wet/dry tropics site - medium size, moderate -complex issues	15	12	*0*	0
Wet/dry topics site - large size, moderate -simple issues	25	12	*0*	0
Wet/dry topics site - large size, moderate -complex issues	30	12	*0*	0
			sub total	***$82,500***

STAGE 2-10

Mine site features	Number of features	Sampling points	Sampling per year	Enter No. of years 1-10	Subtotal cost ($)
Water retaining structures with no discharge		1	1	*10*	0
Water retaining structures with possible discharge		1	2	*10*	0
Bioremediation structures		1	1	*10*	0

PLUS

Mine site features	Number of features	Sampling points	Sampling per year	Enter No. of years 0-10	Subtotal cost ($)
Perenial streams discharging from site		2	4	*10*	0
Ephemeral streams discharging from site		2	2	*10*	0

OR Please note: Fill out either the streams or the site operational complexity, size and climate section, but not both

Site operation complexity & size and climate	Default sampling sites	Sampling per year	Enter No. of years 0-10	Subtotal cost ($)
Arid zone site - small to medium	5	1		0
Arid zone site - large	10	2		0
Wet/dry tropics site - small size, simple issues	10	2		0
Wet/dry tropics site - small size, moderate -complex issues	10	4		0
Wet/dry tropics site - medium size, simple issues	15	2		0
Wet/dry tropics site - medium size, moderate -complex issues	15	4		0
Wet/dry topics site - large size, moderate -simple issues	25	4		0
Wet/dry topics site - large size, moderate -complex issues	30	4		0
			sub total	***$0***

STAGE 11-12

Mine site features	Number of features	Sampling points	Sampling per year	Enter No. of years 1-10	Subtotal cost ($)
Water retaining structures with no discharge	*9*	1	1	*5*	11,250
Water retaining structures with possible discharge		1	2	*10*	0
Bioremediation structures		1	1	*10*	0

PLUS

Mine site features	Number of features	Sampling points	Sampling per year	Enter No. of years 0-10	Subtotal cost ($)
Perenial streams discharging from site		2	4	*10*	0
Ephemeral streams discharging from site	*6*	2	2	*5*	30,000

OR Please note: Fill out either the streams or the site operational complexity, size and climate section, but not both

Site operation complexity & size and climate	Default sampling sites	Sampling per year	Enter No. of years 0-10	Subtotal cost ($)
Arid zone site - small to medium	5	1		0
Arid zone site - large	10	2		0
Wet/dry tropics site - small size, simple issues	10	2		0
Wet/dry tropics site - small size, moderate -complex issues	10	4		0
Wet/dry tropics site - medium size, simple issues	15	2		0
Wet/dry tropics site - medium size, moderate -complex issues	15	4		0
Wet/dry topics site - large size, moderate -simple issues	25	4		0
Wet/dry topics site - large size, moderate -complex issues	30	4		0
			sub total	***$41,250***

3 FIELD SAMPLING & EXPENSES

Assumptions:
Road travel <200km = day trip , 2 people, no accommodation, fuel (300km return) & expenses
Road travel 200-500km =min 1 night accom, 1 day travel +1 night ea additional sampling day, 2 people, fuel (av 800km return)
Road travel >500km =min 2 night accom, 2 day travel +1 night ea additional sampling day, 2 people, fuel (av 1600km return)
Fuel = $1.20/L @ 6km/L Accom & meals = $130 per person/per night Personnel = $800 per person/day
Air travel = $2000 /person return Expenses (e.g. vehicle/consumables etc) $100/day

STAGE 1

Travel and expenses	Enter No. of years 0-10	Distance from nearest centre eg Darwin	Quantity	Enter est. days each sampling trip	Subtotal cost ($)
Field trips - Road travel	*5*	<200km	6	*3*	52,800
		200 - 500km	12	*3*	0
		> 500km	12	*3*	0
Field trip - Air travel (Proof of availability & suitability required)			12	*3*	0
				sub total	***$52,800***

STAGE 2-10

Travel and expenses	Enter No. of years 0-10	Distance from nearest centre eg Darwin	Quantity	Enter est. days each samplin g trip	Subtotal cost ($)
Field trips - Road travel	*5*	<200km	2	*1*	17,600
		200 - 500km	4	*1*	0
		> 500km	4	*1*	0
Field trip - Air travel (Proof of availability & suitability required)			4	*1*	0
				sub total	***$17,600***

STAGE 11-12

Travel and expenses	Enter No. of years 0-10	Distance from nearest centre eg Darwin	Quantity	Enter est. days each sampling trip	Subtotal cost ($)
Field trips - Road travel	*5*	<200km	2	*1*	17,600
		200 - 500km	4	*1*	0
		> 500km	4	*1*	0
Field trip - Air travel (Proof of availability & suitability required)			4	*1*	0
				sub total	***$17,600***

4 WATER QUALITY INTERPRETATION AND REPORTING

STAGE 1

Item	Site size& water mgmt challenges	Quantity	Enter No. of yrs 0-10	Unit cost ($)	Subtotal cost ($)
Quaterly data collation & interpretation	small	9	*0*	2,500	0
	medium	9	*0*	5,000	0
	large	9	*0*	10,000	0
Annual data collation & interpretation	small	3	*5*	1,000	5,000
	medium	3	*0*	5,000	0
	large	2	*5*	20,000	200,000
Other reporting		*3*	*0*	5,000	0

STAGE 2-10

Item	Site size& water mgmt challenges	Quantity	Enter No. of yrs 0-10	Unit cost	Subtotal cost ($)
Quaterly data collation & interpretation	small	3		2,500	0
	medium	3		5,000	0
	large	3		10,000	0
Annual data collation & interpretation	small	1	*5*	1,000	5,000
	medium	1		5,000	0
	large			20,000	0
Other reporting		*1*		5,000	0

STAGE 11-12

Item	Site size& water mgmt challenges	Quantity	Enter No. of yrs 0-10	Unit cost (	Subtotal cost ($)
Quaterly data collation & interpretation	small	3		2,500	0
	medium	3		5,000	0
	large	3		10,000	0
Annual data collation & interpretation	small	1		1,000	0
	medium	1		5,000	0
	large	1	*5*	20,000	100,000
Other reporting		*1*		5,000	0

STAGE 1

Item	Site size& water mgmt challenges	Quantity	Enter No. of yrs 0-10	Unit cost ($)	Subtotal cost ($)
Quaterly data collation & interpretation	small	9	*0*	2,500	0
	medium	9	*0*	5,000	0
	large	9	*0*	10,000	0
Annual data collation & interpretation	small	3	*5*	1,000	5,000
	medium	3	*0*	5,000	0
	large	2	*5*	20,000	200,000
Other reporting		*3*	*0*	5,000	0

STAGE 2-10

Item	Site size& water mgmt challenges	Quantity	Enter No. of yrs 0-10	Unit cost	Subtotal cost ($)
Quaterly data collation & interpretation	small	3		2,500	0
	medium	3		5,000	0
	large	3		10,000	0
Annual data collation & interpretation	small	1	*5*	1,000	5,000
	medium	1		5,000	0
	large			20,000	0
Other reporting		*1*		5,000	0

STAGE 11-12

Item	Site size& water mgmt challenges	Quantity	Enter No. of yrs 0-10	Unit cost ($	Subtotal cost ($)
Quaterly data collation & interpretation	small	3		2,500	0
	medium	3		5,000	0
	large	3		10,000	0
Annual data collation & interpretation	small	1		1,000	0
	medium	1		5,000	0
	large	1	*5*	20,000	100,000
Other reporting		*1*		5,000	0

sub total	$205,000
Total	$552,800

sub total	$5,000
Total	$35,100

sub total	$100,000
Total	$258,850

sub total	$100,000
Total	$258,850

Assumptions

Ripping
Deep rip low level disturbance - 14G grader or equivalent with multishank ripper to 3m width. At $180/hr and at 3km/hr with 0.83 efficiency will cover 7500m2/hr = $240/ha.
Deep rip medium level disturbance- Cat D6 with triple shank rippers ripping to a depth of 0.3m and 3m width covered per pass. At $220/hr and 2km/hr with 0.83 efficiency will cover 4980m2/hr = $441/ha.
Deep rip high level of disturbance and compaction - using a Cat D9 with multishank
ripper to a width of 2.64m. At $300/hr and 1.6km/hr with 0.83 efficiency will cover 3320m2/hr = $900/ha.

Tracks
Assume D9 used to rip to depth of 0.3m, which can do 1.36km/hr. Assume $300/hr. Requires 2 passes on track ~5m wide = $440/km.
Windrows - 14G grader will grade in windrows at 3km/hr (2nd gear) and require two passes each side of road = 1500m of road/hr @ $180/hr =$120/km
two passes with grader to rip track <4m wide at 3km/hr =$120/km

Grading
Grading firebreaks with 14G equivalent grader @$180/hr. Blade width of 14', travelling at ~5km/hr. Two passes required = 24minutes/km=$72/km

Drillpads - major reshaping
Using a Komatsu PC650 excavator or similar at $320/hr, can move 300bcm/hr assume one pad per hour

Haul roads
haulroads assumed to be an average of 12m wide with an additional buffer of 5m each side of the road which has been cleared or significantly disturbed. Surfaces are heavily compacted and constructed of imported fill.

Road fill which may be ARD producing is removed using an excavator ($320/hr) and 3x50t dump truck ($750/hr), watercart @ $140/hr, dozer@$250/hr. Excavator will produce 300bcm/hr = $4.86/bcm

Stockpile/WRD removal/pit infill
Assume load and haul to pit using excavator and 3 dump trucks. Excavator ($320/hr) and 3 trucks ($840/hr total) as above = $3.87/bcm

Bund - assume excavator and 3 dump trucks, with minimal haul distance (no greater than 1km.)
As per road fill above using and excavator and 3 trucks = $3.87/bcm. If bund is 5m wide and 2m high = 5m3/m then bund ~$19/m to construct

Fertiliser - current (09/01/09) Landmark price per tonne for NPK fertiliser = $1487.50
Fertiliser applied at 500kg/ha (best practice) = $743.75/ha
If applied at only 100kg/ha = $148.75/ha
Application dependent on growth medium

RC drillpads assume average 10mx10m, DDH pads 10mx20m

Post closure cost for pest, fire and weed management comes from contrators estimate for Woodcutters site

Contractor costs for meals, accommodation, travel and supervision:
meals & accom @ $150/head/day
travel @$60/head/hr
supervision@$1000/day
So for 10.5hr day daily costs = $1845/hr/300bcm/hr of production = $6.15/bcm
This tool has assumed cost of $210-$320/man/day

Future considerations

Treatment and removal of water from tailings dams and ponds prior to rehabilitation activities.

Review requirements for contaminated site assessment against Australian Standard.

The inclusion of additional category for mines with materials that require specific health and safety related management and rehabilitation eg radiological materials, asbestiform, maybe even ARD, heavy metals and sites with specific contaminants introduced as part of the process (e.g. arsenic, cyanide). In particular the case of radiological materials involves specialised management and costs. I have started jotting a few ideas down on this below:

Special considerations for asbestiform or radioactive material removal (Eg licensing, Access control – security guard, lockable exclusion areas, health and safety equipment, Records management – recording of exposures, deliveries and removals, procedures for all crews, Radiation control – spill control and clean up, appropriate storage and sealing prior to transport, Training of staff, Monitoring and inspections, Monitoring equipment purchase, repairs & consumables (eg testing and calibration), Waste & scrap management of contaminated materials – is specialised clean up (and pre-disposal assessment) required? Is specific disposal taken into account by specialised contractors eg asbestos, PCBs, other additives)

Records collation, documentation and archiving costs for minimum 7 years to ensure capacity to manage the relevant information;

In lieu of estimating study (eg hydrological modelling, water balance, geochemical assessment etc) which would be hard to do, develop a checklist of items that, depending on the scale of the operation, we can use to will incrementally change the contingency applied to the security. I.e. the less they know the higher contingency is applied. This will discourage the trend of "this is all we know and therefore all we are liable for".

Consideration of additional security where larger mines do not have a closure plan and agreed closure criteria?

Consider council rates on authorised titles as closure/post closure cost.

Australian Government
Department of Climate Change, Energy, the Environment and Water

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Approval of variation of conditions and Biodiversity Management Plan for Nolans Rare Earth Project, 135 km North-West of Alice Springs, Northern Territory

Dear Ms Perry,

Thank you for your correspondence dated 25 March 2024 to the department requesting variation of conditions attached to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval 2015/7436, dated 11 May 2018. Thank you also for your correspondence dated 17 May 2024 to the department requesting approval of the Biodiversity Management Plan in accordance with condition 5 of the approval.

Officers of this department have reviewed the variation request. As delegate of the Minister for the Environment and Water, I have varied the conditions and Attachments attached to EPBC Act approval 2015/7436 under section 143(1)(c) of the EPBC Act. The action must now be taken in accordance with the varied conditions specified in the variation notification, which has been attached for your information.

I note the 25 March 2024 variation request also sought the addition of new tenements to the approved project area to accommodate an explosives magazine, gravel borrow pits, and additional access points associated with the approved activity. As advised by officers of this department, the proposed additional tenements were not considered to be within scope of the approved action and therefore, could not be considered as part of a variation. As such the requested additional tenements were not contemplated and have not been approved.

Officers of this department have advised me on the Biodiversity Management Plan (Rev 4.0, 17 May 2024) and the requirements of the conditions of the approval for this project. On this basis, and as a delegate of the Minister for the Environment and Water, I have decided to approve the Biodiversity Management Plan (Rev 4.0, 17 May 2024). This plan must now be implemented.

As you are aware, the department has an active monitoring program which includes monitoring inspections, desk top document reviews and audits. Please ensure that you maintain accurate records of all activities associated with, or relevant to, the conditions of approval so that they can be made available to the department on request.

Should you require any further information please contact Thomas Sands by email to PostApproval@dcceew.gov.au.

Yours sincerely



Rachel Short
Branch Head,
Environment Assessments (Vic and Tas) and Post Approvals Branch
Nature Positive Regulation Division

24 October 2024

Attachment A: Variation of conditions

BIODIVERSITY MANAGEMENT PLAN

Document No:	ARMS-0000-H-PLN-N-0002 Rev 4.0
Project Name:	Nolans Rare Earths
Date of Plan:	17 May 2024
EPBC Approval:	EPBC 2015/7436
Proponent:	Arafura Nolans Project Pty Ltd (ABN: 88 118 158 900)
Proposed Action:	To construct and operate an open pit rare earths mine, intermediate processing facility using a phosphoric acid pre-leach process and associated support infrastructure, approximately 135 km north-west of Alice Springs, Northern Territory.

REVISION HISTORY

Date	Revision	Description	Prepared	Reviewed	Approved
17/05/2024	Rev 4.0	Issue for Use from DCCEEW comments	T. Ewers-Reilly EcOz Environmental Consultants	T. Perry Head of Sustainability and Environment	T. Perry Head of Sustainability and Environment
08/04/2023	Rev 3.0	Issue for Use from DCCEEW comments	T. Ewers-Reilly EcOz Environmental Consultants	Y. Smythe McGuinness S. Environmental Scientist	T. Perry Head of Sustainability and Environment
04/10/2023	Rev 2.1	Issue for Use from DCCEEW comments	T. Ewers-Reilly EcOz Environmental Consultants	M. Robinson ESG Manager	M. Robinson ESG Manager
17/04/2023	Rev 2	Issue for Use from DCCEEW comments	T. Ewers-Reilly EcOz Environmental Consultants	M. Robinson ESG Manager	S.Watkins GM Projects
01/07/2022	Rev 1	Issue for Use	M. Robinson ESG Manager	M. Robinson ESG Manager	S.Watkins GM Projects
23/07/2021	Rev 0	Issue for Use	M. Robinson ESG Manager	B.Fowler GM NT & Sustainability	S.Watkins GM Projects

DECLARATION OF ACCURACY

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed 

Full name (please print) DARRYL CUZZUBBO

Organisation (please print) Arafura Rare Earths Limited

Date 17 / 05 / 2024

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1.0 INTRODUCTION

Arafura Rare Earths Limited (Arafura, the Company) proposes to develop and operate the Nolans Rare Earth Project (Nolans, or the Project), a rare earth mining and processing operation located approximately 135 km north-northwest of Alice Springs in the Northern Territory (NT). The Project is situated approximately 10 km west of Aileron Roadhouse and comprises four main areas – mine site, processing facility, accommodation village and a borefield (Figure 3-1).

1.1 Purpose

The purpose of the Biodiversity Management Plan (BMP or the Plan) is to provide a framework for the Project that will ultimately identify, mitigate and monitor potential biodiversity impacts.

This document and its subsequent revisions form part of the Nolans Mining Management Plan (MMP), which supports Mining Authorisation 1127 granted under Part 4 Division 2 of the *Mining Management Act 2001*.

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 Management System (ARMS).

To manage biodiversity impacts the Company has adopted the following approach:

- Identify the legal commitments related to biodiversity management.
- Describe the existing environment of the Project area.
- Understand the potential risks imposed by the Project on biodiversity values.
- Identify the key biodiversity objectives of the Project.
- Describe monitoring, measurement, trigger points and reporting requirements.
- Provide an action plan for biodiversity management for the reporting period.

The BMP was developed prior to disturbance activities occurring and implemented during the pre-construction phase of the Project. It is intended that the plan is adaptive and will be maintained throughout the construction (2023-2025), operations (38 years) and closure phases of the Project.

A full description of the Project is referenced in the Nolans MMP.

2.0 MANAGEMENT FRAMEWORK

2.1 Approvals and Legislation

This BMP has been developed to facilitate compliance with the Northern Territory and Commonwealth legislation. The current regulatory approvals and legislation relevant to biodiversity management are summarised in Table 2 1.

Table 2-1 Approvals and Legislation

Jurisdiction	Legislation	Details
Northern Territory	*Environment Protection Act 2019*	Administered by the Northern Territory Environment Protection Authority (NT EPA), this Act and subordinate procedures establish the framework for the assessment of potential or anticipated environmental impacts of development. The Nolans Rare Earth Project was assessed at the level of an Environmental Impact Statement (EIS). The Assessment Report was completed by the NT EPA 21 December 2017 (Assessment Report 84). Recommendation 11 of Assessment Report 84 stipulates minimum expectations for the BMP: ▪ An identification of potential project impacts and risks, mitigation measures and preventative actions for the protection of biodiversity values and habitat for threatened species. ▪ A procedure for pre-clearing surveys for threatened species, including the Great Desert Skink and Central Australian Rock-wallaby (previously known as the Black-footed Rock-wallaby *Petrogale lateralis* MacDonnell Ranges race). Pre-clearing surveys will also target Brush-tailed Mulgara *Dasycercus blythi*. (Note that this species was listed as Vulnerable under the Territory Parks and Wildlife Conservation Act 1976 (TPWC Act) at the time of Project approval, although not listed under the EPBC Act. The species status has since been downgraded to Least Concern under the TPWC Act – refer to Section 3.3.6 for more details) and continues not to be listed under the EPBC Act. ▪ The final alignment of the borefield access track, incorporating a buffer of at least 200m around the known previously occupied warren of Great Desert Skink. ▪ The scope, standards and timeframes for a flora and fauna monitoring program ▪ Procedures for managing fire risk from the Project on habitat for threatened species. ▪ Weed hygiene and control procedures for avoiding the introduction and/or spread of weeds into habitat for threatened species. ▪ Procedures for avoiding and/or managing the risk of introduced fauna on threatened species. ▪ Goals, measures, and criteria for the rehabilitation of habitat for threatened species following the closure and decommissioning of the Project.
	Mining Management Act (and	Mining operations are regulated by the Mining Management Act. A Mining Authorisation for the Project was provided to Arafura Resources following assessment under the Environmental Assessment Act. Authorisation 1127-01 was granted on 10 November 2022.

Jurisdiction	Legislation	Details
	regulations) *2001*	Arafura submits a Mining Management Plan (MMP) annual report to the NT Department of Industry Tourism and Trade (November 2022) outlining progress against the previous MMP and plans for the upcoming reporting period. No subsequent versions of the MMP have been submitted. The MMP contains the legal commitments pertaining to the mining operation.
	Bushfire Management Act 2016	This Act establishes the framework for the management of fire in rural and regional (non-urban) areas of the Northern Territory for the protection of life, property and the environment. Bushfires NT administers the Act and provide permits for burning within fire management zones and fire protection zones, as required.
	Weeds Management Act 2001	This Act obligates all land owners and/or occupiers to control and manage weeds on their land. Weeds are categorised under the Act and requirements for their control and management are established under each category.
Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	The Project was assessed and approved with conditions under the *EPBC act* on the 11 May 2018 (EPBC 2015/7436). The approval remains in effect until 31 December 2069. Conditions of the *EPBC Act* in regards to biodiversity management are as follows: ▪ **Condition 1:** The approval holder must not clear more than 4530 ha of vegetation within the project area, including no more than: - 267 ha of Central Australian Rock-wallaby habitat - 123 ha of Great Desert Skink habitat - 125 ha of Brush-tailed Mulgara habitat ▪ **Condition 5:** To manage the impacts of terrestrial fauna and flora, the approval holder must submit to the Minister for approval, a Biodiversity Management Plan that meets requirements a) to h) of recommendation 11 of Assessment Report 84 (NT EPA, 2018). ▪ **Condition 6:** Surveys required under condition 5 of this approval must be undertaken in accordance with survey guidelines and by a suitably qualified expert. Buffers of at least 200 m must be applied to any additional Great Desert Skink warren identified during surveys required under condition 5 of this approval. It is noted that there are several other conditions for the Project, however these are covered in other specific documentation. Ensure that annual compliance reports (and associated independent audit report of compliance) are published as per EPBC conditions.

2.2 Threat Abatement Plans

Under the EPBC Act, threat abatement plans establish a national framework to guide and coordinate Australia's response to key threatening processes. The plans identify research, management and other actions needed to ensure the long-term survival of native species and ecological communities affected by key threatening processes. Threat abatement plans directly relevant to fauna at the Project include:

- Threat Abatement Plan for Predation by European Red Fox – 2008 (https://www.dcceew.gov.au/sites/default/files/documents/tap-fox-report.pdf); and

- Threat Abatement Plan for Predation by Feral Cats – 2015 (https://www.dcceew.gov.au/sites/default/files/documents/tap-predation-feral-cats-2015.pdf).

EPBC listed threatened species considered to be at high risk of predation by feral cats and/or foxes identified for the Project area include the Central Australian Rock-wallaby and Great Desert Skink. Accordingly, monitoring must focus on these threatened species and the threats posed within the broader landscape of the Project.

2.3 Related Management Plans

This BMP is one of several management plans that support the Nolans MMP. Together these plans provide the company with an environmental management framework.

Specific management plans relevant to this BMP include:

- Weed Management Plan (Appendix A of MMP)
- Air Quality and Dust Management Plan (Appendix C of MMP)
- Waste Management Plan (Appendix D of MMP)
- Erosion and Sediment Control Plan (Appendix F of MMP)
- Emergency Response Management Plan (Appendix I of MMP)
- Noise, Vibration and Light Management Plan (Appendix J of MMP)
- Water Abstraction Management Plan (Appendix R of MMP)

2.4 Reporting

2.4.1 Compliance Reporting

Two key environmental legislative reporting items that must be complied with by the Company. A summary of the impacts and findings on biodiversity must be included within these reports as identified in Table 2-2.

Table 2-2 Compliance Reporting

Directive	Summary of Condition	Details to be Provided	Due date
EPBC 2015/7436: Condition 11	The approval holder must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of the management plan. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the Department at the same time as the compliance report is published.	Additional impacts and risks identified during the reporting year. Results from pre-clearance surveys conducted. Details of any buffers imposed around any Great Desert Skink burrows identified. Details of and summary findings from flora and fauna monitoring programs. Evidence of weed hygiene controls implemented onsite.	Within 3 months of 11 May annually.

Directive	Summary of Condition	Details to be Provided	Due date
Mining Authority 1127-01	The Operator must submit an Environmental Mining Report (EMR) covering environmental performance for the previous 12-month reporting period.	The EMR will be used to report environmental performance to the regulator. Reporting against biodiversity performance is not specified however key outcomes and details of the monitoring programs and events of incident/trigger exceedances should be included.	On or before 1 May annually.

2.4.2 Incident Reporting

Triggers that would initiate a reportable biodiversity related incident have been included within the monitoring programs in Section 4.5 – Internal Ground Disturbance Permitting and Pre-Clearing Surveys.

The triggers are indicative of the minimum level of change accepted by the Company prior to action and investigation being implemented. Although conservative, triggers are also a point where possible environmental harm may be occurring. Subsequently, Arafura consider an exceedance of the trigger a reportable incident and will follow reporting processes under the *Mining Management Act 2001* (the MM Act) accordingly.

Under Section 29 of the MM Act environmental incidents must be reported. An environmental incident is an unplanned event that results in environmental harm. Environmental harm is defined in the MM Act as any harm to, or adverse effect on, the environment; or any potential harm (including the risk of harm and future harm) to or potential adverse effect on the environment, of any degree or duration and includes environmental nuisance. Reporting will be carried out as soon as practicable after the mine site operator becomes aware of the occurrence of an environmental incident. Details of the internal reporting processes are documented within the Arafura Incident/Accident Reporting Form, as referenced within the approved Nolans Project Mine Management Plan (MMP).

2.5 Training and Competency

Staff induction and environmental awareness programs are to include reference to biodiversity values of the Project site, with particular emphasis on threatened species, project related hazards and how they will be managed. The site induction is to include the following components for biodiversity management:

- Summary of biodiversity at the Project including ecologically sensitive areas and threatened species.
- Identification of potential impacts to biodiversity from the Project activities.
- Requirement to enter and exit site through recognised vehicle access points, and to travel around site using existing or approved roads and tracks only.
- Requirement for speed restrictions across the Project.
- No vegetation or land clearing / disturbance activities to be undertaken without an approved Ground Disturbance Permit (GDP).

Competent and suitably trained people (whether internal staff or contractors) are to undertake the following:

- Assessment of Ground Disturbance Permit (GDP) applications.
- Vegetation condition surveys.
- Threatened species pre-clearing surveys and monitoring (to be conducted by a suitable qualified expert as per the definition provided in the EPBC approval conditions: a person who has professional qualifications, training, skills and a minimum of ten years demonstrated experience related to the nominated subject matter that can provide an authoritative independent assessment and/or advice on performance relative to the subject matter using the relevant protocols, standards, methods and/or literature).
- Weed pre-clearing surveys and monitoring.
- Weed treatment, including safe handling and use of chemicals.
- Fire management (protection burns and/or maintenance of fire breaks).
- Feral animal control.

Arafura has engaged EcOz Environmental Consultants as the preferred specialists to undertake required ecological surveys and monitoring. EcOz employ a number of staff with diverse expertise that is suited to the ecological assessment and management needs of the Nolans Project.

The lead Ecologist at EcOz for the Nolans Project is Tom Reilly, who has extensive ecological consulting experience in the Northern Territory, extending from the central deserts to the Top End. All ecological work for the Nolans Project is completed under Tom's guidance, and he is responsible for ensuring that relevant EcOz resources are allocated to complete the needs of each defined scope.

See APPENDIX A for a copy of EcOz's capability statement and CV for Tom Reilly.

3.0 ENVIRONMENTAL CONTEXT

This section provides background context relevant to management of key biodiversity values of the Project. Information has been prepared using biodiversity information obtained from studies conducted as part of the approvals process.

3.1 Previous studies

A summary of baseline investigations relevant to biodiversity is provided in Table 3-1 which focused studies on the mine site, borefield, and surrounding areas where relevant.

Table 3-1. Summary of baseline flora and fauna studies for the Project

Date	Company	Description
4 – 7 May 2006	Low Ecological Services	Flora and fauna survey of mine site only.
21 – 24 November 2006	Low Ecological Services	Flora and fauna survey of mine site.
16 – 25 August 2010	GHD	Baseline flora survey of mine site and a proposed haul route (note: haul route no longer included in proposed project footprint).
30 August – 8 September 2010	GHD	Baseline fauna survey of mine site and a proposed haul route (note: haul route no longer included in proposed project footprint).
6 – 8 December 2011	GHD	Baseline flora survey of the proposed transport corridor (noting that this transport corridor was abandoned prior to EIS submission).
8 – 9 December 2011	GHD	Targeted Central Australian Rock-wallaby survey of mine site only.
27 April – 3 May 2015	GHD	Baseline flora and fauna survey of current study area including mine site, processing site, accommodation facility, access roads, utilities corridor (potable water pipeline, water supply pipeline, power line corridor) and borefield area.
21 – 23 July 2015	GHD	Targeted survey of the borefield area to detect presence of any threatened species including the Great Desert Skink, Brush-tailed Mulgara and Greater Bilby.
23 – 26 July 2015	GHD	Targeted surveys for Central Australian Rock-wallaby in the eastern end of the Reynolds Range, Hann Range, Reaphook Hills and outcrops in between.
18 – 19 October 2016	Desert Wildlife Services	Vegetation survey of Day Creek and associated floodplain (EIS Supplement Appendix 9)
6 May 2022 31 August 2022 25-28 September 2022 13 – 14 October 2022	Low Ecological services	Threatened species and weed pre-clearance surveys to identify the presence (absence) and location, if present, of threatened fauna, which may occur within and surrounding the Project footprint for early works.
February 2023	Low Ecological services	Revision of the vegetation community mapping produced for the EIS (GHD 2016) to align with current (as of December 2022) project footprint and mineral tenements – which includes extractives areas that are currently under application.

3.2 Vegetation communities

Vegetation communities and associated landforms have been described and mapped for the Project area. Main vegetation groups have been shown in Table 3-2, Table 3-1 and Figure 3-1 (refer to baseline report for more detailed maps) (GHD 2016a; Low Ecological 2022). Baseline surveys indicated there are no threatened ecological communities present within or surrounding the Project area; however, some are considered as sensitive vegetation communities and / or provide suitable habitat for threatened species known to occur in the area (described below).

The mine area comprises of red earth plains, alluvial plains, rocky hills and several moderate sized drainage features (Kerosene Creek and associated tributaries). The red earth plains support a Mulga shrubland over either tussock grassland or spinifex grassland. The alluvial plains support a mixed open woodland over tussock grasses, with the occasional calcareous low rise that supports Senna shrubs. Several rock hills and outcrop areas are present which support an open shrubland of Acacia or mallee (*Eucalyptus spp*.) over spinifex. The larger drainage channels are typically lined with River Red Gum (*Eucalyptus camaldulensis)* over tussock grasses (including the weed Buffel Grass *Cenchrus ciliaris*). Small channels generally do not support River Red Gum.

The process area predominantly comprises of flat red earth plains that support Mulga shrubland / low woodland over tussock grasses. The northern part of the process area comprises of alluvial plains, gravel rises and some isolated low rocky hills.

The camp site is situated on flat alluvial plains and red earth plain that either support a Mulga shrubland or mixed woodland over either tussock grass or spinifex grass. There are some low rocky hills on the eastern side of the camp that support Acacia shrubland over spinifex – these are flanked.

There are several extractive areas located off the main access road, these areas support rocky hills, gravel or rocky rises, alluvial plains and red earth plains. A Coolabah Swamp (V14) is present within one extractive area to the south of the main access road, which is considered as a wetland under the NT *Land Clearing Guidelines* (DEPWS 2021), which is a habitat type that requires protection / management in the NT.

The bore field occurs within an extensive spinifex sandplain (flat to gently undulating) that supports an open shrubland (various species) over spinifex (*Triodia basedowii*). There is local variation in structure and species within this vegetation community, which is mostly likely to be associated with fire regime. Further to the west is the Day Creek alluvial floodplain, which supports low gravel rises (with either Mulga or Witchetty Bush) that transitions into alluvial plain and large drainage channel (Day Creek) lined with River Red Gum. The Day Creek floodplain areas were surveyed (and reported on) separately by Desert Wildlife Services in 2016 as part of the Groundwater Dependent Ecosystem/vegetation assessment as such this information has not been presented in this BMP.

The following communities are considered as significant / important at a regional scale:

- **Riparian woodland (V1)** – considered as a sensitive vegetation type in the NT under the Land Clearing Guidelines (DEPWS 2021). It is mostly present within the mine area associated with Kerosene Creek and its associated tributaries; however, there are small occurrences elsewhere.

- **Coolabah swamp (V14)** – important vegetation type of the Burt bioregion and considered as a wetland under the NT Land Clearing Guidelines. Small swamp located within an extractives area.

The following communities are considered as suitable habitat for threatened species known to occur within, or surrounding, the Project area:

- **Acacia shrubland on rocky outcrops (V7)** – potential habitat for the threatened Central Australian Rock-wallaby
- **Rocky or gravelly gneiss or schist outcrops with no spinifex (V8)** – potential habitat for the threatened Central Australian Rock-wallaby.
- ***Triodia basedowii* hummock (spinifex) grassland on sandplains (V12)** – potential habitat for the threatened Great Desert Skink and the Brush-tailed Mulgara (no longer threatened).

Table 3-2 Vegetation Community Descriptions

DRAINAGE FEATURES	
1	Riparian woodland along watercourses and drainage channels
10	Claypans with chenopods and herbs
14	Coolabah swamp associated with claypans
ALLUVIAL PLAINS	
3a	Mixed woodland over tussock grasses on alluvial plains
3b	Mixed woodland over spinifex on alluvial plains
3c	Mixed woodland over a highly disturbed understory dominated by Buffel Grass
5	Hakea / Senna shrubland on calcareous alluvial plains and low rises
11	Cottonbush chenopod shrubland on highly erodible duplex soils
MULGA SHRUBLANDS / PLAINS	
2a	Mulga shrubland on sandy red earths over spinifex
2b	Mulga shrubland on sand red earths over tussock grasses
2c	Mulga shrubland on sandy red earths over chenopods
HUMMOCK GRASSLANDS	
12	Hummock grassland (*Triodia basedowii*) on sandplains
LOW ROCKY OR GRAVELLY RISES	
9	*Acacia kempeana* and/or Mulga shrubland on gravel
13	Senna shrubland on quartz
ROCKY SLOPES AND OUTCROP	
6	Eucalyptus (mallee) / *Acacia kempeana* shrubland over hummock grass (spinifex) on rocky slopes
7	Acacia shrubland over spinifex on rocky slopes
8	Acacia / Senna shrubland on rocky gneiss or schist outcrops with no spinifex

Full vegetation community descriptions are provided in Appendix M – Flora and Vegetation Report of the Nolans Project Environmental Impact Statement (GHD May 2016).

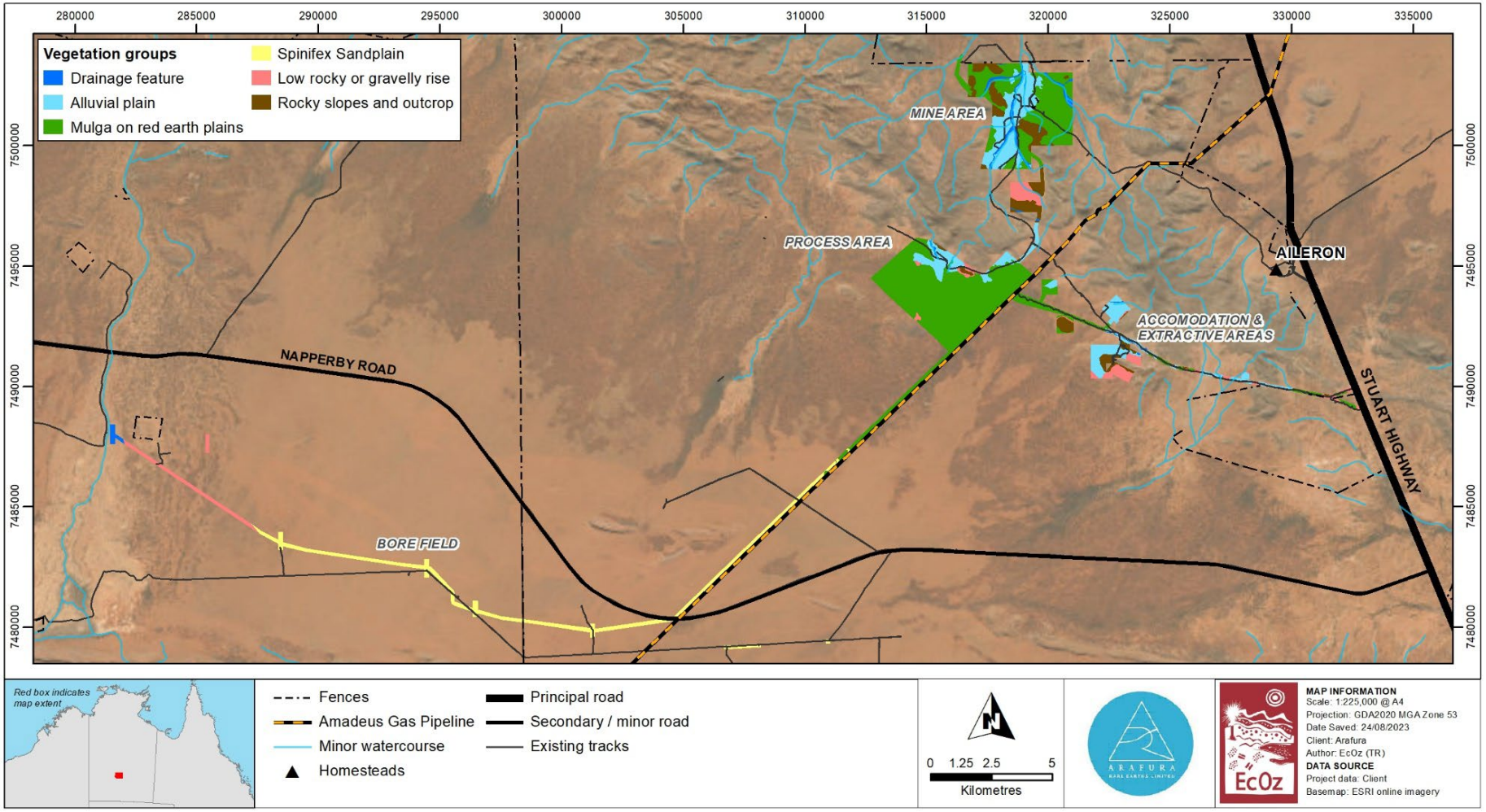


Figure 3-1 Map of vegetation Landform Groups within the Lease Areas

3.3 Threatened species

A total of 172 native vertebrate fauna species have been recorded during baseline studies for the Project, including 25 mammals, 103 birds, 41 reptiles and three amphibians (GHD 2016b). Of these, two species are currently listed as threatened under EPBC Act and/or TPWC Act and as such there are regulatory requirements as per the EPBC Act approval conditions and EP Act recommendations:

- Central Australian Rock-wallaby (*Petrogale lateralis centralis*) (previously known as the Black-footed Rock-wallaby *Petrogale lateralis* MacDonnell Ranges race) (Vulnerable EPBC Act; Near Threatened TPWC Act)
- Great Desert Skink (*Liopholis kintorei*) (Vulnerable EPBC Act and TPWC Act).

The following threatened species are considered to have potential to occur within or surrounding the Project area, however baseline studies did not record any evidence to suspect species presence:

- Greater Bilby (*Macrotis lagotis*)
- Princess Parrot (*Polytelis alexandrae*)
- Grey Falcon (*Falco hypoleucos*).

The Brush-tailed Mulgara (*Dasycercus blythi*) was included as a threatened species (Vulnerable under the TPWC Act) in the NT EPA Assessment Report 84 and previous EIS approval documents. However, this species is no longer listed as a threatened species under the TPWC Act – it is now considered as Least Concern under the TPWC Act. However, as this species was listed as Vulnerable under the TPWC Act at the time of Project approvals, there are regulatory requirements that will be adhered to (such as habitat clearance threshold of 125 ha), and as such it is included for management within this plan.

A total of 315 native flora species have been recorded during baseline studies for the Project. None are listed as threatened, or require specific conservation management.

3.3.1 Central Australian Rock Wallaby (species known to occur within Project area)

The Central Australian Rock-wallaby (*Petrogale lateralis centralis*) is listed a Vulnerable under the EPBC Act (Commonwealth) and Near Threatened under the TPWC Act (Northern Territory). It is a small to moderately sized macropod found in central Australia and is a habitat specialist that occurs in rocky ranges and slopes (Geelen 1999), including areas of outcrop (see Figure 3-2 and Figure 3-3). They shelter during the day in caves and under boulders, where relative humidity is higher and air temperatures cooler. They emerge in the later afternoon / early evening to feed. They may bask in the sun during the early morning following a cold night (NRETAS 2006).

Major threats include predation by introduced species (fox and cat) and to a lesser extent native species (Dingo) (NRETAS 2006; Read and Ward 2011). Habitat degradation caused by changed fire regimes and grazing by introduced herbivores are also a key threat to this species (NRETAS 2006; Read and Ward 2011). With their specific habitat requirements, the species can be limited in their ability to disperse.

Targeted surveys in 2010, 2011 and 2015 confirmed that Central Australian Rock-wallaby inhabits rocky ranges and hills located within the Project area (GHD 2016b). Suitable habitat within the Project area is shown on Figure 3-4**.** Survey data, and NT Atlas records, indicates that the species is widespread within the surrounding ranges and hills.

Most areas where Central Australian Rock-wallaby were recorded are not within the Project footprint or associated infrastructure corridors, with very few records within 2 km from the mine site area. Therefore, direct impacts from the mine are expected to be minimal. However, potential for indirect impacts on the population in the broader area arise with increased wildfire events and introduced predators – and as such management measures will be implemented to minimise these effects.



Figure 3-2 Photograph of Central Australian Rock Wallaby (taken at Finke Gorge National Park)



Figure 3-3 Photograph of indicative habitat for Central Australian Rock Wallaby

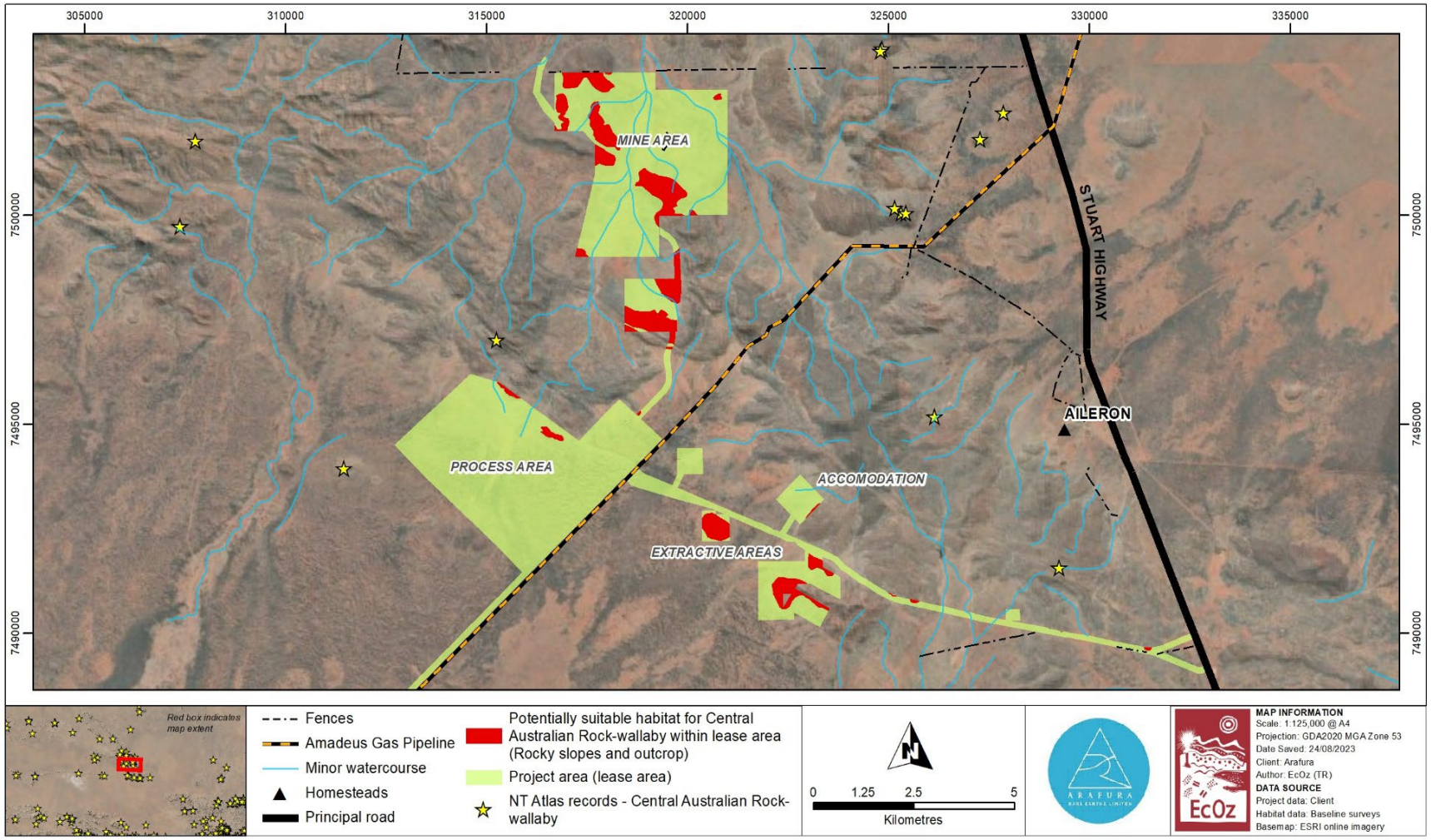


Figure 3-4 Map of suitable habitat for Central Australian Rock Wallaby within Project Area

3.3.2 Great Desert Skink (species known to occur within Project area)

The Great Desert Skink (*Liopholis kintorei*) is listed as Vulnerable under the EPBC Act (Commonwealth) and the TPWC Act (Northern Territory). The Great Desert Skink is a large burrowing skink that occurs in sandplain and dune swales that support hummock grassland and scattered shrubs / trees, and a low fire impacted vegetation community (McAlphin 2001; McAlpin et al. 2011). They construct communal burrow systems (also referred to as warrens) that can have 5 to 10 entrances and support up to 10 individuals. Each burrow system has at least one latrine located at the surface, where animals defecate over an area of 1 to 3 m^2. Camera trap photograph from baseline surveys is provided in Figure 3-5; and habitat, latrines and scats observed within the borefield area are shown in Figure 3-6.

They forage relatively close to their burrows at dusk and at night. Most individuals enter hibernation by the end of May and generally position themselves in burrows about 30 cm from the surface (i.e. close enough to detect seasonal changes). Lizards emerge in September or October (McAlpin 1997). Breeding is generally from December to February, and young usually leave birth burrows after two or three years.

Threats include intense large-scale fires, predation by foxes and cats, and rabbits digging up burrow systems.

Baseline surveys (conducted in 2015, GHD 2016b) detected two Great Desert Skink (*Liopholis kintorei*) burrows in the borefield (see Figure 3-7):

- Burrow 1: easting 295713, northing 7481271 (Zone 53, GDA2020)
- Burrow 2: easting 295732, northing 7481273 (Zone 53, GDA2020)

No other sign / evidence of the species was detected (during baseline studies) along the proposed access roads and water pipeline corridor, or in the area surrounding a historic record 3 km north of the proposed alignment close to Napperby Road.

All parts of the Project area that are spinifex-dominated sandplain provide potentially suitable habitat for Great Desert Skink, and will be considered to potentially support the species.



Figure 3-5 Photograph of Great Desert Skink from Baseline surveys in 2015 (camera trap image)



Area where Great Desert Skink burrow/latrine was detected



Great Desert Skink latrine



Great Desert Skink burrows beside latrine



Great Desert Skink scat, showing large size

Figure 3-6 Photographs of Great Desert Skink habitat, latrine/scats and burrows observed within the borefield area in 2015 (GHD 2016)

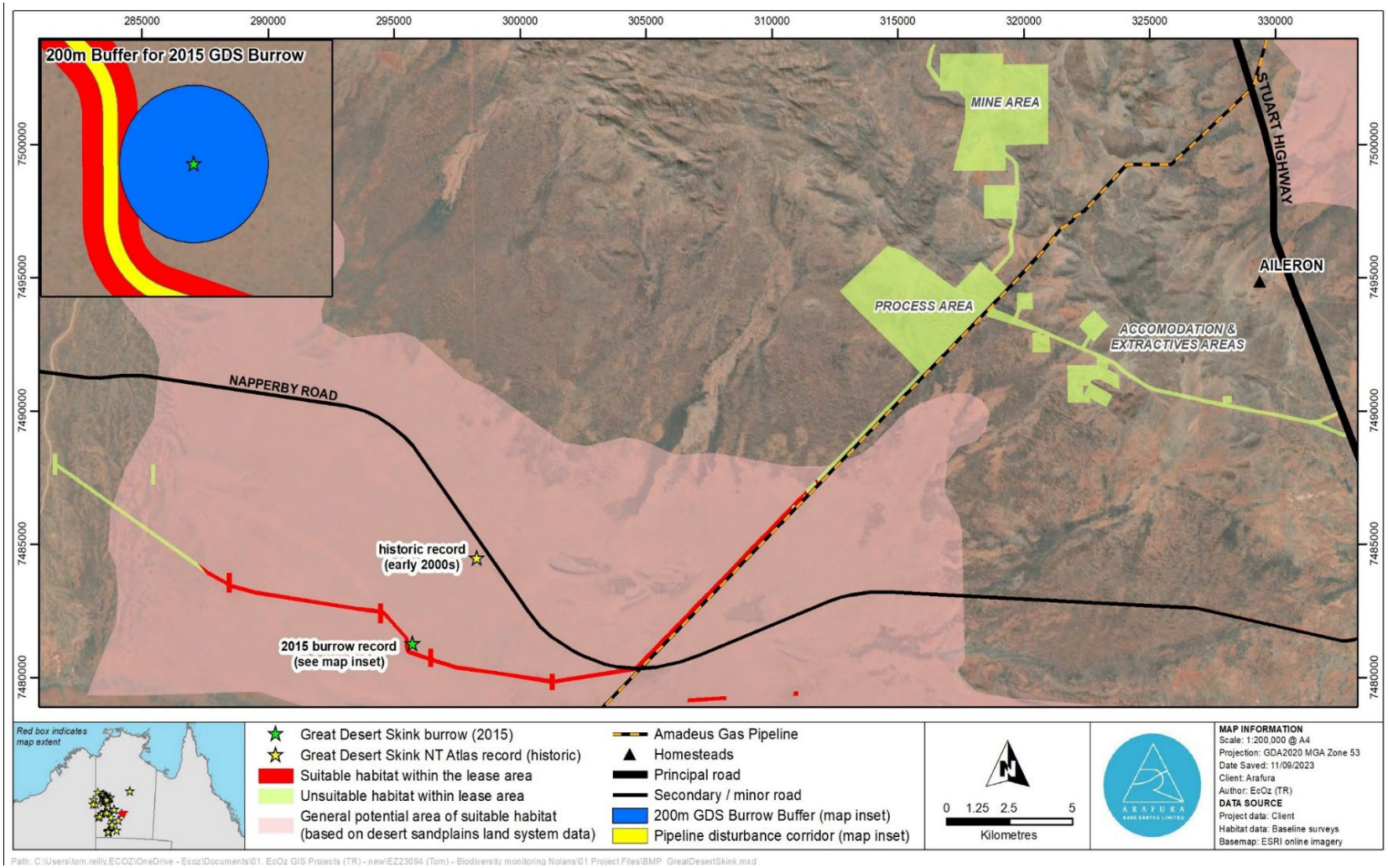


Figure 3-7 Map of Great Desert Skink suitable habitat and previous records

3.3.3 Greater Bilby (species with potential to occur within Project area)

Greater Bilby (*Macrotis lagotis*) is listed as Vulnerable under the EPBC Act (Commonwealth) and the TPWC Act (Northern Territory). The Project area occurs within the known distribution of the species however there are no recent or historic records in close proximity. Baseline fauna surveys did not detect Greater Bilby within the Project area. However, suitable habitat is present (spinifex sandplains where the borefield is planned to be developed – as per Great Desert Skink suitable habitat area, Figure 3-7), and because the species is highly mobile and can expand in abundance and occupied area when favourable conditions persist (Woinarski *et al.* 2007), there is potential that the species could expand into the Project area when suitable conditions persist.

Greater Bilby are considered to potentially occur within the spinifex sandplains of the borefield area, and unlikely to occupy habitat within the mine site area.

3.3.4 Princess Parrot (species with potential to occur within Project area)

Princess Parrot (*Polytelis alexandrae*) is listed as Vulnerable under the EPBC Act (Commonwealth) and the TPWC Act (Northern Territory). The Project area occurs within the known distribution of the species however there are no recent or historic records in close proximity. Baseline fauna surveys did not detect Princess Parrot within the Project area. Suitable habitat is present (spinifex sandplains where the borefield is planned to be developed – as per Great Desert Skink suitable habitat area, Figure 3-7); however the absence of dune and swale habitats reduces occurrence probability of the species.

Baseline surveys indicated that preferred nesting habitat (i.e. large Eucalyptus trees or Desert Oak *Allocasuarina decaisneana*) does not occur within the Project area, so a sighting/observation of the species will likely only be associated with transiting (flyover) or short term foraging.

The absence of nesting habitat reduces potential impacts on this species (as breeding and roosting will not be interrupted). As such, the species is considered to be a possible (non-breeding) occasional visitor within the Project area (particularly within the spinifex sandplain habitat).

3.3.5 Grey Falcon (species with potential to occur within Project area)

Grey Falcon (*Falco hypoleucos*) is listed as Vulnerable under the EPBC Act (Commonwealth) and the TPWC Act (Northern Territory). The Project area occurs within the known distribution of the species, however there are no recent or historic records within the local region; nor was the species detected during baseline fauna surveys. Grey Falcon are known to occur in lightly wooded lowland plains that have tree-lined water courses (DoEE 2020). They forage over a variety of habitat types; and prefer to nest in tall trees on waterways (particularly River Red Gum), or at the top of telecommunication towers (Falkenberg 2011).

The Project area is considered to support suitable foraging / hunting habitat; however nesting habitat is restricted to tree-lined creeks within the mine area (vegetation types 1 and 14 – see Figure 3-1), particularly creeks that support Red River Gum (*Eucalyptus camaldulensis*). Potential impacts to this species from the Project would be via disturbance or removal of active/occupied nest sites (disturbance of foraging habitat is considered to be insignificant for this species).

3.3.6 Brush-tailed Mulgara (species known to occur within Project area)

The Brush-tailed Mulgara is currently listed as Least Concern under the TPWC Act and the International Union for Conservation of Nature (IUCN) Red List and is not listed under the EPBC Act. At the time of Project approvals, the species was listed as Vulnerable under the TPWC and was not listed under the EPBC Act. However, since approvals, the species status was revised (in 2020) from Vulnerable to Least Concern under the TPWC. This was based on the results of recent long-term monitoring programs of the species in the NT identifying no evidence of current decline (refer to https://depws.nt.gov.au/consultation-publications/nt-threatened-species-review-2020/remove-from-nt-threatened-species-list).

Brush-tailed Mulgara is widespread in arid Australia, and occupy sandplains dominated by mature hummock (spinifex) grasslands, and other vegetation types adjacent to hummock grasslands (Menkhorst and Knight 2011). It is a nocturnal species (although are known to be active during the day when conditions are suitable) with a diet that consists of insects and small vertebrates (Menkhorst and Knight 2011). Populations can fluctuate with quality of seasons (i.e. populations can 'boom' after high rainfall summers when food resources are plentiful which triggers breeding), and 'bust' during dry times when food resources are scarce. Populations of the species can be impacted by frequent fire, predation (cats and fox) and habitat change (i.e. grazing / climate change).

Brush-tailed Mulgara were detected in the spinifex sandplains during baseline surveys (in 2015) within the borefield area (GHD 2016b). Results indicated that the species is present in relatively high numbers (indicative of a boom period) and are widespread in areas of suitable spinifex sandplain habitat within the borefield area (GHD 2016b). As such, all spinifex-dominated areas on the sandplains within the borefield area are considered to have potential to support the species (habitat is sympatric to that used by Great Desert Skink shown in Figure 3-7). The age of spinifex will likely have an influence on presence/abundance with patches of older more established spinifex expected to have a higher chance of supporting the species. Habitat within and adjacent to the process plant, accommodation and mine area are not expected to support the species as suitable habitat is not available.

Potential impacts to Brush-tailed Mulgara from the project are from activities conducted within the borefield area, such as direct disturbance of active burrows, reduction of area of suitable habitat and increase in predator numbers. Measures will be in place to minimise these impacts to ensure the species and its population distribution are not significantly impacted. (See Table 4-1 and Table 4-3).



Figure 3-8 Brush-tailed Mulgara (left) and habitat (right) (baseline survey photos)

3.4 Threatening processes

3.4.1 Weeds

Baseline studies identified several weed species within the Project area (listed in Table 3-3). Except for Buffel Grass (*Cenchrus ciliaris*), all species generally occur in low abundances / isolated plants. One of these species – Caltrop (*Tribulus terrestris*) – is declared as a Class B (spread must be controlled) species under the *Weeds Management Act 2001* (Northern Territory). This species was found in low abundance throughout all vegetation types within the Project area and can be spread by cattle and vehicle movement. Of note, it is now considered uncertain whether this species is introduced. *Alice Springs Regional Weeds Strategy 2021-2026* (DEPWS 2021) states it's to be controlled around tracks, parks and other infrastructure due to spiny fruit nuisance.

Baseline surveys recorded Buffel Grass predominantly within floodplain and riparian vegetation types and in disturbed areas (i.e. tracks, cattle yards, Amadeus Gas Pipeline corridor, and mineral exploration areas) – particularly in the mine site area, accommodation village and northern part of the process area. It was absent (or at very low densities) in all other project areas and non-alluvial habitat types.

Although not a declared species in the Northern Territory, Buffel Grass is a Category 2 species in the *Alice Springs Regional Weeds Strategy 2021-2026* (DEPWS 2021), which means that the species warrants strategic control across the landscape due to the high impact on land managers and on broader economic and environmental values. The species can alter the composition and structure of vegetation communities by outcompeting native taxa, and increasing fire severity due to its ability to rapidly accumulate high amounts of combustible biomass compared to native species (Miller *et al.* 2010).

Table 3-3. Weed species recorded within the Project area during baseline studies

Scientific name	Common name	WMA Status	ASRWS Category
Tribulus terrestris	Caltrop	Class B / C	Category 4
Bidens bipinnata	Cobblers Peg	-	-
Cenchrus ciliaris	Buffel Grass	-	Category 2
Chloris barbata	Purple-topped Chloris	-	-
Chloris virgata	-	-	-
Citrullus lanatus	Paddymelon	-	-
Cynodon dactylon	Couch Grass	-	-
Digitaria ciliaris	Summer Grass	-	-
Eragrostis barrelieri	Pitted Lovegrass	-	Category 3
Eragrostis trichophora	-	-	Category 3
Eragrostis minor	Lovegrass	-	Category 3
Malvastrum americanum	Spiked Malvastrum	-	-
Sonchus oleraceus	Milk Thistle	-	-

WMA – *Weeds Management Act 2001* NT Status. ASRWS – Alice Springs Regional Weed Strategy 2021 – 2026.

3.4.2 Feral animals

Feral animals are prevalent in the region within which the Project is located. Although their presence is not a direct result of mining activities, Arafura is responsible for the land management of its leases, and is required to conduct feral animal management so that the Project does not increase current feral animal populations within the region. Feral animals can impact native species directly, through competition, predation or poisoning. They can have indirect impacts through habitat change and also pose a risk to rehabilitation, through grazing and trampling of revegetation, and compacting soil.

Baseline surveys identified six introduced fauna species (Table 3-4). Of these species, Cat, Red Fox and Rabbit are listed as a key threatening process under the EPBC Act as they can have significant impacts on many native species, including threatened species known to occur within the Project area and surrounds.

Table 3-4 Feral Animal recorded within the Project Area during baseline studies

Common name	Scientific name	Baseline occurrence summary
Cat	*Felis catus*	Widespread evidence observed (tracks, camera trap).
Red Fox	*Vulpes vulpes*	Suspected tracks observed in 2015 (GHD 2015).
Rabbit	*Oryctolagus cuniculus*	Low numbers within the mine site area in 2010
Camel	*Camelus dromedarius*	Widespread evidence observed (tracks, sightings, camera trap, scats)
House Mouse	*Mus musculus*	Captured in small numbers during fauna surveys

Native Dingoes	*Canis famiiaris*	Acknowledged as native and present within the Project area. Dingoes are commonly influenced by mining activities and increased population can cause potential predatory pressures on some native fauna.

3.4.3 Bushfire

Fire is a frequent occurrence in the region and poses a risk to people, property, flora and fauna. Management of fire within the region surrounding the Project is essential for reducing threats to the infrastructure, personnel, threatened species and general biodiversity. The North Australia and Rangelands Fire Information (NAFI) website (https://firenorth.org.au/nafi3/) provides live fire tracking and fire histories, at 250m x 250m pixels for Northern Australia (FireNorth 2017). This resource has been used to describe the general fire history of the region within the past 20 years.

The Project area has experienced six bush fire events since the year 2000 - in years 2001, 2002, 2011, 2012, 2013, 2022. A map of 'time since last burn' is provided in Figure 3-9. This dataset indicates that several areas have not burnt between 2000 - 2023 and therefore may contain high fuel loads.

Fuel load reduction is the responsibility of, and will be managed by, the neighbouring stations. Arafura will implement controls to manage the risk of ignition and create firebreaks within the Project area to protect assets and ensure fire doesn't spread during the event of a mine related fire.

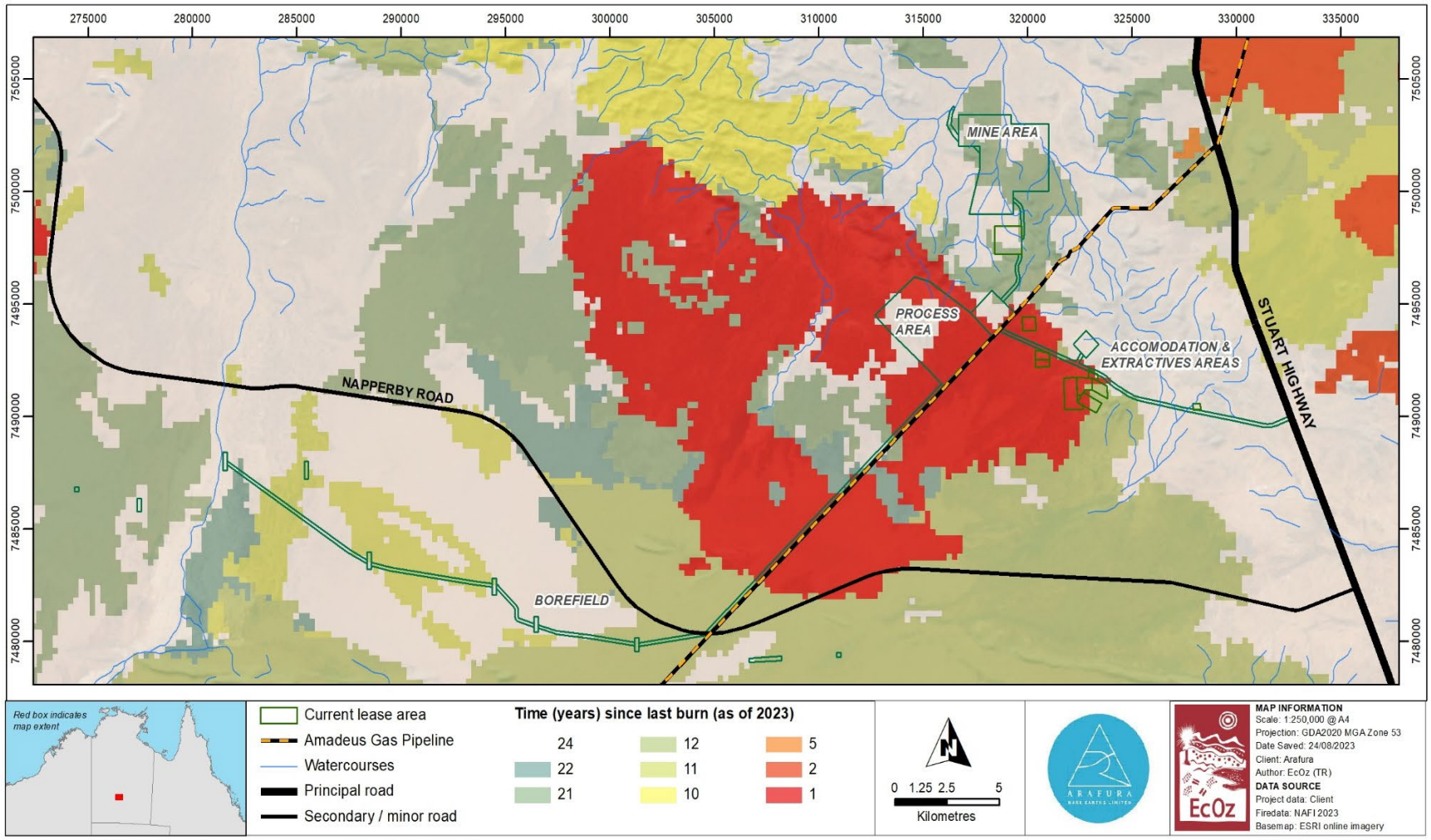


Figure 3-9 Map of fire history (time since last burn)

4.0 BIODIVERSITY MANAGEMENT

4.1 Approach

As identified within the Project MMP, the approach to environmental management for the Nolans project is systematic and is applied to all environmental aspects identified within the Project. The approach has been standardised across the Project to ensure that Project risks are adequately identified to ensure that the desired objectives can be achieved. Once the mitigation measures are identified, clear linkages are made to a performance framework enabling the Company to assess the effectives off the control and continually improve processes to maximise environmental management potential.

The following steps are fundamental to managing Biodiversity at Nolans:

- Identification of risk associated with key mining activities.
- Establishment of biodiversity objectives.
- Implementation of mitigation strategies to avoid potential impacts.
- Development of a performance framework that will determine the effectiveness of the mitigation strategies to achieve the desired biodiversity outcomes.
- Identification and implementation of specific training regimens to support the implementation of the BMP.

4.2 Key Activities, Risks and Impacts

Key activities, risks and impacts associated with biodiversity have been summarised in Table 4-1. To manage the effectiveness of the assigned mitigation measures, each risk pathway has been linked to the performance framework described within Table 4-3.

Table 4-1 Managing Key Risks

Item	Activity	Risk Pathway	Key Impact	Mitigation Measure	Link to Performance Framework
1.1	Clearing of habitat	Uncontrolled vegetation clearing may lead to larger disturbance footprint, increase habitat/vegetation disturbance, and potential impacts to important communities and species.	Non-compliance with environmental approvals, land access or heritage agreements.	Prior to clearing a Ground Disturbance Permit is required to be issued by Arafura Environmental Manager (Section 4.5). Ensure that vegetation clearing complies with condition 1 of EPBC Approval (EPBC 2015/7436), which states that the total cleared area must not exceed 4530 hectares, including no more than: • 267 hectares of Central Australian Rock-wallaby habitat • 123 hectares of Great Desert Skink habitat • 125 hectares of Brush-tailed Mulgara habitat	Performance Framework Item 1.1 Performance Framework Item 1.2
1.2		Vegetation clearing / disturbance activities have the potential to directly impact (i.e. kill or injure) or indirectly impact (i.e. displace, reduce habitat quality) the following biodiversity values: ▪ Known threatened species: - Central Australian Rock-wallaby - Great Desert Skink - Brush-tailed Mulgara (threatened under the TPWC Act at the time	Threatened species in rocky areas: ▪ Central Australian Rock-wallaby Threatened species in spinifex sandplain: ▪ Great Desert Skink ▪ Brush-tailed Mulgara ▪ Greater Bilby ▪ Princess Parrot Threatened species with nesting habitat within creeks:	Use previously disturbed areas before clearing vegetation from undisturbed areas. Minimise ground disturbance at all locations and specifically at/near riparian zones. Maximum clearing easements for haul roads and access roads will be complied with. Clearly mark areas of land to be cleared and areas to be retained (No-Go areas), so that impacts do not extend any further than necessary into important habitat.	Performance Framework Item 1.1 Performance Framework Item 1.2

Item	Activity	Risk Pathway	Key Impact	Mitigation Measure	Link to Performance Framework
1.3		of Project approvals – refer to Section 3.3.6) ▪ Potential threatened species: - Greater Bilby - Princess Parrot - Grey Falcon ▪ Native flora and fauna species (in general) ▪ Sensitive vegetation (riparian, Coolabah swamps) ▪ Vegetation communities and habitat (in general).	▪ Grey Falcon	A suitably qualified expert (as defined in EPBC approval conditions and outlined in Section 2.5) will complete pre-clearing surveys in areas that support suitable habitat for threatened species (refer to Section 4.5.1). Pre-clearing surveys will aim to determine risks and inform management mitigations. Infrastructure will detour around / buffer or move away from identified locations (such as active burrows or nests from threatened species) (refer to Section 4.5.1). No clearing works to be undertaken within 200 m of known active Great Desert Skink burrows (i.e. 200 m buffer from burrow system). If an active burrow/nest from a potential threatened species is identified, a protection buffer will be implemented until confirmed (appropriate buffer distance to be determined in consultation with DEPWS). Mitigation measures for Brush-tailed Mulgara will incorporate current conservation advice for management of the species in the NT, which are focused on minimising clearance of suitable habitat and minimising direct disturbance of active burrows.	Performance Framework Item 2.0 Performance Framework Item 2.1
1.4		Increased weed establishment	Weed infestation can lead to degraded habitat quality and increased fire risk.	A Weed Management Plan has been prepared and will be implemented for this Project (Refer to Nolans MMP, Appendix A). The plan	Performance Management Framework Item1.3 and 1.4.

Item	Activity	Risk Pathway	Key Impact	Mitigation Measure	Link to Performance Framework
				includes the following key mitigations for biodiversity management: ▪ All vehicles/machinery/equipment entering the Project area to be cleaned and free of soil and vegetative matter and have a valid weed hygiene declaration prior to entering Project area. ▪ Spot checks on vehicle/equipment/machinery to ensure inspections are completed correctly. ▪ All vehicles, machinery and equipment to stay on formed access tracks, except for those involved in clearing. ▪ Site environmental inductions for all personnel and contractors to include vehicle weed hygiene requirements. ▪ All personnel and contractors made aware of existing infestation locations and educated in the identification of existing weeds and potential priority weeds in the region. ▪ Pre-clearing weed survey to identify weed infestations to be avoided or managed under the GDP.	
1.5		Failure to implement adequate rehabilitation activities that will meet the desired closure criteria post operations.	Native vegetation habitat including threatened species.	Refer to Nolans MMP; Appendix F - Mine Closure Plan	Refer to Section 7.0.

Item	Activity	Risk Pathway	Key Impact	Mitigation Measure	Link to Performance Framework
2.0	Dust - generating activities (e.g., habitat clearing, drilling, blasting, excavation, haulage and movement of vehicles, handling of materials)	Increased dust levels from general Project activities may result in: ▪ Reduced habitat quality in surrounding vegetation ▪ Sedimentation of waterways.	Habitats proximal to the Projects area.	An Air Quality and Dust Management Plan has been prepared and will be implemented for this Project (Refer to Nolans MMP, Appendix C). Use of water carts for dust suppression. ▪ Tailings kept moist ▪ Sealed Site Access Road (SAR) ▪ Sprayers to be installed along conveyor transfer points.	Performance framework Item 1.5.
3.0	Activities generating noise and vibration (e.g., habitat clearing, drilling, blasting, excavation, haulage and movement of vehicles, handling of materials)	Increased noise and vibrations from general Project activities may result in displacement of native fauna by disrupting nesting, roosting, foraging habits and/or changing behaviour.	All species, but particularly birds and nocturnal fauna.	A Noise and Vibration Management Plan has been prepared and will include the following measures: ▪ Assessment of alternative quieter equipment ▪ Close engine covers when operating ▪ Broadband reversing alarms.	Performance Framework Item 2.0 Performance Framework Item 2.1
4.0	Use of permanent/	Increased light (permanent or long-term) within Project area may lead to:	Nocturnal fauna, particularly in areas near the mine and processing facilities, in particular:	Conformance with the National Light Pollution Guidelines for Wildlife – Appendix A Best	Low Risk: No performance framework assigned.

Item	Activity	Risk Pathway	Key Impact	Mitigation Measure	Link to Performance Framework
	long-term lighting	▪ Displacement of native fauna ▪ Increased susceptibility to predation ▪ Disruption of nesting/roosting behavior ▪ Disorientation of nocturnal bird and bats ▪ Attraction, disorientation and altered breeding behaviour of amphibians ▪ Altered activity rhythms.	▪ Central Australian Rock-wallaby ▪ Spectacled Hare-wallaby ▪ Northern Nailtail Wallaby.	Practice Lighting Design (DCCEEW 2020), including: ▪ Use adaptive controls ▪ Light only the intended area ▪ Use appropriate lighting ▪ Use of non-reflective surfaces ▪ Use lights with filtered out blue, violet, and ultraviolet wavelengths.	
5.0	Activities that could start an unplanned wildfire (e.g., hot work)	Proliferation of weeds in disturbed areas and surrounding areas may lead to reduced habitat quality and increased fire hazard / fuel loads.	▪ Excessive habitat loss due to unseasonal wildfire. ▪ Rapid and widespread changes of native flora composition.	Fuel load reduction is the responsibility of, and will be managed by, the neighbouring stations. Arafura will implement controls to manage the risk of ignition and create firebreaks to protect assets and ensure fire doesn't spread during the event of a mine related fire. The following measures will be implemented: ▪ Awareness of pastoral landholder fire management obligations and strategies ▪ No hot works are permitted on total fire ban days without written approval from a fire control officer or fire warden ▪ Maintenance of fire access trails and fire breaks around infrastructure ▪ Communication system for monitoring bushfire alerts in the area	Refer to the Emergency Management Plan for performance framework.

Item	Activity	Risk Pathway	Key Impact	Mitigation Measure	Link to Performance Framework
				▪ Monitor the NAFI website (and SecureNT) and adhere to total fire ban days. Updates provided at daily toolbox meetings ▪ Fire extinguishers fitted to all vehicles ▪ Clean out vehicle engine bay regularly, with special attention paid on red alert days, to prevent grass igniting on the hot vehicle components ▪ Smoking only allowed in designated smoking areas.	
6.0	Refuse/ garbage management and storage – Pest management	Attraction of feral animals (cats, fox, rabbits) and native predators (dingo, raptors) associated with: ▪ Waste management, particularly putrescible waste (i.e. rubbish, landfill) ▪ Increased available surface water ▪ General site infrastructure can be used as refuge / shelter.	Some species in habitats where people congregate and where rubbish bins exist. Landfill management will be limited to industrial refuse.	General site wastes will be managed to prevent/reduce interaction with fauna. Waste management includes: ▪ Regular covering of the landfill ▪ Dingo proof fencing installed surrounding the landfill to restrict interaction with fauna ▪ Waste storage outside of the landfill is to be situated in bins with lids secured ▪ Waste oils and/or hazardous substances will be kept in sealed containers and/or covered ▪ All domestic waste outside the landfill/waste-storage facility is to be stored in vermin-proof bins with lids secured.	Performance Framework Item 3.0

Item	Activity	Risk Pathway	Key Impact	Mitigation Measure	Link to Performance Framework
7.0	Storage of contaminated water (e.g., Tailings)	Presence of contaminated surface water bodies, including the RSF decant pond may lead to poisoning of fauna from consuming water leading to death or injury to native fauna; or drowning.	All fauna species	Reduce attractiveness (to wildlife) of the Residue Storage Facility, sediment basins and process water Ponds through the implementation of Best Practice Guidelines for Reducing Impacts of Tailings Storage Facilities on Avian Wildlife (DME, 1998). Installation of fauna egress matting in lined facilities. All water dams will be fenced.	Performance frameworks included within: ▪ Residue Storage Facility Management Plan ▪ Surface Water Management Plan.
8.0	Alteration to hydrological processes	Hydrological processes have the potential to be altered through the extraction of groundwater or the diversion of water courses.	Groundwater Dependent Ecosystems downstream of the Reaphooks borefield. Up and downstream ecosystems associated with Kerosene creek.	Mitigation measures to protect GDE have been incorporated into the GWEL L10013 Conditions and associated Water Abstraction Management Plan. Mitigation measures to protect ecosystems associated with Kerosene Creek have been incorporated within the Kerosene Creek Diversion Management Plan.	Performance frameworks included within: ▪ Water Abstraction Management Plan. ▪ Kerosene Creek Diversion Management Plan
9.0	Construction of roads, hard stands or embankments Haulage and movement of vehicles	Vehicle movement / traffic within the Project area may lead to: ▪ Road kill or injury to native fauna, including threatened species ▪ Safety issues for mine site personnel, contractors and visitors.	All fauna species	Keep the proposed road network to a minimum and upgrade and utilise existing vehicle tracks. Ensure that all vehicles travel on these designated roads, and not on secondary or short-cut roads/tracks. Implement slower speed limits for all vehicles moving at night, and a sensitive time of the day in sensitive habitat areas, to reduce the likelihood of roadkill.	Low Risk: No performance framework assigned.

Item	Activity	Risk Pathway	Key Impact	Mitigation Measure	Link to Performance Framework
				Upgrade high-use areas to be safer for vehicles and fauna (e.g. no blind curves, wider shrub-free verges). Site environmental officers will be trained in wildlife first aid. In addition, if injured fauna is encountered, assess the situation and potential requirement to euthanize and/or contact Wild Care Alice Spring for advice: M: 0419 221 128 E: wildcareasp@gmail.com	

4.3 Biodiversity Objectives

The key biodiversity management objectives associated with the Project are outline in Table 4-2. Arafura biodiversity objectives consider key biodiversity values identified by baseline studies and regulator feedback to ensure the Project does not have a significant impact on biodiversity values within the Project area and surrounding region.

Table 4-2 Biodiversity Management Objectives

Aspect	Key Biodiversity Objectives
Vegetation communities	Limit the direct impacts to vegetation communities resulting from the development of the Project. No unfavourable impacts on vegetation condition / habitat quality within and surrounding the Project footprint, particularly sensitive communities and threatened species habitat.
Native fauna	Limit the direct loss of threatened species habitat, particularly threatened species known to occur within the Project area. Ensure that the Project operations do not negatively influence the natural populations of threatened species within or adjacent to the Project area.
Threatening processes	Animal pests and invasive weeds influenced by the Project, are controlled such that there are no impacts to native fauna and vegetation communities.

4.4 Performance Framework

The performance management framework (Table 4-3) has been developed to accurately measure the Company's performance towards meeting biodiversity objectives. Taking into consideration the impacts and mitigation measures presented in Section 4.2, the performance management framework identifies specific targets and performance criteria that should be achieved if the mitigation measures are implemented successfully. Details of monitoring and/or evidence required to support the performance criteria have been included within the performance management framework to provide a quantifiable record that supports the performance outcomes.

Table 4-3. Performance Management Framework

Item	Related Objective	Mine phase	Target	Performance Criteria	Monitoring/Evidence
1.1	Vegetation	Construction/Operation	Prevent any unnecessary removal of vegetation or habitat (i.e. minimise habitat loss / project footprint).	No occurrence of clearing outside of Project tenements or the approval area.	Annual verification and reporting of authorised clearing.
1.2		Construction/Operation		No event of non-conformance with approval conditions.	Ground disturbance tracking and post clearing assessment by environmental department.
1.3		Construction/Operation	No spread of existing Declared weeds within the Project area.	No significant change to the extent and distribution of Declared weeds within one year of completion of construction activities compared to the extent and distribution of weeds prior to construction.	Weed surveillance monitoring of the Project area and adjoining vegetation.
1.4		Construction/Operation	Prevent the introduction of new Declared weed species across the Project.	Zero occurrences of new weed species.	Weed surveillance monitoring of the Project area and adjoining vegetation.
1.5		Construction/Operation	No reports of dust impacts from the Project at sensitive receptors.	No reported incidents of dust deposition at selected sensitive receptor sites.	Work area inspection report observations on visible dust.
2.0	Native fauna	Construction/Operation	Minimise adverse impacts on Central Australian Rock Wallaby populations proximal to the Project.	Recordings within moderate acceptable change (as defined in Table 5-2) of Central Australian Rock-wallaby populations.	Refer to Section 5.2; Central Australian Rock-wallaby Monitoring Program. Pre-clearing reports in accordance with Section 4.5.1.
2.1		Construction/Operation	Minimise adverse impacts on Great Desert Skink populations proximal to the Project.	No recordings of small acceptable change (as defined in Table 5-2) of Great Desert Skink populations.	Refer to Section 0; Greater Desert Skink Monitoring Program. Pre-clearing reports in accordance with Section 4.5.1.

Item	Related Objective	Mine phase	Target	Performance Criteria	Monitoring/Evidence
				No clearing works to be undertaken within 200 m of known active Great Desert Skink burrows (i.e. 200 m buffer from burrow system). If active burrows are found in the project area during biodiversity surveys and other opportunistic observations, then DEPWS will be consulted for management advice on feral animals and fire management and no further vegetation clearing will occur within 200 metres of the active burrows.	
2.2		Construction/Operation	Minimise adverse impacts on Brush-tailed Mulgara populations proximal to the Project as per current conservation advice for the species in the NT (see Section 3.3.6 for more details).	Recordings within large acceptable change (as defined in Table 5-2) of Brush-tailed Mulgara populations. Where possible, active burrows will be avoided. In cases where avoidance of active burrows is not possible, the proposed clearance area will be designed to minimise direct impacts to active burrows. This will ensure that the colony/population within the bore field area will not be significantly impacted.	Pre-clearing reports in accordance with Section 4.5.1.
2.3		Operation	Contaminated water storage bodies do not adversely impact native fauna populations.	No regular occurrence (>2 events in consecutive months) of fauna deaths recorded within water storage bodies.	RSF daily monitoring check. Hazard and Incident Registers and reports.
3.0	Threatening Processes - Pests	Construction/Operation	Pest fauna will not adversely impact native fauna because of the Project.	No increase of pest fauna richness or abundance in areas within and surrounding the Project site compared to reference sites.	Refer to Section 0; Invasive Species Monitoring Program.

4.5 Internal Ground Disturbance Permitting and Pre-Clearing Surveys.

Ground disturbance permitting (GDP) is an internal Company process that ensures that all ground disturbance is conducted in compliance with the Company's environmental approvals and requirements. All proposed disturbance is assessed by an Arafura environmental professional prior to being acknowledged and approved by Arafura management prior to physical disturbance or clearing of the land. Surveys or inspections related to threatened species will be undertaken by a suitable qualified expert (as defined in EPBC Approval Conditions and detailed in Section 2.5).

4.5.1 Pre-Clearing Surveys

Pre-clearing surveys will be undertaken prior to ground disturbance where there is significant biodiversity risk to threatened species, threatened species habitat, or significant weed colonisation/spread. The prerequisites for a pre-clearing survey have been provided in Table 4-4 below:

Table 4-4 Prerequisite for pre-clearing surveys at the Nolans Project

Prerequisite	Responsibility	Timing	Method	Evidence
The proposed activity is within or close to known threatened species occurrences, or in areas considered to be potentially suitable habitat for threatened species (including those species that are known to occur, or potentially occur, or targeted species that have been delisted since approvals within the Project area).	To be arranged by Arafura environmental personnel prior to ground disturbance activities taking place. The survey will be conducted by a suitably qualified expert (as defined in EPBC Approval Conditions and detailed in Section 2.5) in accordance with the pre-clearing protocols.	No more than 8 weeks prior to clearing.	The survey will be conducted by walking transects 20 m apart over the entire area proposed to be cleared. The surveyor will search for target species sign (i.e. scats, burrows, tracks, nest). If sign is detected, a field assessment will be made to determine current activity / occupancy. The surveyor(s) will then conduct a wider search in the surrounding 200 m to check for additional sign.	Field report including survey map showing GPS track log, and survey results, and recommendations to avoid / minimise impacts where relevant (i.e. buffers).
The proposed activity is within or close to a known weed infestation that needs to be managed.	To be conducted by Arafura environmental personnel prior to ground disturbance activities taking place.	No more than 8 weeks prior to clearing.	The survey will be conducted by walking representative transects within the area proposed to be cleared to record weed occurrence.	Field report including survey map showing GPS track log, and any weed occurrences. Provide recommendations for weed management where relevant.

5.0 MONITORING PROGRAMS

5.1 Monitoring Approach

This chapter describes the monitoring programs and inspections that will be implemented as part of the performance assessment process for this BMP. This process allows for adaptive management of aspects relevant to biodiversity management. The assessments and associated measurement criteria will be established to allow baseline information to be compared against subsequent repeat surveys. If monitoring indicates that the current management measures are inadequate, then revised or additional measures will be determined and implemented to meet the objectives of the BMP (under consultation with experts and/or relevant authorities).

5.1.1 Assessment Criteria

Monitoring of (current) threatened species and management of pest species population density within the Project area will be undertaken at agreed intervals as detailed in Table 5-3, Table 5-4 and Table 5-5, this includes:

- Central Australian Rock-wallaby
- Great Desert Skink
- Key predator species (Cat, Fox and Dingo)

A monitoring program for Brush-tailed Mulgara has not been proposed because it was removed from the TPWC Act threatened species list in 2020 (and was/is not listed under the EPBC Act). However, monitoring data on Brush-tailed Mulgara will be incidentally collected as part of the Great Desert Skink and predator monitoring programs. As such, presence and activity estimates of the Brush-tailed Mulgara will be reported using available data collected to ensure that regulatory approvals and commitments for the species are met, and that current conservation advice for the species in the NT is adhered to.

Data is to be utilised to determine if the population has increased, decreased, or remained unchanged, and be assessed against historical data to indicate trends. This is important to understand if mining operations are having an impact on threatened species populations (and feral animal populations) around the mine site as compared to the broader landscape surrounding the Project.

Triggers and responses are to be determined by predicted 'levels of acceptable change'. The accepted levels of change are determined by known species characteristics and include three scenarios as provided in Table 5-1. With the understanding of species characteristics, levels of acceptable change have been developed for each monitoring and management plan. A summary of acceptable levels of changes are provided in Table 5-2.

Table 5-1. Scenarios for triggers and responses

Scenario	Description
Known to Fluctuate	If a species/community is known to fluctuate broadly in numbers or activity patterns, then a higher level of change (as determined through monitoring) is acceptable, because that level of change may simply reflect natural fluctuations.
Generally Consistent	If a species/community is known to remain consistent in numbers or activity patterns, then a lower level of change is acceptable, because any change at all may indicate that the Project is having an effect.
Unknown	If the populations or activity levels of a species/community are not understood adequately to determine the natural levels of variability, and less is known about the dynamics of a species/community, then smaller levels of change will be accepted until there is a better understanding of the species population variability.

Table 5-2. Levels of acceptable change.

Acceptable level of change	When to apply
No increase	The species/community being investigated is known to have naturally very small variation in population size or activity patterns. Thus, detection of any deleterious change (as found through monitoring) suggests that the Project may be having an effect.
Small change	The species/community being investigated is known to have naturally small variation in population size or activity patterns. Thus, detection of small deleterious change (as found through monitoring) suggests that the Project may be having an effect.
Moderate change	The species/community being investigated is known to have naturally moderate variation in population size or activity patterns. Thus, small changes (as found through monitoring) may simply reflect natural variation, and more substantial changes would need to be detected to suggest that the Project may be having an effect.
Large change	The species/community being investigated is known to have naturally high variation in population size or activity patterns (e.g., boom-bust or irruptive species). Thus, even moderate changes (as found through monitoring) may simply reflect natural variation, and large consistent long-term changes would need to be detected to suggest that the Project may be having an effect.

5.2 Central Australian Rock-wallaby

The monitoring program is based on survey techniques described in the EPBC survey guidelines for threatened mammals (Survey guidelines for Australia's threatened mammals, DSEWPC 2011a). The monitoring program will primarily use daytime searches for scats in areas of suitable habitat. This method is commonly used in central Australia to determine species presence and also species abundance estimates, such as in Newhaven Wildlife Sanctuary. Camera trapping may also be used as part of the monitoring program, which is a relatively new survey technique and methodology is continually evolving. Arafura plan to meet with local experts and Fauna Scientists from DEPWS on an annual basis to discuss monitoring results and methodology.

Table 5-3 Monitoring Program for the Central Australian Rock Wallaby

Program		Threatened Species Monitoring – Central Australian Rock-wallaby
Objectives		To estimate the presence and abundance of Central Australian Rock-wallabies within known sites surrounding the Project area.
Survey area		Rocky habitat and rocky outcrops within 5km of the mine site and in surrounding rocky areas (landscape context).
Method	**Survey**	Scat searches along permanent 100 m transects. Scat age categories used so that results can be used to estimate current inhabitation and previous/recent occurrence. The following data will be collected (at a minimum): Scat type / adult or juvenile Scat age: 1) Fresh - black, glossy, 95% intact. 2) Recent – black, some gloss, 70% intact 3) Old – grey or whitish; or black/dark brown with no glossy sheen, <70% intact ▪ Number and location of recently occupied refuges ▪ Number and location of unused refuges ▪ Presence / absence of evidence of grazing by rock-wallaby ▪ Presence / absence and type of predator scats (cat, fox, dingo) ▪ Presence / absence and type of other herbivore scats or grazing or sighting. ▪ Presence / absence and type of other herbivore scats or grazing or sighting. ▪ Presence / absence of key food plants (spearbush and fig) ▪ Fire history and weed presence.
		Camera traps may be utilised for continuous data collection of wallabies, feral animals, and other native species.
	Timing	Annually initially, then timing subject to previous surveys results / recommendations.
	Personnel	Qualified ecologist (suitably qualified expert as per definition in the EPBC approval conditions – refer to Section 2.5)
Trigger Points		**Acceptable level of change exceeds moderate, which may include:** ▪ Rock-wallabies are not detected in rocky outcrop near the mine site and in the preceding year or if rock-wallabies are killed on the roads in the study area. ▪ Predator monitoring shows that numbers of predators in the study area over the preceding 12 months increased (cat and fox) or increased greatly (dingo); or ▪ Wildfire in rocky areas during the preceding 12 months and no rock-wallabies are detected in nearby rocky areas.
Corrective Actions		Conduct population review by qualified ecologist which will include an assessment of: ▪ Incident of direct fauna impact caused by project activities. ▪ invasive species population fluctuations. ▪ Regional fire regime.

5.3 Great Desert Skink

The monitoring program is based on Commonwealth survey guidelines for the Great Desert Skink (Survey Guidelines for Australia's Threatened Reptiles, DSEWPC 2011b). The most effective survey technique to identify the presence / absence of Great Desert Skink is to locate warrens by walking along transects through suitable habitat, and then check the burrow entrances for recent signs of activity (active latrine site, recently dug soil at entrances, fresh tracks at burrow entrance). Survey timing will occur during the onset of warm spring weather, which is expected to coincide with the emergence of Great Desert Skinks post-hibernation.

Table 5-4 Monitoring Program for the Great Desert Skink

Program		Threatened species monitoring – Great Desert Skink
Objectives		▪ To document the presence/absence within previous identified active burrows ▪ To search other areas of suitable habitat for new burrow systems to better understand the size and extent of the current 'population.' It is noted that this monitoring program occurs in addition to pre-clearing surveys conducted as part of Ground Disturbance Permits (for proposed areas to be cleared / disturbed for mining operations).
Survey area		▪ Previously recorded Great Desert Skink burrow systems. ▪ Spinifex sandplain habitats surrounding site infrastructure and roads within the borefield.
Method	**Task 1**	Inspection will be undertaken on known Great Desert Skink burrows. The following data will be collected: ▪ Burrow system is active / inactive (based on fresh scat, tracks, fresh spoil, burrow maintenance, sighting, or camera evidence) ▪ Number of burrow entrances in use ▪ Burrow system size (estimate in m^2) ▪ Number of latrines ▪ Size of latrine ▪ Scat size variation within latrine(s) – used to indicate adults and juveniles. ▪ Presence of predator signs within and surrounding burrow system. ▪ Vegetation and habitat description ▪ Fire history ▪ If possible, camera traps will be installed to recorded footage of burrow occupants – as additional evidence of presence / absence to sign-based protocols described above.
	Task 2	Track-plot (sign-based) surveys to detect species presence. Track-plots will be 5 ha (500 m x 100 m). Great Desert Skink burrow systems will be recorded as per data collection protocols described in Task 1. Site selection of track-plots will include areas surrounding known occurrences of Great Desert Skink burrows, as well as other locations within general area that have not been surveyed. All information will be collated into the threatened species monitoring register (Excel and GIS).
	Timing	Annually initially, then timing subject to previous surveys results. Surveys to be conducted during the summer months when the species is active (latrines and tracks will be clearly visible) so that assessment can be made on current inhabitation.
	Personnel	Qualified ecologists (suitably qualified expert as per definition in the EPBC approval conditions – refer to Section 2.5).

Program	Threatened species monitoring – Great Desert Skink
Trigger Points	**Acceptable level of change exceeds small, which may include:** Additional mitigation action required if: ▪ >20% decrease in numbers of Great Desert Skink; and ▪ Predator monitoring shows that numbers of predators in the study area over the preceding 12 months increased (cat and fox) or increased greatly (dingo); or ▪ Wildfire in the sandplain habitat during the preceding 12 months and no Great Desert Skink where previously detected.
Corrective Actions	Conduct population review by qualified ecologist which will include an assessment of: ▪ Incident of direct fauna impact caused by project activities. ▪ Invasive species population fluctuations. ▪ Regional fire regime.

5.4 Predator Species

Predator monitoring to align with relevant EPBC Threat Abatement Plans. To monitor key predator species within and surrounding the Project site to determine if additional control measures are required. The focus species will be cats, foxes, and native dingos.

Table 5-5 Monitoring Program for Invasive Species

Program		Predator monitoring (focused on Cats, Foxes and Dingos)
Objectives		Establish baseline and subsequent comparative data on population sizes of feral predators and dingoes to inform control programs.
Method	**Survey**	Establish baseline data by undertaking a motion-sensing camera surveys. Invasive scat and/or track surveys to be incorporated into Central Australian Rock-wallaby and Great Desert Skink monitoring programs.
	Operation	Establish baited camera stations that can be repeatedly used including: ▪ Sites that are known to be possible attractants to pests / predators (i.e. landfill, water bodies etc.) ▪ Sites within 100 m of proposed mine activities (particularly around the landfill).
	Timing	Regularly through construction and operations.
	Personnel	Transect surveys will require completion by a suitably qualified expert as per definition in the EPBC approval conditions – refer to Section 2.5) Environmental staff for inspections and camera trap data retrieval.
Trigger Points		**Acceptable level of change**: No increase Any increase in population size is likely to be detrimental to biodiversity. Action required if >10% increase in numbers of individuals detected across two surveys.
Corrective Actions		Investigate the occurrence with qualified ecologist. Implement or increase predator control program as required. Increase cat/fox control efforts, through trapping, poisoning, shooting. Predator/pest control methods are to be regulated to ensure that there is no unintentional capture or death of threatened fauna species.

6.0 CORRECTIVE ACTIONS

For each monitoring program (see the tables in Section 4.5 above), specific triggers have been assigned as an indication of when corrective actions must be taken. In all events, a suitably qualified expert (as per defined in EPBC Approval Conditions and outlined in Section 2.5) will be engaged to investigate the cause of the trigger and to provide assurance that the proposed corrective actions would be suitable based on the outcomes of the investigations.

7.0 BIODIVERSITY GOALS, MEASURES AND CRITERIA AT CLOSURE

7.1 Closure Overview

The principle aims of mine closure and rehabilitation for the Nolans project are:

- To establish a safe and stable post-mining land surface which supports vegetation growth over the long-term;
- To return the land, as close is reasonably practical, to its pre-disturbance land use; and
- To make the site suitable for future leaseholders likely uses for the site.

With these principle aims in mind, the following mine closure objectives have been identified:

- **Legal compliance** - to meet all legal obligations and commitments
- **Meet stakeholder expectations** - to meet stakeholder expectations for the closed site
- **Public safety** - to provide a closed site with no unacceptable safety risks or hazards to people and animals
- **Long-term stability** - to achieve physical, chemical and biological stability of rehabilitated areas
- **Minimise impacts to groundwater or surface waters** so that the nominated post-closure land uses are not affected.

7.2 Completion Criteria

The completion criteria provide a means of evaluating the successful achievement of the closure objectives.

Ideally these should be SMART (specific, measurable, attainable, relevant and timely) and, once agreed, set the conditions on which the relinquishment of the Project site can take place.

The level of detail of completion criteria should be appropriate to the stage of development. This conceptual closure plan is submitted pre-approval and further detail and definition will be added to the criteria during Project design, construction and during operations.

In agreement with the regulators, the criteria may be reviewed and amended in response to operational and post-closure management and monitoring programmes.

The preliminary Completion Criteria for biological stability of rehabilitated areas are provided in Table 7-1.

Table 7-1 Closure Objectives and Completion Criteria for Biological Stability of Rehabilitated Areas.

OBJECTIVE	CRITERIA	MEASUREMENT
Biological Stability of Rehabilitated Areas		
Rehabilitated ecosystem has equivalent values, functions and resilience as the target ecosystem.	Nolans site recolonised by previously existing fauna communities.	Camera surveys of fauna populations.
	Revegetation uses locally sourced seeds at the optimum mix for successful establishment and representativeness of target ecosystem.	Records of seeding trials Audit seed list.
	Self-sustaining vegetation cover is successfully re-established on disturbed areas.	Rehabilitation vegetation monitoring and assessment.
	Rehabilitated vegetation community species composition and diversity, density and structure are representative of the target ecosystem.	Rehabilitation vegetation monitoring and assessment.
	Weed populations do not restrict establishment of target ecosystem.	Weed surveys.
The rehabilitated landscape is compatible with the agreed final post-closure use.	As far as possible, post-closure watercourses have geomorphology and riparian communities consistent with those on site prior to development. Post-closure drainage does not lead to flooding of pit or erosion of waste landforms during storm events. Drainage can accommodate a 1 in 1000-year ARI wet year rainfall.	Flood modelling Flow monitoring Audit of approved designs and specifications for drainage pathways and outflows including design flows.
	Landforms, including surface covers, designed with drainage pathways and outflows that manage surface drainage, including extreme rainfall events, erosion and sedimentation have been agreed with relevant stakeholders.	Record of consultation with stakeholders representing future land users.
	Permanently altered land is limited to the WRDs, TSF, RSF and mine pit footprints and agreed infrastructure.	As built fencing/bunding plans.
The landscape and integrity of waste storage landforms is retained through extreme future events such as flooding, bushfires and drought.	Research trials demonstrate the potential of the rehabilitation to regenerate following fire.	Success of post-fire regeneration.
	Monitoring has confirmed the rehabilitation can survive one or more seasons of drought.	Qualitative assessment of vegetation health.
Disturbed areas will be progressively rehabilitated during operation.	Operational areas on site will be progressively rehabilitated.	Mining programme rehabilitation reports.

8.0 AUDIT AND REVIEW

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

8.1 Inspections and Audits

Routine environmental inspections are required to assess adherence to and effectiveness of policies and procedures.

Inspections will cover environmental aspects including:

- Weeds
- Pests
- Waste control checks
- Erosion and sediment control checks and identification of issues that need remediation.

Table 8-1. Inspections and Audit Schedule

Performance assessment	Description	Frequency	Responsibility
Environmental inspections	Daily work area inspections to include animal pest observations (behaviour or population).	Daily	Work area supervisor
	Monthly environmental inspections to include animal pest observations (behaviour or population).	Monthly	Environmental Advisor
Ground Disturbance Permit (GDP) Procedure	Verification audit of ground disturbance activities and non-conformance.	Annual	Environmental Advisor
Induction register checks	Ensure induction records are kept demonstrating what was covered in the induction and who was inducted. Record to be provided in the Monthly Environmental Report.	Monthly	Environmental Manager

8.2 Registers / Data Control

- GDP register (Excel and GIS)
- Pest monitoring and management control register (Excel and GIS)
- Weed monitoring and management control register (Excel and GIS)
- Fuel load monitoring and fire control action register/database (Excel and GIS)
- Fauna sighting and fatality register (Excel and GIS)
- Threatened species monitoring register and spatial data (Excel and GIS)
- Site induction register.

8.3 Review of this management plan

This BMP should be reviewed annually (to coincide with the review process of the Project's MMP) and updated accordingly, such that it remains relevant to site conditions. The next review is due in April 2025.

9.0 REFERENCES

Read JL and Ward MJ (2011). Bringing back the warru: initiation and implementation of the South Australian Warru Recovery Plan. *Australian Mammalogy* 33, 214-220.

NRETAS (2006). Threatened species of the Northern Territory, Black-footed Rock-wallaby, *Petrogale lateralis*. Compiled by Chris Pavey May 2006. Northern Territory Natural Resources, Environment, The Arts and Sport (NRETAS).

Department of Environment, Parks and Water Security (DEPWS) (2021). *Alice Springs Regional Weeds Strategy 2021-2026*. *https://depws.nt.gov.au/__data/assets/pdf_file/0003/291513/alice-springs-regional-weed-mgt-plan-2021-2026.pdf*

DEPWS (2021), NT Land Clearing Guidelines https://nt.gov.au/__data/assets/pdf_file/0007/236815/land-clearing-guidelines.pdf

GHD (2016a). Appendix M – Flora and Vegetation Report for the Nolans Project. Report prepared by GHD for the Nolans Environmental Impact Statement.

GHD (2016b). Appendix N – Fauna and Threatened Species Repor for the Nolans Project. Report prepared by GHD for the Nolans Environmental Impact Statement.

Low Ecological (2022), Preclearance Survey – Enabling Works, Bill Low, October 2022.

Geelen LJ (1999). A preliminary study of the black-footed rock-wallaby (Petrogale lateralis MacDonnell Ranges raxe) in the Anangu Pitantjatjara lands, South Australia. B.Sc (Honours) Thesis, University of Adelaide.

McAlphin S (2001). A Recovery Plan for the Great Desert Skink (Egernia kintorei) 2001-2011. Prepared by Steve McAlpin on behalf of the Arid Lands Environment Centre, February 2001.

McAlphin S, Duckett P, Stow A (2011). Lizards Cooperatively Tunnel to Construct a Long-Term Home for Family Members. PLoS ONE vol. 6, no 5.

Menkhorst P and Knight F (2011), A Field Guide to the Mammals of Australia. Oxford University Press. 3rd Edition, November 2011.

DSEWPC (2011a), *Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act 1999*, prepared by Commonwealth of Australia.

DSEWPC (2011b), *Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the EPBC Act 1999*, prepared by Commonwealth of Australia.

Woinarski J, Pavey C, Kerrigan R, Cowie I and Ward S (2007) *Lost from our Landscape: threatened species of the Northern Territory*. NT Government printer, Darwin.

DoEE (2020). Consultation Document on Listing Eligibility and Conservation Actions – Falco hypoleucos (Grey Falcon) https://www.dcceew.gov.au/sites/default/files/env/consultations/ad34afee-a901-4c94-8e71-654e9f15f29c/files/consultation-document-falco-hypoleucos.pdf

Falkenberg ID (2011). Aspects of the ecology of the Grey Falcon Falco hypoleucos in the South Australian arid zone. *Corella* 35:23-28.

10.0 APPENDIX A

ENVIRONMENTAL CONSULTANTS

EcOz



EcOz Environmental **Consultants** is the Top End's longest established locally-owned environmental consultancy. Formed in 1990 the company provides a broad range of environmental services to a diverse range of local, national and international clients.

We work closely with our clients to provide commercially **focused** rigorous and practical solutions to environmental matters whilst maintaining integrity in environmental practice. Our local team of 20 demonstrates we can deliver professional results in a timely manner whilst maintaining a personalised relationship with our clients.

Our technical expertise, first-rate safety and management systems, and demonstrated experience has us well placed to service your entire projects environmental requirements.

Our core areas of expertise suited to the Mining, Onshore Oil and Gas, Industrial and Agricultural Development Industries include:

- Environmental Impact Assessments, Environmental Management Planning, Monitoring and Auditing
- Ecology (Terrestrial and Aquatic) Baseline Studies, **Weed Surveys,** Threatened Species Assessments and Monitoring
- Surface and Ground Water Baseline Studies, **Water Management Plans and Water Quality Monitoring**
- **Land and Soils Investigations, Erosion and Sediment Control, Rehabilitation and Closure Planning and Monitoring Programs**

APPROVALS



ENVIRONMENTAL ASSESSMENTS AND MANAGEMENT

EcOz has extensive environmental assessment experience. We can manage the environmental aspects of a project from concept to completion.

We offer our client's relationship based professional support, advice and project management services to guide them through the environmental and regulatory approvals process. We maintain a solid working relationship with all levels of Government and are familiar with their systems and regulation. Our experience and stability of well-respected staff can help you navigate through complex legislative pathways to gain approvals in an efficient and effective manner.

We provide total environmental management, as well as auditing, monitoring and regulatory services to companies, departments and organisations.

SERVICES

- Project Approvals Strategies/Plans
- Environmental Impact Statement
- Risk assessment and management
- Petroleum and Pipeline Environmental Management Plans
- Construction Environmental Management Plans
- Mining Management Plans
- Land clearing and development applications
- Environment Protection Licences (NT listed waste approvals)
- Air and noise monitoring
- Compliance monitoring and reporting
- Auditing to ISO 14001

ECOLOGY



ECOLOGY, BASELINE STUDIES, THREATENED SPECIES ASSESSMENTS AND MONITORING

EcOz has the Northern Territory's largest team of consulting ecologists; all are experienced across a wide range of northern and central Australian bioregions and the corresponding flora and fauna of the region.

Our staff, projects and activities are permitted under the Parks and Wildlife Act and staff are registered animal handlers with ethics approvals under the *Animal Welfare Act*. We are fully equipped for safe and effective remote work and have up-to-date specialist vehicles, equipment, technology and safety and management systems.

SERVICES

- Project planning and environmental constraints analysis
- Baseline flora and fauna studies
- Threatened species surveys
- Vegetation surveys and mapping
- Land condition assessment
- Land type mapping and land capability assessment (for development applications)
- Weed and pest animal surveys and management plans
- Threatened species management plans and monitoring programs



CORE INDUSTRIES

Mining – from Exploration through to Closure

Onshore Oil and Gas

WATER



SURFACE AND GROUND WATER

EcOz can manage your water-related requirements, with specialist capabilities in surface and groundwater assessments and sampling in a variety of industries and locations in northern Australia. We have many years of experience in water quality assessment, monitoring and management, including an in-depth knowledge of the specific regulatory requirements.

We have the capability to cover all aspects of water quality for a given project, such as surface and groundwater baseline water quality assessments and routine monitoring, mine water balances, biological monitoring, and investigative monitoring and reporting.

SERVICES

- Baseline surface water and groundwater assessments
- Aquatic ecology surveys
- Water quality monitoring
- Marine monitoring programs
- Incident response sampling and assessments
- Water Management Plans
- Waste Discharge Licences
- Water Extraction Licences

LAND & SOILS



LAND ASSESSMENT, MONITORING AND REHABILITATION

EcOz can manage your site assessment, monitoring, rehabilitation and closure requirements. EcOz prides itself on delivering effective, economical and compliant land remediation and rehabilitation solutions. We have worked closely with a number of mining, commercial and infrastructure clients to deliver successful land remediation plans and rehabilitation outcomes. Our experience incorporates the project planning phases, statutory approvals, implementation and monitoring.
Our technical expertise, first-rate safety and management systems, and demonstrated experience have us well placed to service your land assessment, monitoring and rehabilitation requirements.

SERVICES

- Site contamination assessments and validation reports
- Baseline soil studies to support mine closure planning
- Land Capability Assessments for wastewater and irrigation
- Acid Sulfate Soils assessments and management plans
- Certified Erosion and Sediment Control Plans
- Rehabilitation Plans
- Mine Closure Plans
- Rehabilitation monitoring



LOCAL
CONNECTED
EXPERIENCED

OTHER CAPABILITIES

Other areas of capability include:

- Land tenure, acquisition advice and due diligence
- Planning and development approval advice
- Air, dust, noise, insects and other general monitoring activities
- Community Consultation (including Indigenous stakeholders)
- Community Benefit Programs and Environmental and other Offsets
- Spatial Information and Mapping (GIS)

EcOz



PEOPLE AND CONTACTS

EcOz's management team contacts are provided below. Full CVs can be sent on request.

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Tom Reilly

MANAGING CONSULTANT – ALICE SPRINGS

CAREER OVERVIEW:



Tom has worked as an ecological consultant in Alice Springs and Darwin since 2002. In this time, he has gained ecological expertise from habitats and species extending from the central deserts to the Top End, and as such, is well recognised by government authorities (i.e. DEPWS) in providing high quality reports for impact assessments or biodiversity monitoring projects.

Tom specialises in threatened species surveys and assessments, biodiversity surveys, vegetation / habitat mapping and weed surveys; and is often tasked with leading technical ecological studies required to inform environmental impact assessment (or equivalent environmental approvals). He also has expertise in water and soil sampling and assessment, sediment and erosion control plans, and is highly proficient in GIS mapping.

AREAS OF EXPERTISE:

Project management I Environmental impact assessment I Flora & fauna surveys I Threatened species assessment I Environmental risk assessment I EPBC referrals I GIS Mapping (ArcMap) I Weed survey I Rehabilitation monitoring

QUALIFICATIONS:

Bachelor of Science in Natural Resource Management (Hons) – University of Western Australia

PROFESSIONAL AFFILIATIONS:

Environment Institute of Australia and New Zealand (currently a committee member & Treasurer for the NT Division)

ECOZ PROJECT EXPERIENCE:

- Targeted surveys for Central Australian Rock-wallaby for proposed gravel, access and magazine tenure associated with the Nolans Rare Earths Project (2024). Arafura Resources Limited
- Biodiversity monitoring for the Nolans Rare Earth Project, including development of methodology and field surveys for Great Desert Skink, Central Australian Rock-wallaby and predator species (cats, dingo and fox) (2023/24). Arafura Resources Limited
- Preparation and advice for the Nolans Rare Earths Project Biodiversity Management Plan (2023). Arafura Resources Limited
- Pre-Clearing surveys for Great Desert Skink (and weeds) for proposed vegetation clearing associated with the Nolans Rare Earths Project (2023). Arafura Resources Limited
- Ecological Survey of the revised alignment of the Zevon Testline, including targeted surveys for Princess Parrot and Grey Falcon (2023). Central Petroleum
- Weed survey for the Dukas 1 (2023). Santos
- Environmental audit and assessment mineral exploration at Hatches Creek, including targeted checks for including Black-footed Rock-wallaby (2023). Tungsten Mining
- Environmental and safety audit of legacy mines in the Alice Springs and Harts Range region (2023). DITT
- Greater Bilby survey and land type mapping of ancillary infrastructure associated with the Australian ASEAN PowerLink Solar Project on Powell Creek Station (2022). SunCable
- Ecological survey and assessment of proposed well pads at Mereenie Oil and Gas Field, including threatened species habitat surveys and likelihood of occurrence assessments, including Black-footed Rock-wallaby (2022). Central Petroleum
- Ecological survey and assessment of the proposed Rover 1 Gold Mine, including targeted Greater Bilby surveys (2021). Castile Resources

- Ecological survey and assessment (and associated Environmental Management Plan) for the proposed Wiso Basin 2D Seismic Exploration Program, including targeted surveys for Greater Bilby, and habitat assessments for Grey Falcon, Purple-crowned Fairywren and Gouldian Finch (2021). Blue Energy
- Ecological survey and assessment of the Zevon seismic project, including land type mapping and threatened species habitat mapping including Black-footed Rock-wallaby (2021). Central Petroleum
- Greater Bilby surveys for sand exploration project on Murranji Station (2021). Territory Sands
- Ecological Survey of the Zevon Testline, including targeted surveys for Princess Parrot (2021). Central Petroleum
- Weed and environmental audit of the Pine Gap Powerline (2021). Yurika
- Ecological assessment of the proposed seismic exploration project on EP134 (2021). Peak Helium
- Great Desert Skink surveys for Tjukarru Road upgrade project (2021). DIPL
- Rehabilitation surveys of seismic exploration on EP105 (2021). Santos
- Ecological reconnaissance survey of the proposed Maurentania Mine, including vegetation and threatened species likelihood of occurrence assessment (with some Greater Bilby targeted survey) (2020). Tennant Creek Consolidated Mining Group
- Targeted surveys for Eremophila prostrata (threatened plant) (2020). DIPL
- Baseline ecological studies and assessment for the Australian ASEAN PowerLink Solar Project on Powell Creek Station, including land type / vegetation mapping and targeted threatened species surveys for Greater Bilby, Gouldian Finch, Grey Falcon, Floodplain Monitor (2020). SunCable
- Groundwater Dependant Vegetation survey on Singleton Station (field work only) (2020). GHD
- Ecological assessment for the proposed Arumbera Industrial Development, including land type / vegetation mapping and targeted survey for Slaters Skink (threatened species) (2020). DIPL
- Ecological assessment for Yulara Hybrid Power Station Development Application (2020), including targeted surveys (fauna tracking) for Brush-tailed Mulgara and Great Desert Skink; and vegetation mapping. Territory Generation
- Ecological assessment for conventional gas exploration, including threatened species surveys and vegetation mapping (2020). Central Petroleum
- Flora and fauna surveys at Alice Springs Airport in 2009, 2014 and 2019. Northern Territory Airports Pty Ltd.
- Flora and fauna surveys at Darwin International Airport in 2008, 2009 and 2014. Northern Territory Airports Pty Ltd.
- Threatened species surveys and vegetation mapping for the Roper Valley Iron Ore EIS, including Ghost Bat and Gouldian Finch (2018). NT Iron Ore
- Rehabilitation assessment of restored seismic line associated with the Southern Amadeus Project (2018). Santos
- Ecological assessment of the Dukas 1 conventional well site (2018). Santos
- Ecological assessment for Ammaroo Phosphate Project – Central Australia, NT (2017), including habitat mapping, targeted threatened species surveys (for Greater Bilby, Brush-tailed Mulgara, Grey Falcon and Great Desert Skink), habitat suitability assessment for Southern Marsupial Mole, weed surveys and sensitive vegetation assessment. Verdant Minerals
- Land condition surveys for Territory Conservation Agreements (Montejinni Station & VRD Station (2017). TNRM
- Rehabilitation assessment of Lethbridge and Andranangoo mine areas on the Tiwi Islands (2017). MZI Resources
- Ecological assessment for the Northern Gas Pipeline (2016), including vegetation, land type mapping and weed surveys, targeted threatened species surveys for Greater Bilby, Brush-tailed Mulgara, Latz's Grass, Tobermorey Melon; and Habitat suitability assessments for Grey Falcon and Plains Death Adder. Jemena
- Biodiversity Assessment, focusing on Threatened Species, RAAF Delamere Range Facility (2015). AECOM
- Baseline ecology surveys for the proposed Esmeralda Gold Project, Pine Creek, NT (2015). NT Mining Operations
- Finniss River Biodiversity Monitoring Project (2015). Territory NRM
- Environmental approvals for the Tiwi Islands Mineral Sands Project (Andranangoo, Lethbridge West, Lethbridge West) (2008 to 2014). MZI Resources

- Flora and fauna surveys for the Noonamah Ridge Sustainable Village Project (2013). Intrapac Property
- Baseline ecological studies for the SupleJack Gold Project, Tanami region, NT (2013). Ord River Resources
- Baseline ecological studies for the Twin Bonanza Gold Project, Tanami region (2012/13). ABM Resources.
- Flora and fauna surveys for road works approvals, Big Horse Creek VRD, NT (2012). Dept of Infrastructure.
- Environmental Assessments for mining exploration activities in the Simpson Desert, NT (2011). Tristar Petroleum
- Baseline Flora and Fauna Studies for Rover 1 Exploration Decline in 2011 – Tennant Creek, NT. Westgold
- Regional Biodiversity Monitoring for Defence Estates NT/K region, including Yampi Sound Training Area (WA), Bradshaw Field Training Area (NT) and Delamere Range Facility (NT) (2010). Spotless
- EIS and Baseline Flora and Fauna Studies for Redbank Copper Mine Expansions 2009. Redbank Copper Ltd.
- Fauna recovery from pipeline construction trench, Bonaparte Gas Pipeline (2008). AJ Lucas Pty Ltd.
- Flora and Fauna Surveys Muirhead Defence Housing Estate in 2008. Connell Wagner

TRAINING AND PROFESSIONAL DEVELOPMENT:

- Current First Aid Certification
- Side by Side Vehicle Certification
- 4WD Certification
- Animal Ethics Certification
- White card
- Weed certification course
- Snake handling course

WASTE MANAGEMENT PLAN

Document No: ARMS-0000-H-PLN-N-0007 Rev 2

Project Name: Nolans Rare Earths Project

REVISION HISTORY

Date	Description	Prepared	Reviewed	Approved
May 2025	Rev 2	Y. Smythe McGuinness, S. Environmental Scientist	G. Calderon, Environmental Scientist	D. Jordan, Manager Environment
July 2022	Rev 1	Michael Robinson, ESG Manager	Michael Robinson, ESG Manager	Stewart Watkins, GM Projects
August 2021	Rev 0	Michael Robinson, ESG Manager	Brian Fowler, GM NT & Sustainability	Stewart Watkins, GM Projects

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1.0 INTRODUCTION

1.1 Background

The Nolans Rare Earths Project (the Project) is located approximately 135 km northwest of Alice Springs in the Northern Territory (NT). The Project is owned and operated by Arafura Rare Earths Limited (also incorporated as Arafura Nolans Project Pty Ltd) (the Company, or Arafura). The Project targets the Nolans Bore mineral deposit for rare earth elements.

Project activities will include earthworks and construction, mining, processing, rehabilitation and decommissioning of an open-cut, rare earth mine, and its associated infrastructure. The Project site comprises five main areas linked by access roads, which includes: the mine site, explosives magazine, processing plant, accommodation village, and borefield areas.

1.2 Purpose

This management plan has been developed to outline how waste will be managed at the Project site to reduce and mitigate potential environmental risks arising from waste generation, handling, storage, and disposal. Including the approach and management hierarchy to be used in decision making and Project management.

This document is an integral part of the Project's Environmental and Social Management System (ESMS). It is a dynamic document, a receptacle for information which is to be reviewed annually (or as determined by regulatory or other requirements) and updated where changes are required. This cycle of continual improvement enables an accurate reflection of the current operational requirements and practices while allowing for responsiveness to conditions, input from stakeholders, and flexibility in planning and prioritisation.

All referenced Company policies, standards, registers, operational procedures, activity specific documents, forms and templates are stored and accessible from Arafura's ESMS.

1.3 Objectives

This management plan aims to prevent potential environmental impact from waste by outlining the measures that will be taken to:

- Avoid/Reduce the amount of waste produced by Project activities;
- Optimise recycling and reuse of wastes wherever feasible;
- Appropriately identify and characterise waste streams;
- Appropriately sort and store wastes according to type;
- Ensure appropriate disposal pathways are identified for each waste type;
- Ensure on site disposal is sited, designed, and maintained appropriately;
- Ensure transport of waste offsite is managed appropriately.

The key waste management objective, target, and Key Performance Indicator (KPI) are outlined within Table 1—1 below.

Table 1—1 Mitigation Objectives

Objective	Target	KPI
Prevent environmental impact from waste generation	Zero environmental incidents associated with the landfill and waste collection sites.	Number of incidents which occur in relation to the landfill and waste generation sites.

1.4 Responsibility

It is the responsibility of Arafura's environment team to develop and review this plan; and to monitor its implementation and effectiveness on site.

It is the responsibility of the site operations team to oversee and manage the activities required on site to implement this plan.

1.5 Legislation and Guidelines

The Project is obliged to comply with all relevant environmental legislation and regulatory requirements.

Of most relevance to the management of waste at the Project site are:

- *Environment Protection Act 2019* (NT)
- *Waste Management and Pollution Control Act 1998* (WMPC Act) (NT) (although does not apply to a contaminant or waste resulting from a mining activity)
- *Soil Conservation and Land Utilisation Act 1969* (NT)
- *National Waste Policy: Less waste more resources* (Commonwealth Government 2018)
- *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory* (NT EPA Guidelines 2013).

Within the Project area approvals for waste management and landfill planning are being managed under the Environment Protection Act 2019 through the environmental licensing regime, as described within the Project's *Mine Management Plan* (NRE-0000-O-PLN-O-0001) (MMP).

2.0 APPROACH TO WASTE MANAGEMENT

A risk-based approach is being taken to manage the potential impacts of waste resulting from Project activities. As outlined within the below section, the potential environmental impacts arising from Project activities related to waste have been identified; mitigation measures identified to manage these risks; and an ongoing Trigger-Action-Response Plan developed to ensure continual improvement of waste management at the Project site.

2.1 Potential Environmental Impacts

The key potential environmental impacts arising from Project activities in relation to waste management are outlined within Table 2—1 below.

Risk identification and assessment of the potential impacts has been further detailed within Arafura's broader Environmental and Social Risk Assessment, which is reviewed and updated on a regular basis.

Table 2—1 Key Potential Environmental Impacts arising from Waste Management on site

Activity	Potential Environmental Impact
Operation of onsite landfill	If the landfill is inappropriately sited or designed: ▪ Production of leachate leading to groundwater contamination ▪ Erosion and surface release of contaminants during rainfall events ▪ Excessive release of methane gases ▪ Cause of unpleasant odours.
Storage of waste	If waste is left uncovered and inappropriately stored: ▪ Attracts and provides a food source for pest species, leading to an increase in their occurrence and population numbers on site, such as cats, dingos, etc. ▪ Impacts to native fauna from increased pest numbers, such as predation and competition for food and habitat.
Storage of hazardous waste	If hazardous waste is inappropriately stored, transported, or disposed: ▪ Leading to uncontrolled release of hazardous substances and contamination of any of the below: • Soil/sediment • Surface water • Groundwater • Surrounding flora and fauna ▪ Causing an increased fire risk ▪ Impacting human health. This could include chemically or radioactively hazardous wastes with varying levels of consequence.

2.2 Mitigation Measures

Mitigation measures have been identified, as shown in Table 2—2 below and further detailed throughout this plan, which will be implemented on site to minimise the potential environmental risks identified. The timing and responsibility for implementation are also outlined. The waste hierarchy is also used to guide the planning and management of wastes and reduce risks, as outlined within Section 4.0 below.

Table 2—2 Mitigation Measures

Mitigation Measure	Timing	Responsibility
Site Induction		
Site inductions will include the following specific waste management components: ▪ Waste management hierarchy ▪ Identification of waste types (classification) ▪ Waste collection, storage, handling, and transport requirements ▪ Safe work practices (particularly in relation to radioactive and hazardous wastes) ▪ Waste collection and disposal locations on site.	Site Induction	All personnel
Waste Hierarchy		
A waste hierarchy will be implemented on site including: ▪ Avoid and Reduce ▪ Reuse, Recycle and Recover ▪ Treatment ▪ Disposal.	At all times	All personnel
Hazardous Wastes		
Waste oils are to be stored in permanent waste oil tanks located at the vehicle workshops and are to be removed from site by a suitably licenced contractor.	As required	Environmental Officer Supply Officer
Hazardous substances are to be stored a minimum of 10 m away from drainage lines.	At all times	Environment Manager
Spill kits are to be located at all hazardous substance storage locations. Spill kits are to be available for relocation to specific areas in accordance with scopes of work.	At all times	Area Managers
Regular inspections of hazardous substance storage locations and workshops are to be conducted to ensure spill kits are present and contain sufficient materials for potential spillages. Inspections are also required to ensure housekeeping and compliance with HSE requirements.	Monthly or as required when operations begin	Safety and Environmental Officers
In the event of a spill, the spill management procedure within the *Emergency Response Management Plan* (ARMS-0000-H-PLN-H-0001) must be followed.	At all times	All personnel

Mitigation Measure	Timing	Responsibility
Hazardous waste will be disposed of within appropriately designed facilities on site where safe and appropriate to do so (e.g. the Residue Storage Facility (RSF)). Only authorised personnel will be responsible in handling hazardous materials.	At all times	Environmental Officer Supply Officer
Where not safe to dispose on site, hazardous waste will be transported from site by appropriately licenced contractor(s) and disposed of within licenced facilities. Certificates of disposal must be supplied by waste disposal contractors, and recorded within Arafura's ESMS.	At all times	Environmental Officer
General		
Waste will be segregated at each area of generation, managed before disposal.	At all times	All personnel
Recyclable materials are to be stored at the landfill storage yard and/or waste collection points and removed from site as required.	As required	Environmental Officer Supply Officer
Litter sweep of the Landfill at monthly intervals required to collect any windblown waste.	Monthly	Environmental Technician
The active landfill area will be fenced with feral animal-proof fencing and access gates will be kept closed when not in use. This will minimise windblown waste and access by feral animals. Putrescible waste will be covered following disposal into the landfill. Landfill trenches will be covered once filled, and progressively rehabilitated.	At all times	All personnel
Inspection and Monitoring		
Monthly landfill inspection and litter sweep as required. Record keeping and reporting of quantities of waste kept on site and sent off site.	Monthly	Environmental Technician
Perform audits of third-party waste management facilities and contractors as appropriate to verify compliance with legislative and contractual requirements, including adherence to this and associated management plans.	As required	Environmental Officer
Management Plan Review		
Waste Management Plan performance review as part of the annual MMP compliance reporting.	As required	Environment Manager

2.3 Trigger, Action, Response Plan

The Trigger, Action and Response Plan (TARP) outlines remedial actions and responses to the situation. The levels of incidents and TARP are provided in Table 2—4 below.

Table 2—3 Trigger, Action and Response Plan

Trigger	Action	Response
Landfill and waste collection sites containing wastes attracting vermin/pests.	1. Complete routine inspections of landfill and waste collection sites. 2. Litter sweep as required.	Environment Manager to continue standard monitoring as per this management plan. Implement a pest control in identified areas as required.
Waste incorrectly disposed of resulting in potential cross contamination of other wastes.	Remove and segregate according to waste classifications outlined in Section 3.	1. Environment Manager to continue standard monitoring as per this waste management plan. 2. Investigate the source of any incorrect handling and/or contamination. 3. Introduce control measures as required.
Spill of hazardous waste causing environmental harm.	Response as outlined in the *Emergency Response Management Plan* (ARMS-0000-H-PLN-H-0001). Generally: 1. Isolate and contain the spill utilising the spill kit if safe to do so. 2. Evacuate from the area if potential danger. 3. Notify Emergency Response Team Coordinator. 4. Monitor and determine if spill kit response has been effective in containing and managing spill. 5. Undertake remediation recommendations as required. 6. Conduct regulatory reporting as required.	Conduct an incident investigation as per the Environmental event procedure (Incident, Non-compliance and Hazard) (NRE-0000-H-PRO-N-0002). Review this plan and emergency response planning for any changes that need to be made as per the learnings from the spill. Introduce controls as required, including regular inspections to storage areas.

3.0 WASTE CLASSIFICATION

All waste generated within the Nolans Project shall be classified into the below categories.

- **Radioactive Waste:** Waste materials containing radioactive substances or contaminated with radioactivity (e.g. through prolonged contact with ore). This can be liquid or solid. Radioactive waste must be treated in accordance with the Arafura *Radiation Protection and Waste Management Plan* (NRE-0000-H-PLN-H-0004). Where radioactive waste is mixed with other waste, it must be classified as radioactive waste.
- **Controlled Waste**: Any type of waste with a unique regulatory requirement such medical waste, asbestos, waste tyres and special waste listed under an NT EPA gazettal notice. This includes listed wastes specified in Schedule 2 of the NT *Waste Management and Pollution Control (Administration) Regulations 1998* ('listed wastes'). Where special waste is mixed with other waste, it must be classified as special waste.
- **Hazardous Waste:** this category encompasses materials with the potential to cause harm to persons or the environment. Hazardous wastes can be liquid or solid. This category encompasses containers that previously held hazardous substances classified under the Transport of Dangerous Goods Code, as well as specific waste types such as coal tar, coal tar pitch, lead-acid and nickel-cadmium batteries, lead paint waste, hydrocarbons, toxic chemicals, and any mixtures of these materials. The classification of dangerous goods must be undertaken considering the Australian Dangerous Goods Code. Where hazardous waste is mixed with other waste, it must be classified as hazardous waste.
- **Putrescible Waste:** refers to any type of waste that undergoes organic decomposition, such as household waste and food waste. As well as consolidated treated solid wastes (biosolids) remaining at the end of the wastewater treatment train.
- **General Waste:** refers to any type of waste that has not been classified under any of the other categories. This includes materials such as glass, plastic, metal, paper, cardboard, wood waste, building and demolition waste, plastics, etc. as well as any mixtures of these materials.

  This type of waste can be further classified as either recyclable (including e-waste and batteries, plastics, cardboard and paper where a recycling service provider is available), or non-recyclable waste.

A diagram depicting the process of waste classification is shown within Figure 3—1 below. Once a waste has been classified, it must then be managed accordingly.

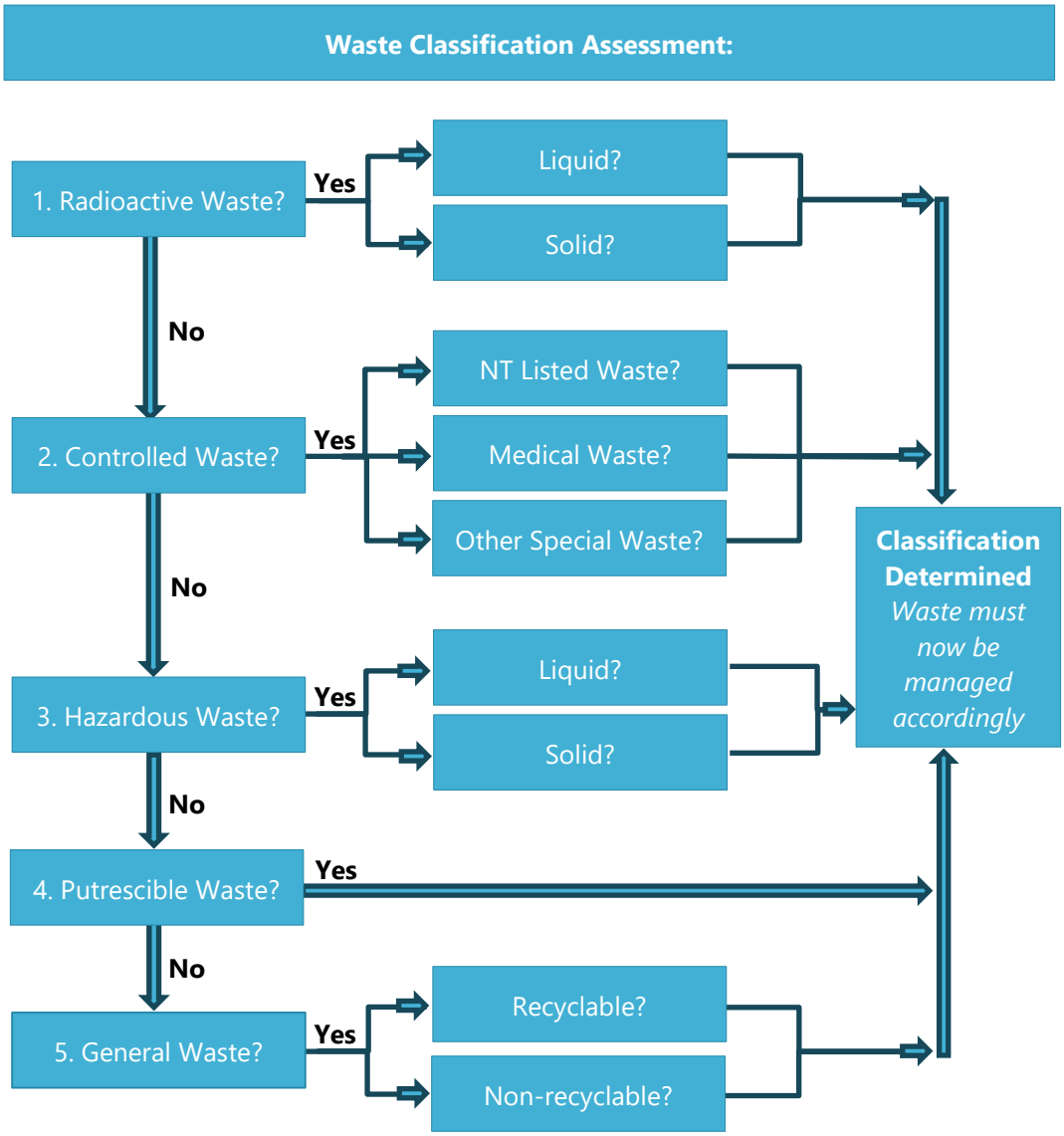


Figure 3—1 Waste Classification Assessment Process Diagram

4.0 WASTE MANAGEMENT HIERARCHY

All waste generated from Project activities will be managed in accordance with the hierarchy of control outlined in the *National Waste Policy* (Australian Government 2018), as shown in Figure 4—1 below. A description of how the hierarchy will be applied is described in Sections 4.1 – 4.5 below.

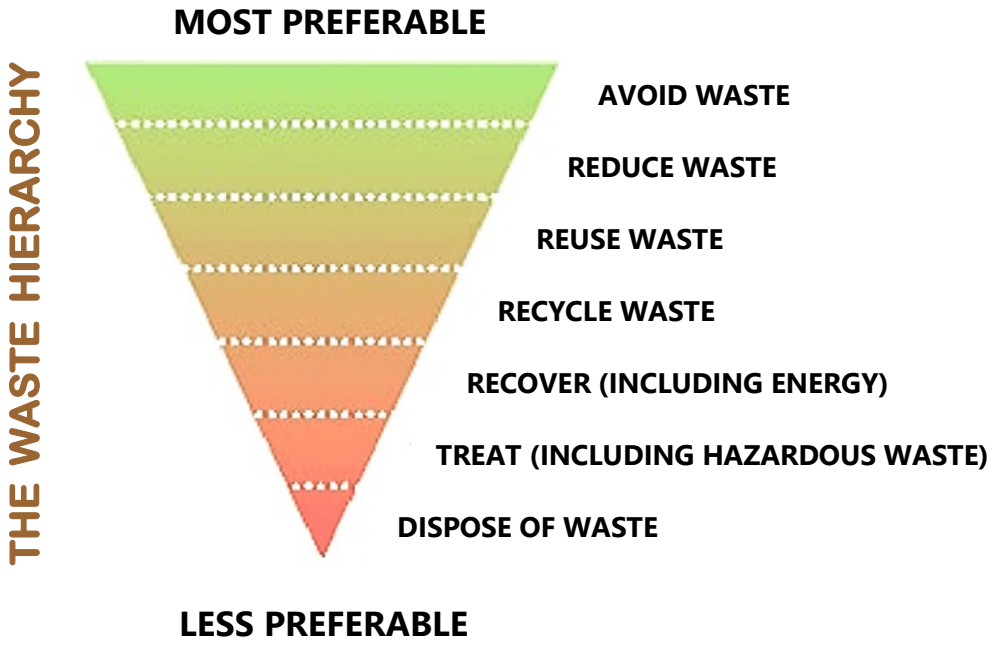


Figure 4—1 The Waste Hierarchy (Source: National Waste Policy, Australian Government 2018)

4.1 Avoid and Reduce

Waste generation shall be avoided during the design phase and by adopting procurement strategies aimed to prevent waste. The following waste management strategies and practices will be adopted:

- Selecting suppliers that prioritise sustainable practices and are environmentally friendly.
- Selecting products/materials that create less waste (including packaging), less hazardous waste, and/or are biodegradable.
- Establishing procurement practices that identify opportunities to return usable materials, while also preventing excessive ordering of supplies.
- Reducing consumption by choosing products with minimal packaging. For example, opting for bulk purchases to reduce packaging waste.
- Conducting a risk assessment for materials to be brought into the Project and their potential waste. This assessment should be integrated into the supplier or contract process and should include a list of pre-approved Waste Management Contractors, the contractor's waste management obligations, licensing and certification records, and any other relevant information.
- Opting for durable products to reduce the need for frequent replacements.
- Embracing digital solutions whenever possible to avoid the use of paper.

- Enforcing rigorous waste segregation practices to ensure that different waste types are kept separate to avoid contamination of materials.
- Planning meals and shopping to avoid purchasing excess food that may go to waste and maintain inventory controls.
- Promoting awareness about proper waste treatment practices among the public and businesses to encourage responsible waste management and treatment methods.
- The Waste Management Performance Standard within the *Arafura Environmental and Social Performance Standards* (NRE-0000-H-STD-N-0002) document is to be issued during the contracting process, to form part of the environmental requirements applicable to all contractors.

4.2 Reuse, Recycle and Recover

Reuse refers to the alternative of incorporating a material or waste into the supply chain requiring a minimum treatment and without reprocessing. Recover may involve reprocessing prior to use. Recycling involves processing waste materials to create new products. Reuse and recovery of waste streams will be undertaken for incorporation into the supply chain as much as possible. Recycling of waste will be prioritised where service providers are available. The following waste management strategies and practices will be adopted:

- As much as possible and where safe to do so, reuse and repair items to extend their lifecycle before discarding them.
- Repurposing waste materials where an alternative use is identified, and it is feasible and safe to do so.
- Donating materials to community organisations where they can be reused
- Adopting material separation by sorting recyclables from general waste.
- Disposing of waste through local or national recycling and reuse programs where they are available (e.g. e-waste).
- Consider composting of putrescible waste when feasible to do so, for use as a garden fertiliser on site.

4.3 Treatment

Treatment refers to the processes applied to materials before their disposal in landfills or through other methods when recovery is not possible. The following waste management strategies and practices will be adopted where applicable and safe to do so onsite; otherwise, offsite by a service provider:

- Sorting, shredding, and compacting waste to reduce its volume and facilitate reuse or further treatment.
- Utilising chemical reactions to neutralise harmful components in waste. This can include processes such as oxidation, reduction, and neutralization to make waste less hazardous. This will be applied through bioremediation of hydrocarbon contaminated soils.
- Treating hazardous waste to immobilise contaminants, making it safer for disposal.

- Ensuring proper landfill design with systems to manage leachate and gas emissions, minimising environmental impact.

4.4 Disposal

Disposal refers to the final, least preferred waste management option. The following waste management strategies and practices will be adopted:

- Off-site waste disposal must be carried out by a licensed handler at a licensed facility.
- Prioritising recycling of recyclable general wastes whenever a local service provider is available.
- All waste taken offsite must be appropriately contained for transportation in accordance with the relevant guidelines, and the distance travelled limited as much as possible, to avoid spills.
- On-site waste disposal must be conducted in Arafura's landfill in full compliance with local regulations.

5.0 WASTE STREAMS

Understanding the types of waste generated by the Project is essential for effective site waste planning and management. This includes understanding the classification, source, type, and quantities of waste produced. The waste management hierarchy can then be applied.

Some of the waste streams anticipated from Project activities have been identified, as shown in Table 5—1 below. Including their anticipated waste classification under normal circumstances, and common source of generation.

Initial estimates of anticipated waste volumes for each key category have been calculated for the Project, and the waste management options planned accordingly.

Further detail of estimated waste streams and volumes will be generated during the detailed design phase of the Project, and actual waste streams and volumes will be recorded once site activities recommence. To continue to better understand the anticipated waste streams and determine how best to manage them.

Table 5—1 Anticipated waste streams from Project activities

Waste Classification	Waste Stream	Source of Generation
Radioactive Waste	▪ Overburden and waste rock ▪ Mill balls ▪ Conveyor belt and mill liners ▪ Wastewater from the controlled area showers with radioactive characteristics ▪ Mine drainage ▪ Process water and slurry.	▪ Mining operations and processes (e.g. drilling, ore extraction, crushing and grinding, concentration/ beneficiation) ▪ Wastewater and mine water drainage systems ▪ Process plant outputs.
Controlled Waste	▪ Medical and related waste: ▪ Biomedical waste (e.g. used first aid materials, dressings, etc.) ▪ Cytotoxic & other pharmaceutical, medicine, or medical drug waste ▪ Needles and sharps.	▪ Medical assistance and first aid ▪ Self-administered medications.
	▪ NT 'listed wastes' such as asbestos and tyres.	▪ Historical asbestos buildings, etc. ▪ Vehicles (LVs and HVs), maintenance and equipment workshops.

Waste Classification	Waste Stream	Source of Generation
Hazardous Waste (solid)	▪ Empty containers that previously held hazardous substances or dangerous goods, from which residues have not been removed by washing (e.g., chemical containers/drums, etc.) ▪ Bulka bags from bulk reagents (flocculant, magnesia, barium chloride, oxalic acid) ▪ Oily rags, oil filters, soils & sludges contaminated by hydrocarbons etc. ▪ Vehicle and plant batteries ▪ Nano filtration tubes, pipes and maintenance items from the Processing Plant.	▪ Pest and weed control activities ▪ Processing plant ▪ Maintenance & equipment workshops.
Hazardous Waste (liquid)	▪ Pesticide and herbicides.	▪ Pest and weed control activities.
	▪ Lubricant and fluids (e.g. hydraulic fluids) ▪ Hydrocarbon waste (e.g. motor oils).	▪ Vehicles and plant ▪ Maintenance & equipment workshops.
	▪ Grease-trap waste, cooking oils, etc.	▪ Accommodation village kitchen.
	▪ Paint waste.	▪ Building maintenance and renovation areas.
Putrescible Waste	▪ Household organic waste ▪ Food waste, including animal waste ▪ Garden green waste (e.g. leaves, branches, and other garden debris) ▪ Sewerage and biosolids ▪ Paper and cardboard waste (where not recyclable/clean).	▪ Kitchen, rooms, and gardens at the accommodation village ▪ Offices and other site buildings.
General Waste (Recyclable)	▪ Electronic waste (e-waste) or discarded electronic devices or equipment such as: • Mobile phones and accessories • Nickel-cadmium and rechargeable batteries (e.g., lithium-ion batteries) etc. • Computer equipment (e.g., laptops, monitors and projectors) • Computer parts (keyboards, mouses, hard drives, memory cards, web camaras, etc.) ▪ Printers, scanners.	▪ Offices.
	▪ White goods (e.g. fridges, microwaves, etc.).	▪ Accommodation Village ▪ Offices and other site buildings.

Waste Classification	Waste Stream	Source of Generation
	▪ Office waste • Toner and printer cartridges • Light bulbs. ▪ Small batteries.	▪ Offices.
	▪ Plastic containers ▪ Aluminium cans ▪ Glass bottles and jars ▪ Paper and cardboard.	▪ Accommodation village ▪ Offices and other site buildings.
	▪ Scrap metal, steel.	▪ Building construction areas.
	▪ Vehicle and machinery batteries.	▪ Maintenance & equipment workshops.
General Waste (liquid)	▪ Sewage ▪ Grey water ▪ RO brine discharge.	▪ Toilets at the accommodation village and offices ▪ Showers, sinks, and kitchens at the accommodation village and offices ▪ Discharge from the wastewater treatment system ▪ Discharge from the reverse osmosis water treatment system.
	▪ Wash down water from maintenance & equipment storage areas ▪ Vehicle wash-down bays.	▪ Drainage systems around maintenance & equipment storage areas ▪ Drainage sumps located at vehicle washdown bays.
General Waste (Solid)	▪ Nanofiltration tubes.	▪ Water treatment systems.
	▪ Equipment parts.	▪ Maintenance & equipment workshops.
	▪ General rubbish (e.g. product packaging, cutlery, tetra packs, meat trays, plastic lids, sanitary & hygiene products, disposable razors and toothbrushes, or others with similar characteristics) ▪ Packaging materials and non-recyclable or contaminated items (plastic, plastic bags, plastic wraps, paper, cardboards, broken glass, mixed items) ▪ Old/ damaged clothing (e.g., non-contaminated safety clothes).	▪ Materials generated at the accommodation village, workshops, and offices.

Waste Classification	Waste Stream	Source of Generation
	▪ Construction debris (e.g., demolition waste, concrete) ▪ Synthetic fibre waste ▪ Asphalt waste.	▪ Construction areas. For example, from the batch plant, road construction, etc.

6.0 WASTE COLLECTION AND STORAGE

All waste generated on site shall be segregated and stored according to its waste classification, to facilitate appropriate management of each waste type.

Waste will be stored in containers, bins, or storage yards as appropriate to each waste type. Waste storage containers, bins, and yards are to be located in each work area according to the anticipated waste streams from each work area. This includes include the below work areas, there will likely be others at varying stages of Project development:

- Village area
- Mine office
- Processing plant area.

All storage yards must be clearly demarcated and signed according to the type(s) of waste to be deposited. Storage areas will be appropriately designed (e.g. lined, bunded, enclosed, and positioned), demarcated and signed for the type and volume of receiving waste. Operational procedures and controls will be established for storage areas to avoid environmental impacts and ensure compliance with regulations.

Waste storage containers and bins must be sized, labelled, colour-coded, and stored appropriate to the waste stream and anticipated waste volume, in accordance with the relevant guidelines. Such as AS 4123.7-2006 for Non-hazardous Waste; the Australian Dangerous Goods Code for Dangerous Goods; and the AS/NZS 3816 for Medical Waste. Waste shall be stored properly, with sufficient space between containers to facilitate inspections and monitoring and be away from incompatible materials or sources of contamination.

A waste collection schedule for each anticipated waste type will be prepared prior to commencement of site activities. Waste collection should occur regularly, as appropriate to their size and waste type, to avoid overfilling of bins. Waste must be transported to the appropriate designated storage, treatment, or disposal area on site.

A central waste storage and sorting yard will be located adjacent to the landfill area. Waste will undergo any necessary additional sorting and handling within the yard to allow for reuse or disposal on site, or preparation for transport offsite for recycling or disposal.

The site office will provide a facility map or site plan showing the demarcated waste storage and disposal areas, which must be easily accessible to all site personnel. Copies of the relevant Safety Data Sheets (SDS) for any anticipated hazardous waste streams must also be available at the site office. SDSs must meet the Safe Work Australia requirements and must be easily accessible to all personnel involved in the handling of hazardous substances, as well as emergency service workers.

Some of the requirements for waste collection and storage have been listed within Table 6—1 below according to waste classification. These are indicative of the storage requirements that will be implemented on site and will be further refined as the Project progresses.

Table 6—1 Waste collection and storage requirements according to classification

Waste Classification	Segregation and Storage Bins
Radioactive Waste	Radioactive material must be placed in the appropriate designated areas on site, e.g. within Waste Rock Dumps (WRDs) and RSF structures. Small components (e.g. contaminated processing parts) can be stored in secure, shielded containers if appropriate. The storage and management of radioactive wastes on site are further covered within the Arafura *Radiation Protection and Waste Management Plan* (NRE-0000-H-PLN-H-0004) including details of applicable guides and codes.
Controlled Waste	**NT 'listed waste':** Any of the wastes listed in Schedule 2 of the WMPC Regulations will need to be segregated as appropriate to the type of waste – e.g. tyres, asbestos, chemical wastes, explosives, etc. **Medical waste:** Medical waste shall be segregated into a specialised container located in the area where it is generated. For example, use of biohazard containers, such as sharp bins for needles and infected sharps waste. Colour-coding for medical waste containers: ▪ White/yellow container for any medical waste. ▪ Purple container for cytotoxic waste. ▪ Other medical waste, other than sharps, shall be collected and stored in plastic bags, and must be labelled according to the coding specified above. ▪ Sharps are to be placed in rigid-walled containers that comply with AS 4031 and AS/NZS 4261. The emptying, cleaning and disinfection of reusable sharps containers must be in accordance with AS/NZS 4478. Single use sharps containers must never be emptied, cleaned or reused. **Tyres:** Tyres will be temporarily stored within designated storage yard(s) within work areas, including the storage yard at the landfill area. These will be taken offsite for disposal by a licenced contractor.

Waste Classification	Segregation and Storage Bins
Hazardous Waste	Hazardous waste must be segregated by hazard class and stored in designated areas. The relevant safety information including SDSs must be readily available at each storage area. Storage areas must be bunded, well-ventilated and clearly demarcated and signed, as appropriate to the type of waste, and the relevant regulatory requirements. Containers must be appropriately labelled according to their type and hazardous nature in accordance with the Code of Practice for Labelling of Workplace Hazardous Chemicals, and must include the following information: ▪ the product identifier ▪ the name, Australian address and business telephone number of either the manufacturer or the importer ▪ a hazard pictogram and hazard statement that are consistent with the correct classification of the chemical ▪ any other relevant information (e.g. precautionary statements, relevant first aid and safety directions) ▪ Unknown waste products should be clearly labelled on the container, for example, 'Caution – do not use – unknown substance'. Hazardous storage containers or areas must have secondary containment systems to minimise the risk of environmental harm from spills and leaks. The net capacity of a bunded storage facility should be either (whichever is the largest by volume): ▪ 110% of the net capacity of the largest tank; or ▪ 25% of the combined total of all bunded containers. Where applicable, the construction of containment systems must comply with the relevant Australian Standard for the type of dangerous substances. For example, the storage and handling of combustible and flammable liquids must comply with AS 1940:2017, The Storage and Handling of Flammable and Combustible Liquids. Which includes requirements for storage areas to be covered and well-ventilated. Underground storage and piping of hazardous waste is not permitted on site. Entry to some hazardous storage areas shall be restricted to trained personnel only, e.g. some sections within the processing plant. Wash down water: water generated from vehicle wash down bays or maintenance and equipment storage areas will be treated as hazardous waste, due to the likelihood of containing contaminants such as hydrocarbons. Water will be collected within drainage sumps and contained for treatment.
Putrescible Waste	**Food and green waste:** Colour coding for bins is dark green or black body with lime green lid. **Sewage:** will be contained within sewage tanks and/or wastewater treatment plant for treatment. Treated water from the village area treatment train will be disposed of within the designated spray field. **Grey water:** will be contained within greywater treatment systems for treatment. Treated water may be disposed of within the designated spray field.

Waste Classification	Segregation and Storage Bins
General Waste	**Non-recyclable:** colour coding for general waste bins is dark green or black body with a red lid. Avoid the disposal of any waste shown below or similar:  **Recyclable:** materials will be stored in segregated areas, for collection and transport offsite for recycling by a licenced contractor. Segregation will be determined based on the contractor's requirements. Colour coding for co-mingled recycling bins is dark green or black body with a yellow lid. Colour coding for cardboard and paper bins is dark green or black body with a blue lid. Bins are to be labelled to avoid the disposal of any inappropriate wastes as shown below or similar:  **Recyclable (e-waste):** e-waste disassembled e-waste shall be collected and transported offsite for reuse by a licenced contractor. Designated and labelled containers to be placed in offices or at any other sources of generation to protect electronics from damage and prevent the leakage of hazardous materials. **Batteries:** recyclable batteries must be temporarily stored in a contained area to prevent any leaks or contamination of the environment in the designed areas, for collection and transport offsite for reuse by a licenced contractor. Non-recyclable batteries are to be treated as hazardous waste. **Construction materials:** are to be collected in bulk bins placed near the source of generation. For transport to the landfill storage yard for sorting, storage, or disposal.

7.0 WASTE HANDLING

All personnel involved in handling and transporting waste must wear appropriate personal protective equipment in accordance with Arafura's health and safety protocol. Including any specific safety requirements defined for each storage area, or applicable for handling a specific type of waste as required in the relevant safety data sheets (SDSs).

The personnel or workers handling and transporting waste must read the relevant SDSs and safety information prior to handling it, and ensure they understand the handling and safety requirements, potential hazards, and have any appropriate emergency response equipment easily accessible. Arafura and/or the responsible contractors must ensure that all personnel involved in the handling and transport of waste have undertaken the required training and inductions to enable them to carry out the task safely.

Hazardous waste handling and transportation must be conducted by authorised and trained personnel. Permits and licences are required for some types of special and hazardous waste. Detailed waste handling procedures will be developed to clearly communicate requirements for anticipated waste streams as the Project develops. Including the development of induction material, and identification of any training, permitting or licencing requirements. Further requirements for the handling of hazardous wastes are outlined within the *Hazardous Materials Management Plan* (ARMS-0000-H-PLN-H-0002) and the *Radiation Protection and Waste Management Plan*.

8.0 TRANSPORT OF WASTE

Onsite and offsite transportation shall be conducted in a manner that prevents accidental spills or release of waste. Transport of materials on site shall be in accordance with the Traffic Management Plan (NRE-0000-H-PLN-H-0013).

Radioactive materials are not to be transported offsite. Transport while on site shall be conducted in accordance with the *Radiation Protection and Waste Management Plan* (NRE-0000-H-PLN-H-0004), which includes the Radioactive Materials Transport Management Requirements and the Radiation Transport Management Procedure.

Vehicles must not exceed their load capacity, and containers must be properly loaded, secured and labelled in accordance with the relevant guidelines and regulations (i.e. the *Waste Management and Pollution Control (Administration) Regulations 1998*).

Requirements for managing spills during transportation are included in the *Emergency Response Management Plan* (ARMS-0000-H-PLN-H-0001) and the *Environmental and Social Performance Standards* (NRE-0000-H-STD-N-0002). These standards are provided to all contractors and form a contractual requirement for all contractors involved in the transport of waste.

All transportation loads taken offsite shall be accompanied by the appropriate manifest.

Waste licensing is required for the transportation of special and some hazardous wastes. If these activities are carried out by a third party, the Company must ensure they hold the appropriate licence(s).

Transportation of Dangerous Goods must be carried out according to the NT and Federal regulatory requirements. Refer to Section 1.5 above for the relevant legislation.

9.0 WASTE DISPOSAL

Appropriate waste disposal shall be determined based on the type of waste. Alternative options according to the waste hierarchy must be considered first. Waste disposal should be considered as the final option, only after assessing all other waste management alternatives within the waste hierarchy. Disposal is only to occur if a material cannot feasibly be otherwise reused, recycled, or recovered.

The following requirements apply to the disposal of waste:

- Waste disposal through a third party must be conducted by a licensed handler.
- NT 'listed wastes' must be handled by a listed licenced company in the NT.
- Certificates of disposal shall be provided by the services providers.
- Detailed operational procedures and controls will be established for waste treatment and disposal to prevent environmental impacts and ensure regulatory compliance.

Detailed planning for anticipated waste streams and disposal methods will be developed. A general guideline for planned waste disposal methods according to waste class is provided in Table 9—1 below. Detailed planning will be further progressed and refined as the Project develops and this plan becomes operational.

Table 10—1 Waste Disposal Methods

Waste	Disposal Method
Radioactive Waste	▪ Will be disposed of within designated facilities on site designed to hold such waste. This includes the WRDs and the RSF. Detailed design and operational planning will be undertaken prior to construction and use of these facilities. ▪ Radioactive waste must not be disposed of in Arafura's landfill.
Controlled Waste	▪ NT 'listed wastes' require specialised management and must be taken offsite for disposal by a waste handler licensed by the NT EPA, and disposed of within a licensed waste management facility. A full list can be found in Schedule 2 of the WMPC Regulations. ▪ Requirements for licensing will form a key contractual requirement for relevant waste handling service providers. ▪ Listed wastes must not be disposed of in Arafura's landfill.
Hazardous Waste	▪ Some hazardous wastes will be disposed of onsite, depending on the type of waste. Appropriately designed onsite facilities (this includes the RSF) are to be used for all onsite disposal. Detailed design and operational planning will be undertaken prior to construction and use of these facilities. ▪ Hazardous wastes are not to be disposed of in Arafura's landfill. ▪ Wastes not able to be safely disposed of on site, or not appropriate under regulatory or industry standards will be disposed of offsite. Any hazardous waste taken offsite must be transported by a licensed contractor, and disposed

Waste	Disposal Method
	of within a licensed waste management facility. ▪ Unused chemical containers can be returned to the supplier where possible. ▪ Empty chemical containers and remaining chemicals must be disposed of according to the label and safety data sheet instructions.
Liquid Waste	▪ Wastewater is to be treated and reused or disposed of onsite and will not be discharged offsite. ▪ Treated water can be reused on site for dust suppression or evaporated within the designated spray field or evaporation ponds.
Putrescible Waste	▪ On site disposal within the landfill facility. ▪ Composting food and green waste may be considered for reuse as a fertiliser on site.
General Waste	Where waste recycling services are available for general waste streams within a reasonable distance from site, this will be prioritised for these materials. Otherwise such wastes will be disposed of as per non-recyclable wastes. **Non-recyclable:** ▪ On site disposal within landfill wherever possible. ▪ Preference not to dispose offsite as much as possible. Any off-site disposal of general waste must be transported and managed by a licensed service provider at a licensed waste management facility, as locally as possible. **Recyclable:** ▪ Licensed contractors to collect and transport offsite to material recovery/ recycling facilities as locally as possible ▪ Dispose eligible recyclable containers through an approved NT collection depot ▪ Specialist construction and demolition recycling operators to be used for some materials, e.g. scrap metal ▪ E-waste, disassembled components that are recyclable shall be returned to the supplier or disposed of through an organisation or service provider approved under the National Television and Computer Recycling Scheme. A specialised recycling company will be engaged to remove e-waste from the mine site on an as-needed basis. Some components of e-waste are considered 'listed wastes' must be disposed through a NT EPA licenced transporter and handler.

10.0 MONITORING AND RECORD KEEPING

Regular monitoring will be undertaken of waste management activities and facilities, including the following:

- Regular inspections of waste segregation and collection practices to identify non-conformities and potential improvements aimed at reducing the volume of waste produced within the Project.
- Housekeeping and inspections of areas of waste generation, storage, and disposal. Check the effectiveness of storage areas for any spills or hazards.
- Regular inspections and general maintenance of hazardous substances storage areas. Ensure storage areas are properly demarcated and signed, and containers are appropriately labelled and stored.
- Routine checks of the emergency response systems to ensure they are in good working order, including fire extinguishers, spill kits, etc.
- Routine inspections and maintenance of environmental pollution control equipment, including monitoring stations.
- Regular environmental monitoring will be undertaken to ensure waste management controls are effective.

Records of waste management activities undertaken on site will be maintained, including the following:

- Records of all monitoring inspections and maintenance carried out are to be maintained within Arafura's Environmental and Social Management System.
- Records of the amount of waste collected at each area source of generation, including type, area of storage and final disposal.
- Up to date records of waste stored on site shall be maintained, including type, quantities, and location.
- Data and information on the waste streams generated at each source (including processes) will be maintained either by the contractors or by Arafura as appropriate. The collected data will include waste characterization, types, quantities, and potential for reuse or disposal.
- Requirements of the *Hazardous Materials Management Plan* (ARMS-0000-H-PLN-H-0002), the *Radiation Protection and Waste Management Plan* (NRE-0000-H-PLN-H-0004), and the *Environmental and Social Performance Standards* (NRE-0000-H-STD-N-0002) will be implemented and records maintained as stipulated in these related documents.
- Maintain waste tracking records of waste disposal offsite, including type, contractor(s) involved, and final disposal location(s). Where appropriate, certificates of disposal shall be provided by the services providers to Arafura upon completion.
- Waste tracking is required for special waste through transport to their final destination, both within the Northern Territory and across state borders. Tracking process shall be completed by the licenced handler through the *EPA Online system*, and a copy of the waste tracking certificates shall be provided to Arafura.

- Dangerous goods must be stored, transported, and disposed of in accordance with NT and Federal regulations, as well as the NT SafeWork guidelines and the Australian Dangerous Goods Code. This includes implementing procedures for transport emergencies, such as an Emergency Response Plan and other necessary requirements.
- Arafura will conduct regular audits of engaged organisations/contractors/service providers involved in waste management, to ensure compliance with legislative and Arafura requirements.

11.0 REVIEW AND IMPROVEMENT

Waste management will undergo continuous improvement driven by regular review, assessment, process evaluation, and any changes in Project requirements. Waste generation will be assessed at all levels of the supply chain and production chain to identify opportunities for product substitution, reduction of waste, and reuse.

Waste management records will be regularly reviewed to ensure effective waste management practices are being implemented in accordance with this document, the *Hazardous Materials Management Plan* (ARMS-0000-H-PLN-H-0002), the *Radiation Protection and Waste Management Plan* (NRE-0000-H-PLN-H-0004), and the *Environmental and Social Performance Standards* (NRE-0000-H-STD-N-0002); and any other relevant aspects of Arafura's ESMS. Including ensuring compliance with all applicable legislative and approvals, licencing, and permitting requirements through Arafura's Compliance Management System.

Project planning, designs, and processes will be regularly evaluated to identify opportunities to improve waste management. Such as opportunities to:

- substitute raw materials with less toxic alternatives
- enhance the efficiency of processes to reduce consumption and waste volumes
- reuse treated waste within current processes
- ultimately reduce the amount of waste being produced and disposed of.

Detailed site planning and operational procedures will be developed as the Project progresses, including the following:

- Detailed landfill design and operational procedure will be developed and implemented prior to construction of the facility.
- A management of change process will be developed, documented, and implemented. To review on site waste management on a regular basis, identify opportunities for improvement, and assess any potential or planned changes to storage facilities, expected waste materials and quantities.
- Established operational procedures and controls will be reviewed to enhance waste management, ensuring effective treatment and disposal practices that prevent environmental impacts and ensure full compliance with regulations.

An annual review of the currency and performance of this management plan will be conducted, to coincide with the review process of the Project's MMP, and any required updates made. The review process is to assess Project performance against the objective, target, KPI (as outlined in Section 1.3 above), and commitments contained within this plan.

12.0 ABBREVIATIONS AND DEFINITIONS

Abbreviation	Meaning
Arafura / the Company	Arafura Rare Earths Limited
AS	Australian Standard
EPA	Environment Protection Authority
ESMS	Environmental and Social Management System
HV	Heavy Vehicle
KPI	Key Performance Indicator
LV	Light Vehicle
MMP	Mine Management Plan
NT	Northern Territory
NT 'listed wastes'	Wastes specified in Schedule 2 of the NT *Waste Management and Pollution Control (Administration) Regulations 1998*
Project	Arafura's Nolans Rare Earths Project
RO	Reverse Osmosis
RSF	Residue Storage Facility
SDS	Safety Data Sheet
TARP	Trigger, Action and Response Plan
Waste	Any material either solid, liquid or contained gaseous material that is discarded or no longer wanted
WRD	Waste Rock Dump
WMPC Act	*Waste Management and Pollution Control Act 1998*
WMPC Regulations	*Waste Management and Pollution Control (Administration) Regulations 1998*

RADIATION PROTECTION AND WASTE MANAGEMENT PLAN

Document No:	NRE-0000-H-PLN-H-0004 Rev 4
Project Name:	Nolans Rare Earths
Location:	Approximately 135 km northwest of Alice Springs, Northern Territory
Date of Plan:	19 March 2025
EPBC Approval:	EPBC 2015/7436
Proponent:	Arafura Nolans Project Pty Ltd (ABN: 88 118 158 900)
Proposed Action:	To construct and operate an open pit rare earths mine, intermediate processing facility using a phosphoric acid pre-leach process and associated support infrastructure, approximately 135 km northwest of Alice Springs, Northern Territory.

REVISION HISTORY

Date	Revision	Description	Prepared	Reviewed	Approved
March 2025	Rev 4	Issued to DCCEEW	Suitably qualified expert(s) listed in Section 2.0	Daniel Jordan Environment Manager	Tommie van der Walt Chief Project Officer
September 2024	Rev 3	Issued to DCCEEW	Suitably qualified expert(s) listed in Section 2.0	Tanya Perry Head of Sustainability & Env	Stuart Macnaughton Chief Operating Officer
November 2022	Rev 2	Issued to DITT	Michael Robinson ESG Manager	Michael Robinson ESG Manager	Stewart Watkins GM Projects
July 2022	Rev 1	Issued to DITT	Michael Robinson ESG Manager	Michael Robinson ESG Manager	Stewart Watkins GM Projects
October 2021	Rev 0	For DITT review	Michael Robinson ESG Manager	Brian Fowler Environmental MGR	Stewart Watkins GM Projects

DECLARATION OF ACCURACY

In making this declaration, I am aware that sections 490 and 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) make it an offence in certain circumstances to knowingly provide false or misleading information or documents. The offence is punishable on conviction by imprisonment a fine, or both. I declare that all the information and documentation supporting this Management Plan is true and correct in every aspect. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Declared	By
Signed:	
Name:	Tommie van der Welt
Position:	Chief Projects Officer
Organisation:	Arafura Rare Earths Limited
Date:	19 March 2025

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1.0 INTRODUCTION

The Arafura Rare Earths Limited (Arafura) Nolans Project (the Project) intends to mine and produce rare earth oxides for the market. The mineralisation is known to contain elevated concentrations of naturally occurring uranium and thorium. During the processing of the ore, the uranium and thorium will be separated from the rare earth elements and placed in the Residue Storage Facility (RSF).

The potential radiological impacts of the Project operations were investigated in detail in the Nolans Project Environmental Impact Statement (Arafura, 2016). This document is the combined Radiation Protection and Radioactive Waste Management Plan (collectively referred to as the RPRWMP) for the Project. It follows on from the EIS and will be implemented from the recommencement of construction activities at the Project site.

The content and structure of the document is based on the Australian Radiation Protection and Nuclear Safeguards Agency (ARPANSA) Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing Radiation (ARPANSA, 2005).

Arafura engaged JRHC Enterprises Pty Ltd as a suitably qualified expert to assist in the development of this RPRWMP, in collaboration with Arafura personnel (see Section 2.0). It has been developed to reflect sound, accepted industry practices for radiation management and associated waste disposal. Arafura takes full responsibility for the RPRWMP's content, implementation and confirmation of compliance with the stated requirements.

This RPRWMP outlines the commitments that Arafura makes for radiation protection. The purpose is to define the process, systems and methods that will be used by Arafura through the phases of the Project to ensure that workers, the public, and the environment are protected from any harmful effects of radiation that may arise from Project activities. It is intended to be a working document and accessible by staff, workers and contractors.

The Nolans Bore rare earth ore deposit (in the mining area) exists in an area with naturally elevated concentrations of uranium and thorium, and therefore, has an elevated natural background radiation level. All other parts of the Project Area, inclusive of the proposed accommodation village, Process Plant, RSF and borefield sites exist where the natural background radiation level is lower than that in the mine area.

The EIS reported that the radiological impacts at the Project site would be low, with predicted mine worker doses less than 5mSv/y and Process Plant workers in the order of 1mSv/y. This was revised to 5mSv/y and 2.5mSv/y, respectively, following the publication of new dose factors by the International Commission on Radiological Protection (ICRP) in 2017. It was also concluded that doses during operations would be maintained As Low As Reasonably Achievable (ALARA) through effective design controls and administrative processes.

It is relevant to note that measures required for control of radiation in rare earth mining and processing are very similar to those required in mineral sands mining and processing and are well understood by the mining industry.

For ease of understanding the variable radiation risk profile of the Nolans Project and the associated controls that will be implemented commensurate with the levels of risk, the Project is described in this

RPRWMP in accordance with the aspects and description summaries provided below. Please note that detailed descriptions for these aspects and maps for reference are provided in Section 8.0.

1.1 Construction – Project Area, Excluding Mine Pit

Activities in the Project Area, outside of the mine pit footprint, are conducted in areas with no NORM containing mineralisation. Clearing and construction activities in these areas will not result in occupational radiation exposure levels that will require specific controls to be implemented.

1.2 Construction – Mine Pit

The Nolans Bore rare earth deposit is known to contain elevated uranium and thorium concentrations, resulting in the potential for occupational and environmental exposure above natural background exposure. Whilst the preliminary site preparation and construction activities in this area won't involve mining or disturbance of the radioactive ore or other material classified as NORM, some radioactive materials may be encountered, and Arafura will take a precautionary approach. From the commencement of clearing and construction in the Mine Pit area, it will be designated as a 'Radiation Supervised Area' and specified controls will be implemented for the commencement of activities.

1.3 Operations – Mining, Processing and Residue Storage

The radiation management controls implemented from the commencement of construction in the Mine Pit area will be reviewed and continue to apply through to actual mining operations. The full Mine Pit area will continue to be designated as a 'Radiation Supervised Area'.

Once ore mining commences, the Mine Pit area will be classified as a 'Radiation Controlled Area' and specified controls will be implemented for the commencement of mining.

Potential exposure to radiation will need to be managed throughout the Process Plant and the RSF – from the commencement of ore commissioning onwards. The Process Plant and RSF will be designated as a 'Radiation Supervised Area'. Key areas of the Process Plant will be designated as 'Radiation Controlled Areas', depending upon the projected radionuclide concentrations of process streams. These areas will be designated commensurate with the risk level and specified controls implemented.

1.4 Site Closure

The Project's final phase occurs when mining and processing is complete, and the Project enters the decommissioning and rehabilitation phase. This phase is characterised by plant and equipment decontamination, with a focus on clearance to a level that maximises recycling.

The RSF will be capped, and the NORM waste rock dumps covered with benign waste rock. Surface contouring will integrate the closed-out facilities into the existing landscape.

Radiological closure criteria have been developed. They focus on ensuring that the final landforms are safe and secure and that radiation levels are consistent with pre-operational levels. The member of public dose limit that has been set for the site closure is 1mSv/y, from all exposure pathways.

Acknowledging that radiation management can be a complex subject, Section 6.1 of this document provides an 'Introduction to Radiation', for information purposes.

2.0 PREPARATION OF THIS DOCUMENT

This document is the responsibility of the Arafura technical and environmental teams. It has been developed in conjunction with the Arafura consultant subject matter expert (SME) – radiation, Mr Jim Hondros of JRHC Enterprises (a resume is provided as APPENDIX A).

The Arafura team chose the SME based on the following aspects:

- 40 Years experience in mining in the areas of occupational health and safety, environment protection and community relations, with expertise in radiation protection.
- More than 10 years of experience providing advice to Arafura on occupational and environmental radiation protection, including co-authoring the radiation impact assessment, which was used as the basis of the radiation chapter of the EIS.
- Extensive national and international experience, including as a recognised expert of the International Atomic Energy Agency (IAEA) on Naturally Occurring Radioactive Materials (NORM).
- Extensive experience in radiological impact assessment and the development and practical implementation of radiation management plans for more than 20 operations with NORM.
- Certified Radiation Safety Adviser by the Australasian Radiation Protection Accreditation Board.

This RPRWMP has been prepared in accordance with the EPBC 2015/7436 Conditions of Approval and NT EPA Report 84 Recommendations for the Nolans Project. Table 2—1 provides a summary of the relevant EPBC 2015/7436 condition relating to radiation management and where it is addressed in this RPRWMP. The conditions current at the time of preparation of this RPRWMP are dated 24 October 2024.

The condition associated with this RPRWMP relates to recommendations from the NT EPA Assessment Report 84. These are described in Table 2—2 below.

Table 2—1 EPBC 2015/7436 Conditions Addressed in this Plan

Condition description		Section(s) within this RPRWMP	Demonstration of how this RPRWMP addresses condition requirements
Condition 7 EPBC 2015/7436	To ensure that radionuclides and radiation do not harm people and non-human biota, the approval holder must submit to the **department** for the **Minister's** for approval, a Radiation Protection and Waste Management Plan that meet requirements of: i. a) to b) of recommendation 15, and ii. g) of recommendation 16 of **Assessment Report 84**. The Radiation Protection and	▪ Entire RPRWMP. ▪ Table 2—2. ▪ Section 1.0. ▪ Section 6.3 refers to the primary ARPANSA Mining Code requirements.	▪ Entire RPRWMP. ▪ A brief resume for the suitably qualified expert is provided in Section 2.0. and a full copy is provided as APPENDIX A.

Condition description		Section(s) within this RPRWMP	Demonstration of how this RPRWMP addresses condition requirements
	Waste Management Plan must be developed by a **suitably qualified expert** based upon guidance material from **ARPANSA**. In association with the Radiation Protection and Waste Management Plan, the approval holder must commence **construction** of the action only in accordance with Condition 8 of this instrument.		

Table 2—2 NT EPA Assessment Report 84 Recommendations Addressed in this RPRWMP

Recommendation Description		Section(s) within this RPRWMP	Status
Recommendation 15. Approvals and decisions for the Project shall have conditions that require the Mine Closure Plan to progressively include:			
a)	Alternative risk-based rehabilitation options that identify a range of closure scenarios and strategies for the Waste Rock Dumps, Tailings Storage Facility, Residue Storage Facility and the pit and provide justification that the preferred closure option minimises environmental risks.	▪ Section 13.0.	This RPRWMP notes that radiological aspects are one component of the final decision on closure options. This RPRWMP only covers radiation risks associated with the Project. Non-radiation rehabilitation options are incorporated into the Mine Closure Plan for the Project.
b)	Identification and management of knowledge gaps relating to closure-specific technical information: including environmental baseline data, waste characterisation, pit lake characterisation, and review of monitoring data; to inform sustainable mine closure.	▪ Section 13.0.	This RPRWMP refers to ensuring that radiological aspects based on monitoring and characterisation are taken into account in closure decision making.

Recommendation Description		Section(s) within this RPRWMP	Status
Recommendation 16. Before approvals or decision are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator a conceptual Mine Closure Plan that must be reviewed and updated every three to five years. The Mine Closure Plan must:			
e)	Include a commitment to ensure all landforms, including the pit lake, are safe and stable.	▪ Section 13.0.	This RPRWMP refers to the radiation related closure goals of the Project.
f)	Include an adaptive management approach in response to progressive rehabilitation performance monitoring results to ensure rehabilitation is successful	▪ Section 13.0.	This RPRWMP refers to the closure decision making processes and the consideration of radiological aspects.
g)	Establish ongoing monitoring and maintenance of the site post-mining in accordance with an approved monitoring and maintenance program until such time as the relevant regulator directs	▪ Section 13.0.	This RPRWMP notes that monitoring will be conducted post-closure (extent is to be defined during the operations phase) to ensure that closure goals for radiation are met.

3.0 CODES AND STANDARDS

Table 3—1 International Codes and Standards

Reference	Details
ARPANSA 2005	The Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing Radiation Protection Series. Canberra. RPS 9
ARPANSA 2010	Environmental Protection: Development of an Australian approach for assessing effects of ionising radiation on non-human species. Technical Report Series No. 154
ARPANSA 2011	Safety Guide for Monitoring, Assessing and Recording Occupational Radiation Doses in Mining and Mineral Processing
ARPANSA 2015	Guide for Radiation Protection of the Environment, Radiation Protection Series G-1
ARPANSA 2019	Code of Practice for the Security of Radioactive Sources
ARPANSA 2019b	Code of Practice for the Safe Transport of Radioactive Material RPS C-2
ARPANSA 2020	ARPANSA Code for Radiation Protection in Planned Exposure Situations
ARPANSA 2022	ARPANSA Updates Radiation Dose Conversion Factors 4 July 2022
DMP 2010	WA Govt, 2010, 'Managing Naturally Occurring Radioactive Material (NORM) in mining and mineral processing guideline', Government of Western Australia DMP, Monitoring NORM - Airborne radioactivity sampling
ERICA 2023	http://erica-tool.com/ (accessed July 2024)
ICRP 1977	Recommendations of the ICRP, Publication 26. Ann. ICRP 1 (3)
ICRP 2007	The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4)
ICRP 2017	ICRP, 2017. Occupational Intakes of Radionuclides: Part 3. ICRP Publication 137. Ann. ICRP 46(3/4)
IAEA 2014	Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. General Safety Requirements Part 3 No. GSR Part 3 — Vienna: International Atomic Energy Agency
UNSCEAR 2000	Annex B: Exposures from natural radiation sources, United Nations Scientific Committee on the Effects of Atomic Radiation, New York
UNSCEAR 2000b	UNSCEAR 2000 Report to the General Assembly, with Scientific Annexes UNITED NATIONS New York, 2000 VOLUME I: SOURCES

4.0 ABBREVIATIONS AND DEFINITIONS

Table 4—1 Abbreviations and Definitions

Abbreviation	Meaning
Arafura / ARU	Arafura Resources Limited
ALARA	As Low As Reasonably Achievable (social & economic factors taken into account)
AMAD	Activity Median Aerodynamic Diameter
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ERICA	Environmental Risk from Ionising Contaminants
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
LOM	Life of Mine
MMAD	Mass Median Aerodynamic Diameter
MCP	Mine Closure Plan
NHB	Non-human biota
NORM	Naturally Occurring Radioactive Material
OSLD	Optically Stimulated Luminescence Dosimeter
PTW	Permit to Work
RPRWMP	Radiation Protection and Radioactive Waste Management Plan
REE	Rare Earth Elements
ROM	Run of Mine
RP Act	Radiation Protection Act
RPP	Radiation Protection Plan
RSF	Residue Storage Facility
Statutory RSO	Statutory Radiation Safety Officer
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
WI	Work Instructions
Bq/cm^2	Becquerel per square centimetre
m^3/h	Cubic meters per hour
mSv/y	Millisievert per year
µJ	Microjoule
mJ	Millijoule

5.0 PROJECT OVERVIEW

Arafura proposes to develop and operate the Nolans Project, a rare earth mine located approximately 135 kilometres (km) north-northwest of Alice Springs in the Northern Territory. The Project is situated approximately 10km west of Aileron Roadhouse. The main access to the Project site will be from the Stuart Highway, 5km south of Aileron Roadhouse and south of the Alyuen community.

The majority of the Project site is situated on the Aileron Perpetual Pastoral Lease (PPL 703), with the exception of the western part of the borefield area, which is situated on the Napperby Perpetual Pastoral Lease (PPL 747/748), and the very northern portion of the Kerosene Creek diversion (ML 32416) which is located on the Pine Hill Perpetual Pastoral Lease (PPL 1030).

The Project comprises an open pit mine at Nolans Bore, an associated concentrator and Process Plant, with ancillary facilities including waste rock dumps (WRD) and Residue Storage Facility (RSF) for the beneficiation tailings and waste streams from the Process Plant. There will also be a water supply borefield, clean-up area for radioactively contaminated waste materials, gas-fired power plant and accommodation village.

The ore body is an REE-P-U deposit with mineralisation-characterised veins of REE-rich apatite with grades from 5-10% Total Rare Earth Oxide (TREO). Mining will be open pit with all material to be mined, drilled and blasted. Mining will be a conventional excavator-truck operation with the ore requiring selective mining with tight geological control. The plan is to commence mining an average of 1.0 Mtpa of ore, increasing to 1.5 Mtpa later in mine life and together with approximately 5 Mtpa of other materials (low grade ore and waste), with staged increases to 8 and 12 Mtpa. Ore will be stockpiled on the ROM pad and ore blends will be loaded onto trucks, for delivery to the Process Plant, 8.5 km to the south.

The ore will be processed through a conventional crushing-milling and flotation circuit to produce an apatite rich rare earth concentrate. The concentrate will be treated in the Process Plant using a complex hydrometallurgical flowsheet. The process will extract the REE and phosphate from the apatite from the concentrate while rejecting impurities, including radionuclides. The REE will be separated to produce ~5000 tpa of rare earth oxides for sale. The impurities, radionuclides and low value REE such as Lanthanum (La) and Cerium (Ce) will be neutralised and disposed of in a lined cell within the RSF. The phosphate that is recovered from the apatite in the feed will be converted into approximately 144,000 tpa of merchant grade phosphoric acid for export.

The Project site includes the following main areas, linked by access roads and pipelines:

- Mine Area.
- Process Plant.
- Residue Storage Facility.
- Explosives magazine.
- Accommodation village.
- Borefield.
- Site access roads.

6.0 BACKGROUND

6.1 Introduction to Radiation

All matter is made of atoms. Atoms are made up of a nucleus that contains protons and neutrons and is orbited by electrons. Some atoms are unstable and breakdown, giving off energy from the nucleus in the form of radiation. These are known as radioactive atoms or radionuclides.

Different radionuclides emit radiation at different rates. The breakdown (or decay) of radionuclides reduces the number remaining, so that the amount of radiation emitted continually reduces. The time taken for one half of the radionuclides to decay away is known as the half-life. Each radionuclide has its own half-life that can range from less than one-thousandth of a second to billions of years.

When a radionuclide decays, the new atom formed may itself be radioactive, which might in turn decay to another radionuclide. This can continue until a stable element is reached. When this occurs, the chain of radioactive decays is called the decay series or decay chain.

Radionuclides are ubiquitous and naturally occurring, existing everywhere in the environment - in food, air, water, soils and rocks. For example, uranium is a naturally occurring heavy metal and is widespread in the Earth's crust, having an average concentration of about three parts per million (ppm). Since radionuclides essentially exist naturally in all materials, it is usual to only define a material as radioactive when the concentration of a radionuclide in the material exceeds a prescribed level.

Radiation emitted from radionuclides is known as ionising radiation because it ionises material through which it passes. This means that radiation produces charged particles called ions as it passes through matter.

There are three types of radiation emitted by naturally occurring radionuclides:

- *Alpha radiation* consists of alpha particles (two neutrons and two protons) and has a very short range in air (a few centimetres), depositing their energy quickly. They are unable to penetrate the outer skin layer but can be hazardous when inhaled or ingested.
- *Beta radiation* is a negatively charged particle, similar to electrons. They have moderate penetration, typically about one metre in air and a few millimetres in water or tissue.
- *Gamma radiation* is not a particle but an electromagnetic wave, like X-rays, but of much higher energy. Gamma rays are generally able to penetrate up to several centimetres of metal or 10 cm of concrete.

Exposure to radiation can only occur when there is an exposure pathway between the radioactive material and the person exposed. This can occur in two ways: through external exposure (where the source of radioactivity is outside the body) and through internal exposure (where the source of radioactivity is inside the body – for example, in inhaled air).

Radiation and radioactivity can be described in a number of ways. The most common way refers to the amount of radioactivity in a material (or how radioactive it is). This is described by its 'activity' and is measured in the unit of becquerel (Bq), which is the amount of radioactive material that produces one

radioactive decay per second. The 'activity concentration' is the amount of radioactivity in a unit mass (or volume) of material and is measured in becquerels per gram (Bq/g) or per litre (Bq/L).

Another way of describing radioactivity is by the radiation 'exposure'. Exposure refers to the amount of radiation received at a point or by a person. Radiation 'dose' is then a standardised measure of the effect (or detriment) of exposure to the radiation and is measured in the units of sieverts (Sv). The unit of dose considers different types of radiation and different exposure situations. The sievert is a large unit of measure, and doses are usually expressed in millisieverts (mSv) (thousandths of a sievert).

Due to radiation being very common in nature, everyone is exposed to natural radiation throughout their life. This radiation comes from the rocks and soil of the earth, the air we breathe, the water and food we consume, and from cosmic radiation from space. Natural background concentrations can vary considerably in different places in the world. While the world average dose is 2.4 mSv/y, the typical range is quoted as 1–10 mSv/y (UNSCEAR 2000).

In addition to natural background exposure, some people around the world are regularly exposed to radiation in their work and from leisure activities (such as flying) and in medical procedures. Table 6—1 shows the average annual dose for a range of different jobs.

Table 6—1 Occupational Radiation Exposures (in addition to natural background levels)

Source practice	Average effective dose from internal and external exposure above natural background (mSv/y)
Industrial uses of radiation	0.5
Medical uses of radiation (doctors/nurses)	0.3
Air crew (from cosmic radiation)	3.0
Nuclear fuel cycle	1.8
Mining (other than coal)	2.7
Coal mining	0.7

Source: UNSCEAR 2000 Report Vol. I Sources and Effects of Ionising Radiation

A major source of radiation exposure to the general public is medical exposure. Radiation is used extensively for diagnosis (such as x-rays) and treatment of disease. The average annual radiation dose from diagnostic medical procedures in developed countries is approximately 1.2 mSv/y (UNSCEAR 2000).

The acute health effects of radiation exposure (both internal and external) are well known. At high doses (several sieverts), significant numbers of cells may be killed, leading to the breakdown of the organ or tissue and possibly resulting in death. The doses required for these effects are similar to those received by Chernobyl fire-fighters. These dose levels are in the magnitude of hundreds of times higher than those expected at the Nolans Project

At lower doses, chronic health effects may arise from cells that are damaged by the radiation but not killed. This may be the initiating event for development of a cancer.

Several studies have found an increased risk of cancer among people exposed to moderate doses of radiation (UNSCEAR 2000). The studies show that the risk increases as the radiation dose increases.

In general, none of the studies have been able to measure increases in cancer risk from exposures to low doses of radiation (below about 50 to 100 mSv); however, it is conservatively assumed that an increased risk does exist. This is called the linear non-threshold hypothesis.

The studies and their results form the basis of radiation standards for the exposure of workers and the general public.

The effective annual dose limits are 20mSv/y for a radiation worker and 1mSv/y for a member of the public.

6.2 Approach to Radiation Protection

Radiation and its effects have been well documented and studied for more than 100 years, and there is international consensus on its effects and controls. The main organisations that oversee radiation and radiation protection and provide guidance and standards are:

- The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) provides a consolidated overview of the effects of radiation by regularly reviewing research and publishing summaries. UNSCEAR provides the scientific basis for radiation protection.
- The International Commission on Radiological Protection (ICRP) is recognised as the pre-eminent authority on radiation protection and has developed the philosophy for radiation protection and publishes recommendations on radiation protection. ICRP provides the philosophical basis for radiation protection.
- The International Atomic Energy Agency (IAEA) develops and publishes standards and guides and provides advice on basic safety precautions for both industry and regulators when dealing with radiation. The IAEA develops operating standards.

The standards and guidelines established at an international level are adopted in Australia as National Standards and Codes of Practice through the work of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). The national standards are then adopted by Australian States and Territories as necessary and enacted in legislation or enforced through licence conditions.

The basis of radiation protection regulation is outlined in ICRP Publication number 26 [ICRP 1977], in which the ICRP first recommended the *system of dose limitation*. This is recognised as the internationally accepted approach to radiation protection and is universally adopted as the basis of legislative systems for the control of radiation. It is made up of three key elements:

- Justification – this means that a practice involving exposure to radiation should only be adopted if the benefits of the practice outweigh the risks associated with the radiation exposure.

- Optimisation – this means that the protection mechanisms for radiation protection have been optimised so that doses are *As Low As Reasonably Achievable*, taking into account economic and social factors. This is also known as the *ALARA* principle.
- Limitation – this means that individuals should not receive radiation doses greater than the prescribed dose limits.

The ALARA principle is generally regarded as the most important and effective of these elements for controlling and managing radiation.

While the ALARA principle is the foundation for radiation protection, radiation dose limits have been established to provide an absolute level of protection. The limits apply only to the radiation dose received as a result of *practice* and exclude natural background radiation. The limits are:

- 20 mSv/y for a worker (whilst at work).
- 1 mSv/y for a member of the public (total year).

Radiation protection is regulated in the Northern Territory under the Radiation Protection Act (RP Act) (2004) and Regulations (2007) and the requirements of the *Environment Protection Legislation Amendment Act 2023* and *Work Health and Safety (National Uniform Legislation) Act 2011*. Arafura has committed, through the EIS (Arafura 2016) to abiding by Territory, National and International standards for radiation protection.

6.3 Radiation Management Requirements

Arafura uses recognised industry standards to ensure that technologies and methodologies for mining, mineral processing and waste management enable the protection of people and the environment.

Arafura recognises that the contents of this RPRWMP must comply with the structure outlined in the ARPANSA Mining Code (ARPANSA 2005). The overriding objective of the Mining Code is to provide a framework for the protection of workers, members of the public and the environment from any harmful effects of radiation exposures arising from mining, mineral processing and waste management. It relates to potential impacts from current, planned and future activities.

The key components of the ARPANSA Mining Code Requirements for radiation protection and waste management, together with where they are addressed in this RPRWMP are presented in Table 6—2 below.

Table 6—2 Radiation Protection and Waste Management Requirements

ARPANSA Mining Code Requirement	Section of this RPRWMP
A description of the operations and the measures that are intended to be taken to control the exposure of employees and members of the public to radiation.	Sections 5.0 – Project Overview, 8.0 – Radiation Exposure and Management, 11.0 – Occupational Radiation Monitoring and 12.0 – Environmental Monitoring.
An outline of the processes generating radioactive waste and a description of the radioactive waste generated.	Section 8.1 – Radiological Characteristics of the Project.

ARPANSA Mining Code Requirement	Section of this RPRWMP
A description of the system for radioactive waste management.	Section 9.0 - Radioactive Waste Management.
Demonstrated access to appropriate professional expertise in radiation protection and details of appropriate equipment, staffing, facilities and operational procedures.	Throughout Section 8.0 – Radiation Exposure and Management. Section 8.4.2.5 – Radiation Safety Officer.
A plan for monitoring radiation exposure and for assessing the doses received by workers and the public.	Section 11.0 – Occupational Radiation Monitoring.
A program for monitoring the concentration of radionuclides in the environment.	Section 7.0 describes baseline radiation levels. Section 12.0 – Environmental Monitoring.
Details of induction and training courses.	Throughout Section 8.0 – Radiation Exposure and Management.
A plan for dealing with incidents, accidents and emergencies involving exposure to radiation.	Section 16.0 – Accident, Incident and Emergency Response.
Circumstances which might lead to an uncontrolled release of radioactive material to the environment and contingencies for mitigating / managing the release.	Section 13.0 – Site Closure. Section 16.0 – Accident, Incident and Emergency Response.
Details of record keeping and reporting, including personal dose monitoring and a schedule for reporting on the operation and results of monitoring and assessments required by this plan. Records will be kept in accordance with regulatory requirements.	Section 14.0 – Record Keeping.
A system of periodic assessment and review of the adequacy and effectiveness of procedures.	Section 17.0 – System of Review.

6.4 Requirements of Northern Territory Radiation Protection & Control Act & Regulations

The *Radiation Protection Act 2004* and Regulations 2007 (in force as of 2012) outline the requirements for radiation protection in the Northern Territory. The requirements for the transport of radioactive materials are outlined in the *Radioactive Ores and Concentrates (Packaging and Transport) Act 1980*, and Regulations 1980.

The Arafura mine and Process Plant are subject to the requirements of the Act and Regulations, requiring a licence and an approved Radiation Protection Plan. Arafura will seek a licence in accordance with Part 3 of the *Radiation Protection Act 2024* and provide this RPRWMP as part of the approval process. It is noted that other licences will be required, including:

- licences for radiation sources.
- registration of radiation sources.

- registration of place where a radiation source will be used or stored.
- disposal of radioactive waste, including general contaminated waste and tailings.
- operators' licences for XRF equipment, licences for any radiation apparatus, including XRF equipment and radiation density gauges.

This RPRWMP incorporates the requirements of the following:

- The Northern Territory Radiation Protection Act 2004 and Regulations 2007.
- The ARPANSA Mining Code.

7.0 LOCAL ENVIRONMENT AND RADIOLOGICAL CHARACTERISTICS

Arafura has completed comprehensive studies and environmental and social impact assessments for the Nolans Project, as presented in the Environmental Impact Statement (EIS). The full EIS is available on the Arafura website at: https://www.arultd.com/projects/nolans/environmental-impact-statement/

Arafura has a long history of radiation monitoring in the region, with levels presented in the EIS and supplement. The key findings from these extensive environmental radiation studies are as follows:

- The mine area is radiologically determined by the extensive geological exploration and drilling of this sparsely outcropping orebody.
- The local region has locally defined elevated gamma radiation levels.
- Some areas with elevated levels of uranium and thorium characterise the broader area.
- There is locally elevated radon and thoron in the region due to the outcropping areas of elevated uranium and thorium.
- Radon and thoron concentrations in the air vary by up to 2 to 3 orders of magnitude.
- The EIS also reported that the findings are similar to those found in the vicinity of other near-surface undeveloped uranium and rare earth mineralisation.

These findings, however, are not dissimilar to those found in the vicinity of other near-surface undeveloped uranium and rare earth orebodies.

The physical environment of the Project setting is described in detail in:

- Nolans Project, Environmental Impact Statement (EIS), Arafura Resource Ltd, February 2016 (GHD, 2016).
- Nolans Project, Environmental Impact Statement (EIS) – Supplementary Report, October 2017 (GHD, 2017).
- Arafura Resources Ltd, Nolans Project Section 14A Notification, June 2019 (GHD, 2019).

A summary of the key environmental attributes of the Project site is provided below, copied from relevant sections of EIS Chapter 12 - Radiation.

7.1 Landforms and Vegetation

Vegetation communities and associated landforms have been described and mapped for the Project area within the EIS. Baseline surveys indicated there are no threatened ecological communities present within or surrounding the Project area; however, some are considered sensitive vegetation communities and/or provide suitable habitat for threatened species known to occur in the area.

The mining area is characterised as red earth plains, alluvial plains, rocky hills and several moderate sized drainage features (Kerosene Camp Creek and associated tributaries). The red earth plains support a Mulga shrubland over either tussock grassland or spinifex grassland. The alluvial plains support a mixed open woodland over tussock grasses, with the occasional calcareous low rise that supports Senna shrubs.

Several rock hills and outcrop areas are present, which support an open shrubland of Acacia or mallee (*Eucalyptus spp.*) over spinifex. The larger drainage channels are typically lined with River Red Gum (*Eucalyptus camaldulensis*) over tussock grasses (including the weed Buffel Grass *Cenchrus ciliaris*).

The Process Plant and RSF areas are characterised as flat red earth plains that support Mulga shrubland/low woodland over tussock grasses. The northern part of the Process Plant footprint is characterised as alluvial plains, gravel rises and containing some isolated low rocky hills.

The accommodation village is situated on flat alluvial plains and red earth plain that either support a Mulga shrubland or mixed woodland over either tussock grass or spinifex grass. Some low rocky hills on the eastern side of the accommodation village support Acacia shrubland over spinifex.

There are several planned extractive areas located off the main access road, which will be used for extracting gravel. These areas support rocky hills, gravel or rocky rises, alluvial plains and red earth plains.

The borefield occurs within an extensive spinifex sandplain (flat to gently undulating) that supports open shrubland (various species) over spinifex (*Triodia basedowii*). There is local variation in structure and species within this vegetation community, which is mostly likely to be associated with the fire regime.

Further to the west is the Day Creek alluvial floodplain, which supports low gravel rises (with either Mulga or Witchetty Bush) that transition into an alluvial plain and a large drainage channel (Day Creek) lined with River Red Gum.

7.2 Local Environment – Radiation

A detailed description of the radiological characteristics of the Project Area is provided in the following sections of the EIS:

- Chapter 3: Project Description.
- Chapter 12: Radiation.
- Appendix P: Radiation Report.

The information provided in the following sections of the RPRWMP draws directly from these sections.

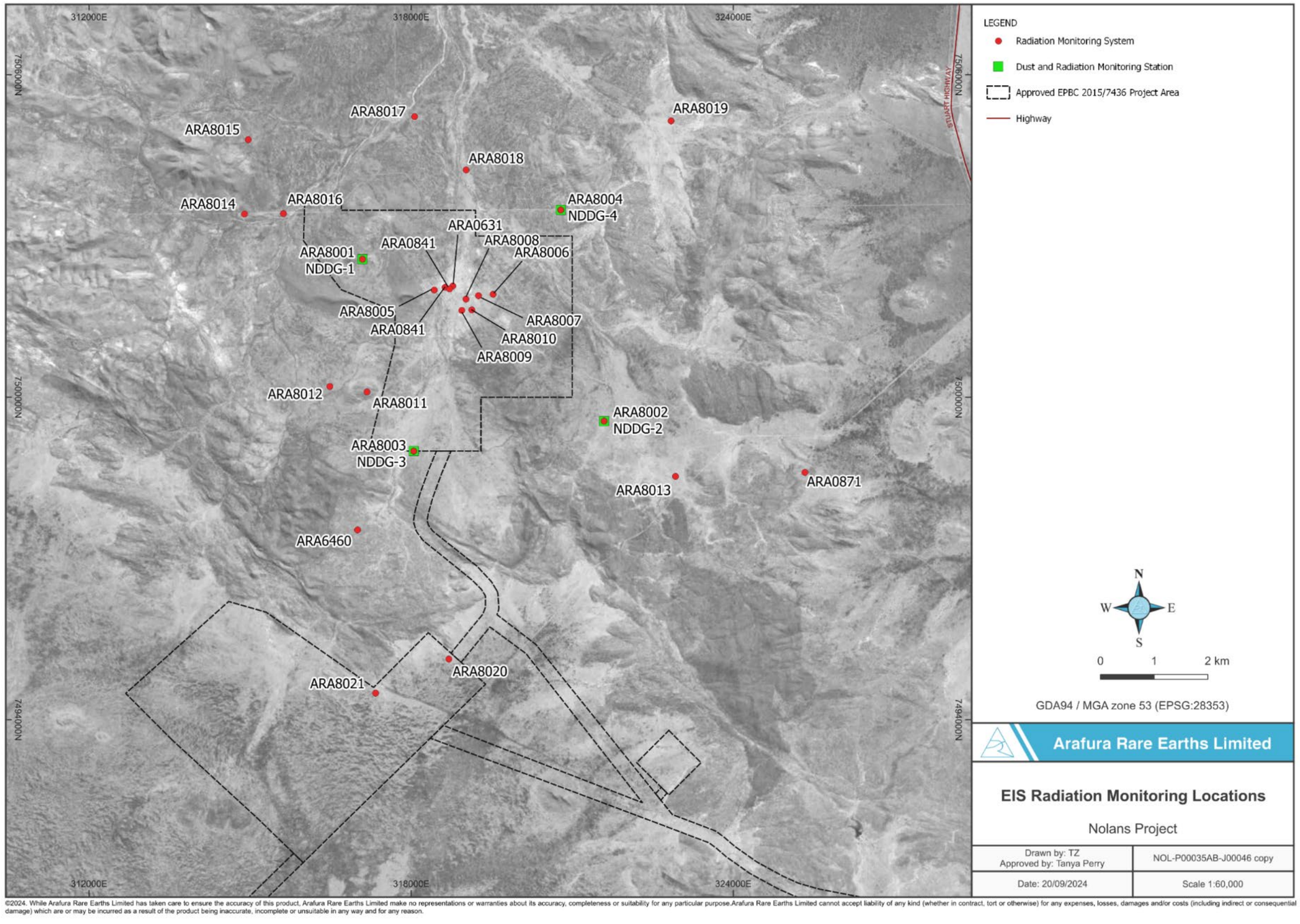
Chapter 12 of the EIS provides an overview of the radiological environment of the Project, including a summary of the natural levels of background radiation in the region and potential impacts from Project activities on workers, the public and the environment.

To understand the existing environment of the Project from a radiological perspective, Arafura undertook comprehensive baseline radiological studies of the site and the region, including environmental and occupational radiation sampling and monitoring in 2005. Monitoring locations are shown in Figure 7—1. These studies are referred to in the EIS and considered the following:

- Environmental gamma monitoring
- soil and sediment sampling

- vegetation sampling
- groundwater sampling
- dust sampling and dust concentration in air
- passive radon and thoron
- real-time radon and thoron monitoring.

Following the publication of the EIS, Arafura has collected additional radionuclides in dust and groundwater data as part of ongoing baseline environmental monitoring. A summary of the monitoring and results is described in Section 7.3 below.



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Figure 7—1 EIS Radiation Monitoring Locations

7.2.1 Gamma Monitoring

A general area survey was conducted in a grid pattern across the mine site area and at sites remote (background) from the Project area. Background sites included two measurements in Kerosene Camp Creek and two measurements at the Aileron Roadhouse. The measurements were taken at locations on and off the ore deposit, and a summary of the results is provided in Table 7—1.

Table 7—1 Summary of Gamma Measurements at the monitoring locations

Location	Environmental Gamma Dose Rate (μSv/h)			Sample Number
	Average	Max.	Min.	
On deposit	0.38	0.63	0.18	12
Off deposit	0.19	0.35	0.13	37
Background	0.17	0.18	0.15	4

The gamma radiation levels in the region have been extensively studied through a number of surveys. A summary of the results is provided in Table 7—2.

Table 7—2 Summary of Gamma Monitoring Results

Sample Program and Method	Average Results (μSv/h)
Nolans Bore (on deposit)	0.8 (highs to > 10)
Nolans Bore (off deposit)	0.25

The EIS provides a summary of gamma radiation levels from other areas of Australia. The data shows that the baseline levels vary considerably around the country. The levels shown in the above tables for the Nolans Bore region are consistent with other areas where there is an outcropping of naturally occurring radioactive materials.

In 2008 Arafura conducted detailed low-level aerial radiometric surveys of the mine site and Process Plant area. The results are shown in Figure 7—2. Aerial radiometric surveys provide a picture of gamma radiation levels across wide areas and are more efficient than handheld gamma surveys. They are useful for obtaining a regional snapshot. It is usual to use aerial surveys to identify areas for more detailed ground surveys.

The Arafura aerial radiometric survey results clearly show the area of the Nolan Bore mineralisation, with average gamma radiation levels up to almost 1 μSv/h, compared to the regional values of between 0.02 and 0.20 μSv/h. These values are consistent with ground truthing gamma survey results shown in the above tables.

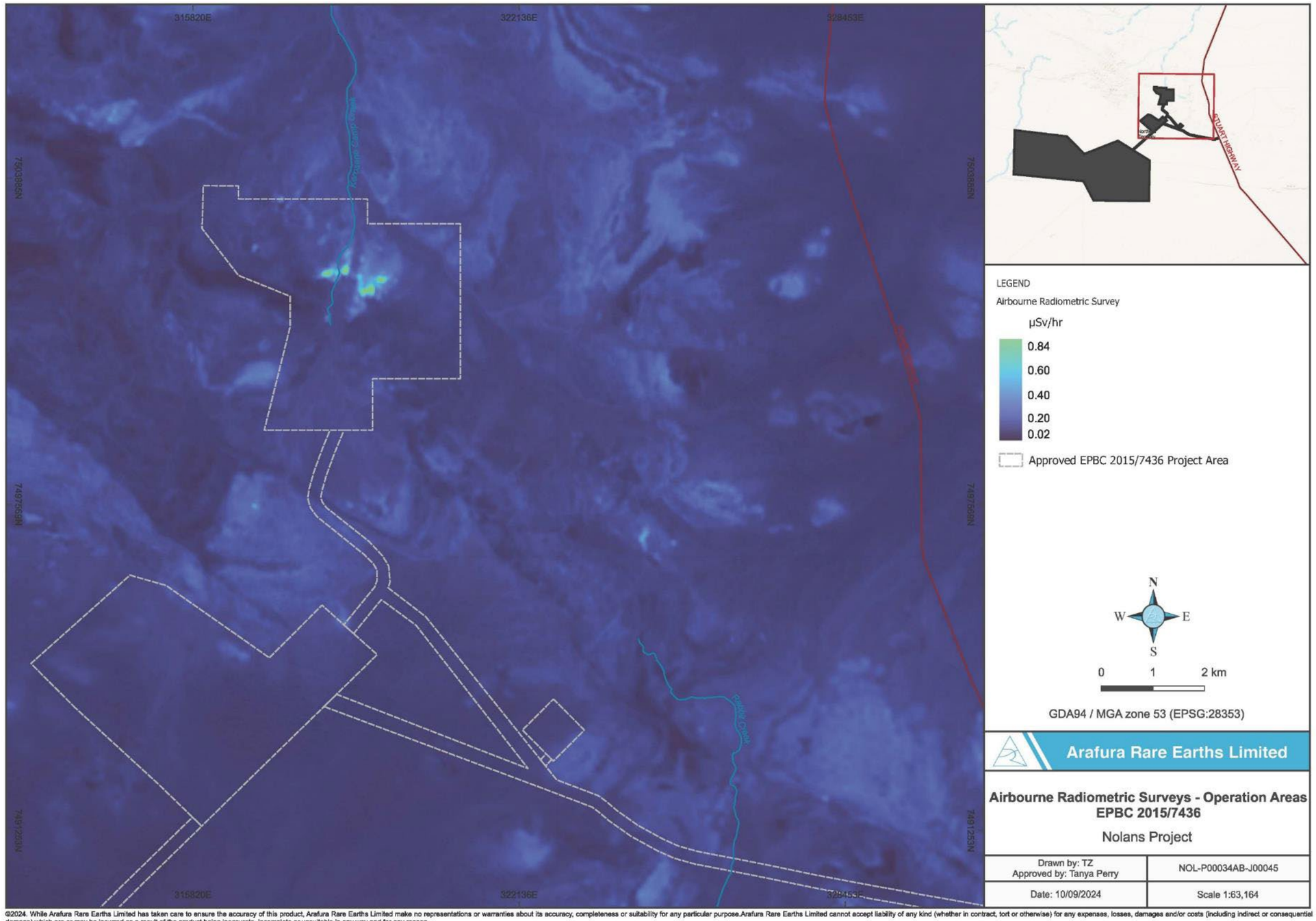
The Arafura aerial radiometric survey did not extend to the borefield area, as this area was known to be generally unmineralised. However, the Northern Territory Department of Mines (now Department of Mining and Energy) did conduct a low-resolution regional airborne survey in 1997. Results are available on the Government Geoscience website (Northern Territory Geological Survey (NTGS):

https://industry.nt.gov.au/projects-and-initiatives/geoscience-projects/geophysical-acquisition.

Figure 7—3 shows collated radiometric data across the area of the borefield. It can be seen that the gamma radiation levels of the borefield area are in the range of approximately 0.05 to 0.15 µSv/h, which is typical of large areas of Australia where there is no uranium or thorium mineralisation, i.e. there are no areas of elevated gamma radiation across the borefield footprint.

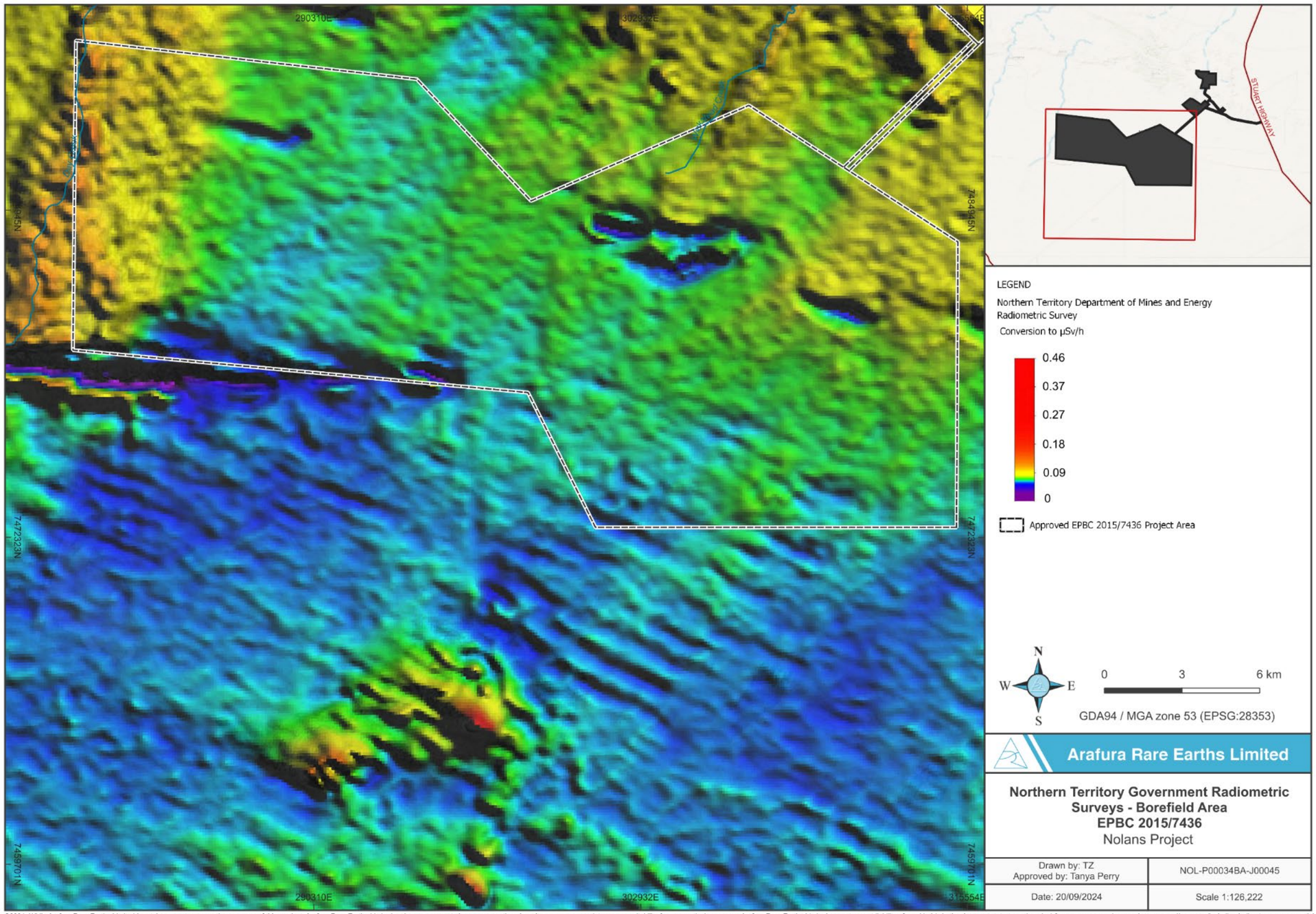
Noting that the data in Figure 7—3 is a different dataset to that collected by Arafura (Figure 7—2), the relative colours shown vary between the two figures. However, for comparison purposes, the reference scales on each figure are the same.

The inclusion of both sets of data provides a comparison, and assurances that work in the borefield and other areas away from the ore deposit will not result in radiation exposure above that of natural background levels.



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Figure 7—2 Aerial Gamma Surveys – Nolans Project Mine & Process Plant Areas (based on Arafura 2016)



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Figure 7—3 Radiometric Surveys of the Nolan Project Borefield Area

7.2.2 Soil and Sediment Analysis

Earlier surface soil sampling was undertaken at three locations: one upstream from the Nolans Bore deposit in the mine site, one downstream, and the third at a site distant (background) from the Project Area near the Aileron Roadhouse. Results are presented in Table 7—3.

Table 7—3 Soil Radionuclide Results

Location	Radionuclide Concentration (Bq/kg)									
	U238	U234	Th230	Ra226	Pb210	Po210	Th232	Ra228	Th228	K40
Mine site	27	20	25	23	15	20	56	77	75	805
Downstream of mine site	25	18	24	18	10	17	32	42	42	891
Background	77	30	72	53	45	47	118	118	121	925

The results show that the concentrations of uranium and thorium in the soil samples from the roadhouse are naturally elevated compared to the samples from the mine region and comparable to the Australian average.

An extensive program of soil and sediment sampling (>230 samples) has also been completed across the region, and these results are shown in Table 7—4.

Table 7—4 Summary of Soil and Sediment Sampling

Sample Type	Number of Assays	Uranium (av.& range in parts per million (ppm))	Thorium (average and range in ppm)
Crustal average	---	2.7	10.5
Soils (on deposit)	9	22 (3.28-83.3)	328 (44.1-950)
Soils (off deposit)	17	5.51 (2.47-24.3)	63.2 (23.2-416)
First drill meter (on deposit)	142	55.6 (1.4-655)	791 (10.4-8730)
First drill meter (off deposit)	18	5.85 (1.6-19)	50.5 (9.55-149)
Stream sediments	51	3.16 (1.36-13.7)	44.5 (14.6-180)
Stream sediments (fine-grained fractions)	51	8.21 (2.81-21.5)	119 (31.7-360)

Uranium and thorium concentrations for a range of samples have been determined and show that:

- Soils and stream sediments in the region have above crustal average uranium and thorium concentrations. This is typical of the region.
- Uranium and thorium compositions of the soils and stream sediments are broadly similar.

- Soils on top of the Nolans Bore ore deposit have higher average uranium and thorium compositions than those outside of the deposit, although there is considerable overlap. In many instances, the first drill meter includes a mixture of soil and the underlying rock, some of which are mineralised.
- It is difficult to distinguish the stream sediment signature of the Nolans Bore deposit because of the masking effect of elevated levels of radionuclides in the region.

7.2.3 Vegetation Analysis

Earlier sampling of vegetation was undertaken at the same three locations as the soil samples reported in Table 7—3. The results are shown in Table 7—5.

Table 7—5 Vegetation Radionuclide Results

Location	Radionuclide Concentration (Bq/kg)									
	U238	U234	Th230	Ra226	Pb210	Po210	Th232	Ra228	Th228	K40
Mine site	0.9	2.1	0.3	14.0	25.5	21.6	0.4	22.0	7.2	433
Downstream of mine site	1.3	2.3	1.0	8.5	29.0	19.5	2.4	20.0	7.5	609
Background	1.1	1.6	1.1	26.5	38.0	23.3	2.4	69.5	21.9	531

The enhanced concentrations of Po210 and Pb210 are generally observed and primarily due to the decay of atmospheric radon (UNSCEAR 2000).

Extensive vegetation sampling has also been completed across the region, and these results are shown in Table 7—6.

Table 7—6 Summary of vegetation sampling

Vegetation type	Number of Assays	Uranium (average and range in parts per million (ppm))	Thorium (average and range in ppm)
Grass (on deposit)	9	0.022 (<0.01-0.06)	0.22 (0.1-0.39)
Grass (off deposit)	17	0.015 (<0.01-0.12)	0.14 (0.02-1.37)
Tree leaves (on deposit)[1]	10	0.046 (<0.01-0.06)	0.15 (0.03-0.59)
Tree leaves (off deposit)[2]	17	0.01 (<0.01-0.08)	0.02 (<0.01-0.04)
Tree leaves (on deposit)[3]	75	0.077 (<0.01-0.48)	0.537 (0.01-5.31)
Tree leaves (off deposit)[4]	1127	0.016 (<0.01-0.71)	0.021 (<0.01-0.34)

[1] Environmental sample with coincident grass and soil samples.
[2] Environmental sample with coincident grass and soil samples.
[3] Exploration sample from 2006-2013.
[4] Exploration sample from 2006-2013.

7.2.4 Groundwater Sampling

Two groundwater samples were collected and analysed and the results are presented in Table 7—7. Table 7—8 presents the additional groundwater sampling within and upstream of the Nolans Bore ore deposit.

The results show that the groundwater radionuclide concentrations are elevated and highly variable across the region.

Table 7—7 Groundwater Radionuclide Results

Location	Radionuclide Concentration (Bq/L)									
	U238	U234	Th230	Ra226	Pb210	Po210	Th232	Ra228	Th228	K40
Nolans Bore (stock bore)[5]	2.5	8.6	<0.05	0.15	<0.01	0.004	0.015	3.1	0.32	1.1
Aileron Roadhouse Bore	6.4	20.8	0.12	0.26	0.33	0.314	0.034	0.78	0.16	0.7

Table 7—8 Summary of Groundwater Sampling

Location	Number of Assays	Uranium (average in ppm)	Thorium (average in ppm)
In deposit	5	0.354	<0.0001
Upstream and off deposit	9	0.361	<0.0001

7.2.5 Dust Deposition

Dust deposition gauges were placed in September 2010 at four locations approximately two to three kilometres distant from the proposed mine area in approximately northwest, southeast, northeast and southwest directions, being downwind, upwind, and orthogonal to the prevailing southeast wind direction. Locations are showed in Figure 7-1. A summary of the baseline background results is provided in Table 7—9.

[5] Now abandoned and no longer accessible.

Table 7—9 Dust Deposition

Dust Deposition Gauge	Total Dust Deposition (g/m2/day)	Thorium Deposition (µg/m2/day)	Uranium Deposition (µg/m2/day)
NDDG-1 (NW)	0.067	0.36	0.20
NDDG-2 (SE)	0.017	0.16	0.07
NDDG-3 (SW)	0.041	0.40	0.29
NDDG-4 (NE)	0.025	0.14	0.08

The uranium and thorium concentrations in the deposited dust are relatively consistent at approximately 3 ppm and 10 ppm, respectively. These figures are consistent with worldwide background levels of radionuclides in soils (UNSCEAR 2000) and the average composition of the continental crust.

7.2.6 Dust Concentrations in Air

Between September 2010 and March 2011, dust concentration sampling was conducted to measure PM_{10} dust. The results show daily average PM_{10} dust concentrations varying between 1 and 35 µg/m^3 over the sampling period, with an average dust concentration of 16 µg/m^3. Radionuclide analyses were not conducted on the dust; however, based on the soil concentrations and the dust deposition results, giving uranium and thorium concentrations of 3 ppm and 10 ppm, respectively, and assuming that the dust is resuspended soil, the radionuclide concentrations in the air can be calculated. The results are 0.4 mBq/m^3 for uranium and 1.2 mBq/m^3 for thorium.

7.2.7 Radon and Thoron Concentrations

During 2015, real-time radon and thoron monitoring was carried out at Nolans Bore (Arafura 2016). The results indicate a high level of variability in both radon and thoron concentrations, up to two orders of magnitude, consistent with variations observed elsewhere.

The natural airborne radon and thoron concentrations are variable, ranging well over an order of magnitude in a typical 24-hour cycle and possibly up to three orders of magnitude.

During the sampling period, the average radon concentrations were calculated to be approximately 80 Bq/m^3, with average thoron concentrations being approximately 800 Bq/m^3.

The thoron activity concentrations are significantly higher than the radon activity concentrations. However, this is as expected (Arafura 2016) due to both the higher thorium content of the outcropping deposit and the shorter half-life of thoron.

In addition to real-time monitoring, longer-term radon and thoron concentration averages were determined. Detectors were placed in the field for a period of four months. The average concentrations of these results are provided in Table 7—10.

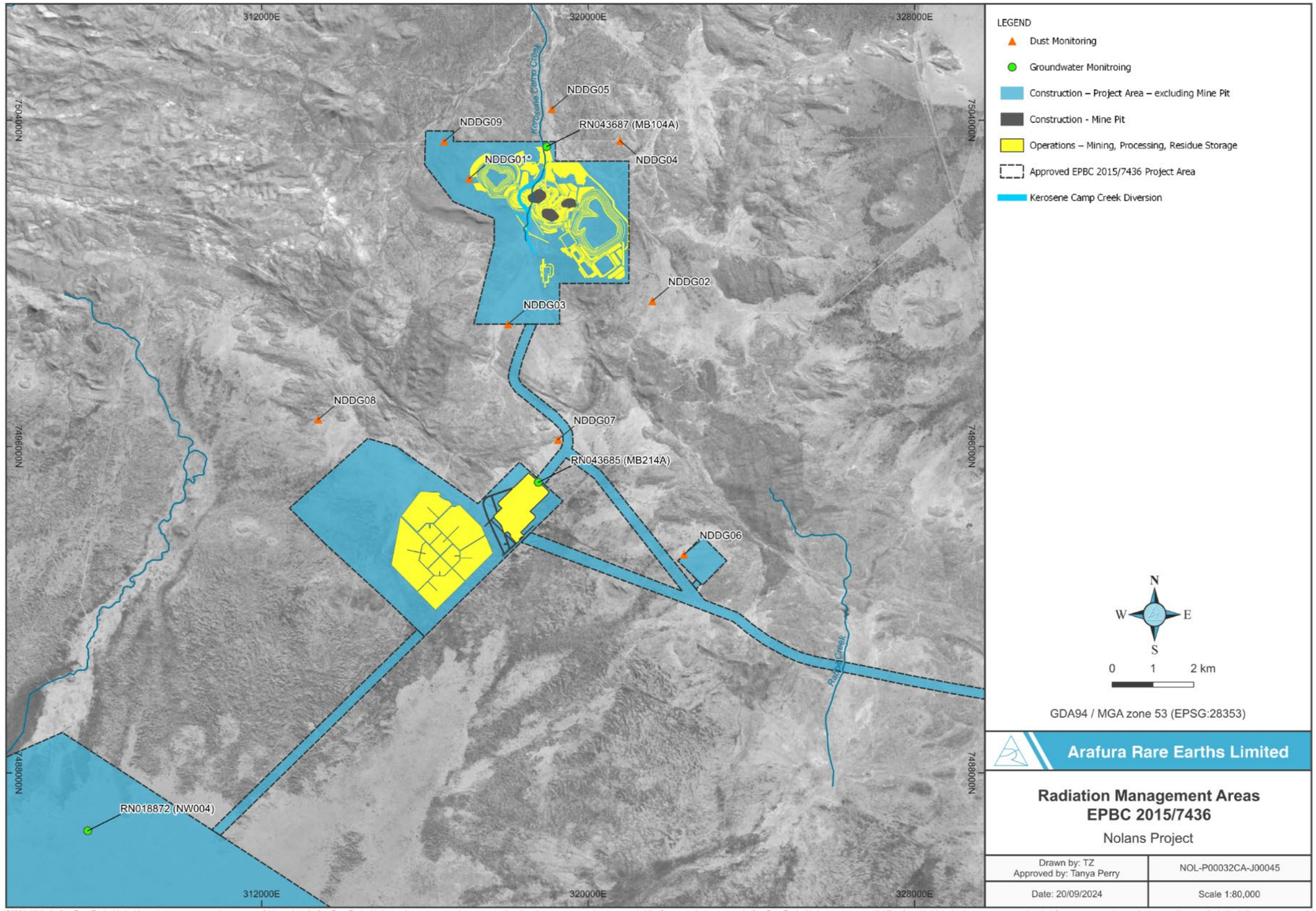
Table 7—10 Passive Radon and Thoron Averages

Location	Average concentration	
	Radon (Bq/m^3)	Thoron (Bq/m^3)
Within mine footprint	44	470
Outside mine footprint (regional)	29	120

7.3 Post-EIS Radiation Monitoring

Since the publication of the EIS, Arafura has increased the monitoring network of Environmental Radiation Monitoring Locations (ERMLs), which has enabled additional data to be collected to build on the existing baseline data. The ERMLs will continue to operate through construction and operations and into closure. The data will be used to determine the potential impacts of the Project. It is also expected that these ERMLs will be used post-closure to determine the effectiveness of closure activities.

Figure 7—4 shows the ERMLs at the Project site. A summary of the recent monitoring at the ERMLs is provided in the following sections.



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Figure 7—4 Current Nolans Project Environmental Radiation Monitoring Locations (ERMLs)

7.3.1 Radionuclide in Dust Monitoring

Two full years of dust deposition monitoring have occurred. Samples are collected on a quarterly basis from the eight sites shown on Figure 7—4, composited for a full year and then sent for gravimetric and radiometric analysis. A summary of results to date can be seen in Table 7—11 and Table 7—12 for rates of radionuclide deposition contained within the dust.

Table 7—11 Annual Average Monthly Dust Deposition

	Dust Deposition (g/m^2.month) (Average and range provided)	
	Year 1 (2022)	Year 2 (2023)
Average	1.12 (0.46 – 2.01)	0.78 (0.45 – 1.10)

Table 7—12 Annual Average Monthly Radionuclide Deposition

Analyte	Radionuclide Deposition (Bq/m^2 month) (Average and range provided)	
	Year 1 (2022)	Year 2 (2023)[6]
U238	0.03 (0.01 – 0.06)	0.04 (0.01 – 0.14)
U234	0.04 (0.01 – 0.10)	0.08 (0.01 – 0.41)[1]
Th230	0.03 (0.01 – 0.08)	0.05 (0.02 – 0.14)
Ra226	0.03 (0.01 – 0.07)	0.02 (0.01 – 0.05)
Pb210	3.89 (2.10 – 5.79)	4.08 (3.41 – 4.41)
Po210	3.88 (2.70 – 5.77)	3.37 (1.94 – 4.60)
Th232	0.02 (0.01 – 0.04)	0.02 (0.01 – 0.04)
Th228	0.03 (0.01 – 0.10)	N/A

The elevated Pb210 and Po210 results in Table 7—12 are due to environmental radon decaying. It is well documented that in the air, there are elevated concentrations of Pb210 and Po210 (UNSCEAR). Bonnyman in 1972 reported Pb210 deposition levels of 7.92 Bq/m^2. The elevated levels of Po210 are due to its ingrowth from Pb210.

[6] The Y2 result for U234 is influenced by one higher measurement. This is likely to be due to an analysis error, since the concentrations of U234 should be practically identical to the concentrations of U238 due to them being the same element. When this anomalous result is removed, the annual values for U234 are 0.04 (0.01 – 0.10), which is more consistent with the measured U238 values.

7.3.2 Radionuclides in Groundwater

In 2023 and 2024, sampling of groundwater was undertaken at four bores in the Project area and radiometrically analysed. Average results are shown in Table 7—13 and Table 7—14.

It is relevant to note that all these results are lower than the values reported in the EIS.

Table 7—13 Average Radionuclide Content (U238 Decay Chain)

Location	Radionuclide Concentration (Bq/l)						
	U238	U234	Th230	Ra226	Pb210	Po210	Rn222
Mine Area[7]	0.98	2.8	0.002	0.07	<0.013	0.002	2.0
Process Plant Area	0.60	1.7	<0.002	0.04	0.016	0.008	1.2
Borefield Area	--*	1.85	<0.002	0.03	0.028	0.006	--[8]

Table 7—14 Average Radionuclide Content (Th232 Decay Chain)

Location	Radionuclide Concentration (Bq/l)		
	Th232	Ra228	Th228
Mine Area	0.001	0.26	0.02
Process Plant Area	0.001	0.24	<0.02
Borefield Area	<0.001	0.11	<0.02

7.3.3 Ongoing and Future Environmental Radiation Monitoring

See Section 12.0 for an overview of the environmental radiation monitoring that will continue at the Project site.

[7] Mine area sample is down gradient and off deposit

[8] Excludes outlier data

8.0 RADIATION EXPOSURE AND MANAGEMENT

This section of the RPRWMP describes the management and controls for each of the Project phases. Arafura is committed to the health and safety of people and the protection of the environment. A risk-based approach will be applied to each phase of the Project to ensure that management and controls are commensurate with the radiological risk.

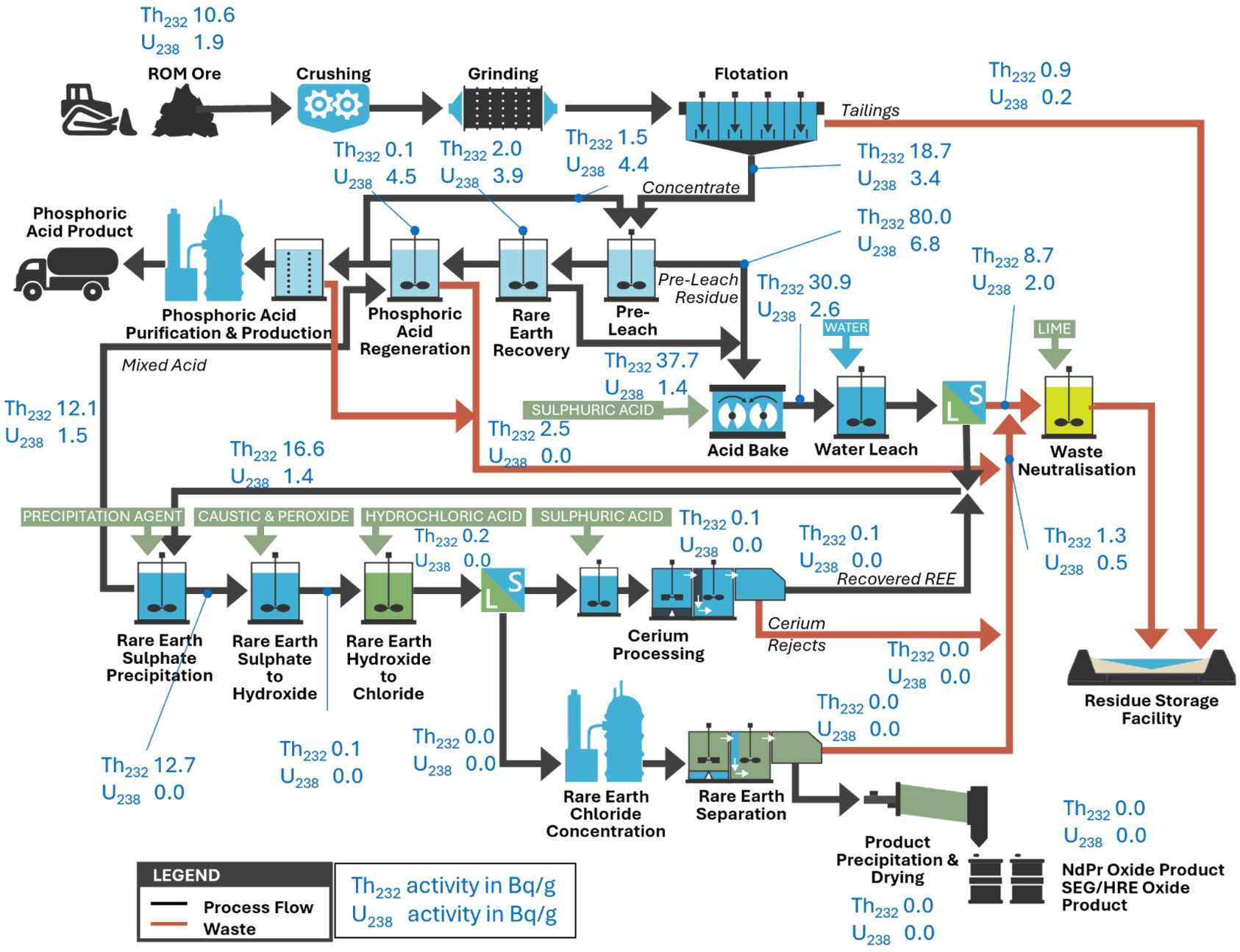
8.1 Radiological Characteristics of the Project

Arafura has a comprehensive understanding of the radiological characteristics of the Project. The mineralisation is well defined, with average mined ore concentrations of approximately 2,500 ppm for thorium (equivalent to 10.6 Bq/g) and 150 ppm for uranium (equivalent to 1.9 Bq/g).

For the processing of the ore, the deportment of radionuclides has been characterised through test work and is summarised in Figure 8—1.

Of note, radionuclides are removed through the process and reported to the RSF. Final products for sale that will be taken offsite are defined as non-radioactive.

The characterisation of the ore and the process streams provides the basis for determining the necessary controls to ensure that workers, the public and the environment are protected from any adverse levels of radiation.



Note: no Uranium or Thorium in the saleable products

Figure 8—1 Uranium and Thorium Deportment Through the Nolans Project Mining and Processing

8.2 Radiation Exposure Pathways

The management and controls apply to the radiation exposure pathways. For the Project, the primary radiation exposure pathways have been identified and are described as described in Sections 8.2.1 - 8.2.5 below.

8.2.1 External Gamma Irradiation

Gamma radiation is emitted from radioactive materials and depends upon the radionuclides in the materials and their concentration. Exposure to gamma radiation is usually controlled through:

- Limiting time of exposure.
- Separating the source of material from people or distancing people from the source.
- Shielding, where necessary.

Gamma radiation results in exposure inside the body from a source that is outside the body. Gamma radiation levels can be predicted based on empirical relationships between the different radionuclide concentrations and gamma radiation levels. Gamma radiation is also readily measurable using a handheld instrument or personal monitoring badges.

8.2.2 Inhalation of Long-lived Radionuclides in Dust

Dust can contain different radionuclides that can be inhaled. Depending upon the dust particle size and solubility of the radionuclides, the dose received from the inhalation can vary. The dose from dust inhalation is generally due to the longer-lived radionuclides in dust, which can continue to emit radiation until cleared from the body.

The chemical characteristics of the radionuclides mean they can be transported to different parts of the body through normal biokinetic processes. For predictive modelling, conservative default values are used when making dose assessments. During operations, dust inhalation will be measured through monitoring.

The radionuclide characteristics of the dust can also be measured, or knowledge of the process that generated the dust can be used to determine the characteristics.

8.2.3 Inhalation of Radon and Thoron Decay Products

Due to the presence of both uranium and thorium in the Project materials, there will be two gaseous isotopes of radon present. Radon-222 (known as radon) and Radon-220 (known as thoron). Each of these radon isotopes decay to produce decay products, which can be inhaled and deliver an immediate dose in the lungs.

The doses that arise from the inhalation of the isotopes of radon are treated differently from the doses received through the inhalation of radionuclides in dust. This is because the radon isotope decay products are short-lived, while the radionuclides in dust are long-lived (in this RPRWMP the term radon refers to the Radon-222 isotope, and the term thoron refers to the Radon-220 isotope).

8.2.4 Surface Contamination (As a Source of Potential Ingestion of Radionuclides)

Ingestion of radionuclides can occur when radioactive contamination is, for example, transferred from dirty hands to food. The ingestion pathway is generally a low exposure pathway and is not usually considered in worker dose assessment unless an incident occurs where there is exposure.

For the public, the ingestion pathway is considered. This could occur if radioactive emissions from the Project are deposited in the environment and are taken up into the food chain. The ingestion dose pathways can be predicted from air quality modelling before an operation commences and can be monitored during operations through environmental dust deposition monitoring.

8.2.5 Estimates of Total Dose

As part of the EIS (Arafura 2016), dose estimates were made for workers and the public. Dose estimates were revised following the publication of new dose factors by the ICRP in 2017.

The estimated doses continue to remain low and are defined as:

- Mineworkers – up to 5 mSv/y.
- Process Plant workers – up to 2.5 mSv/y.
- Accommodation village workers – up to 0.2 mSv/y.
- Residents of Aileron Roadhouse – up to 0.09 mSv/y.
- Residents of Alyuen Community and Alice Springs less than 0.05 mSv/y.

The occupational dose limit is 20 mSv/y, and the member of the public dose limit is 1 mSv/y.

To ensure that worker and public doses are optimised (and considered to be 'As Low As Reasonably Achievable – ALARA'), Arafura will implement internal management control levels. These are operational action levels that may be changed from time to time and set at levels lower than the dose limits that will trigger an investigation and subsequent additional controls.

The management control levels are:

- Occupational exposure – 10 mSv/y (with a pro-rate quarterly dose constraint of 2.5 mSv).
- Member of the public – 0.3 mSv/y.

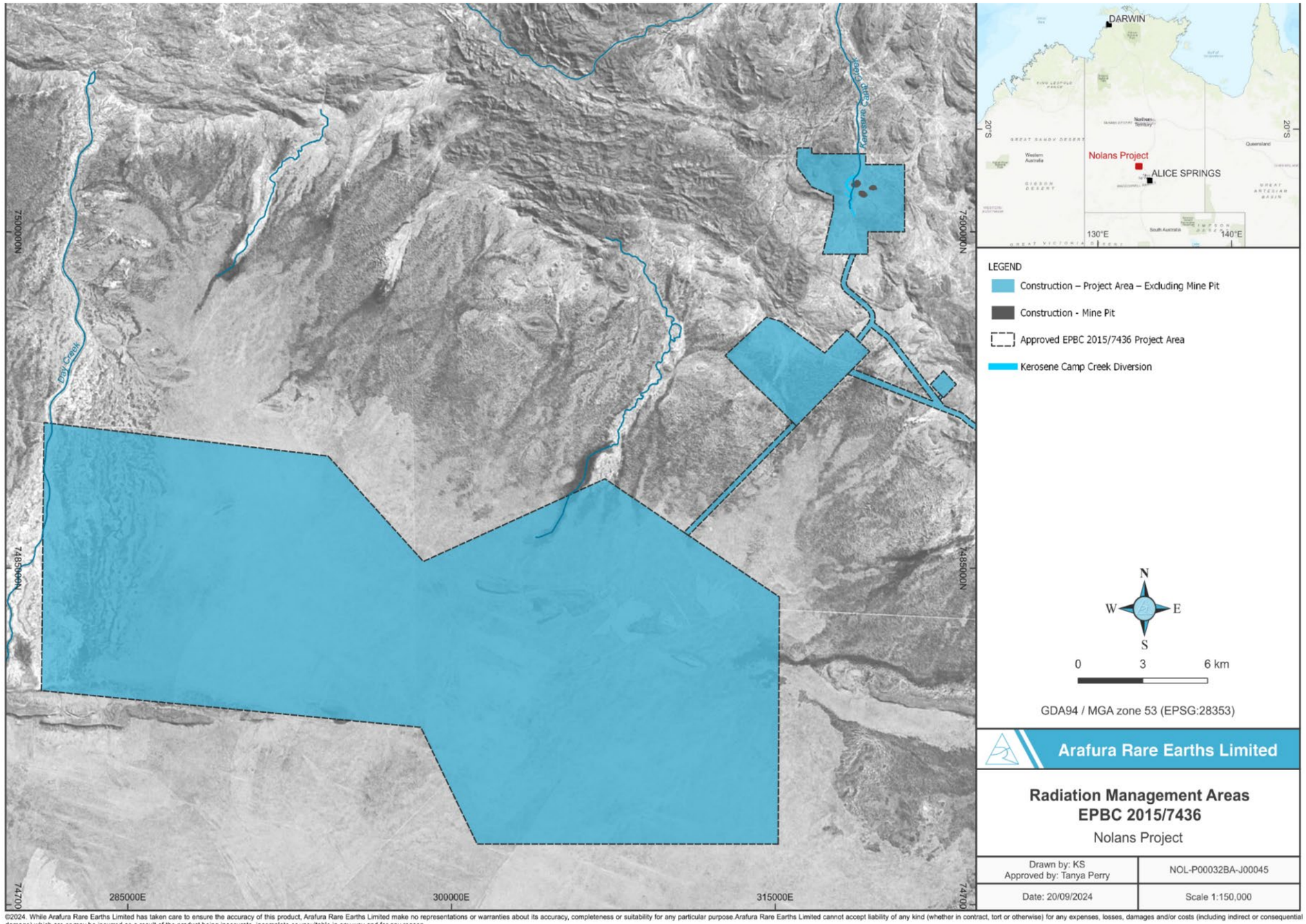
8.3 Project Areas and Risk-Based Radiation Management Controls

Identification of potential radiation hazards and the controls that will be implemented are described in the following sections according to Project areas and phases, due to the varied radiation exposure profile across the site and the phases of the Project.

Table 8—1 describes the phases of the Project, and the Project areas are shown in Figure 8—2, Figure 8—3 and Figure 8—4.

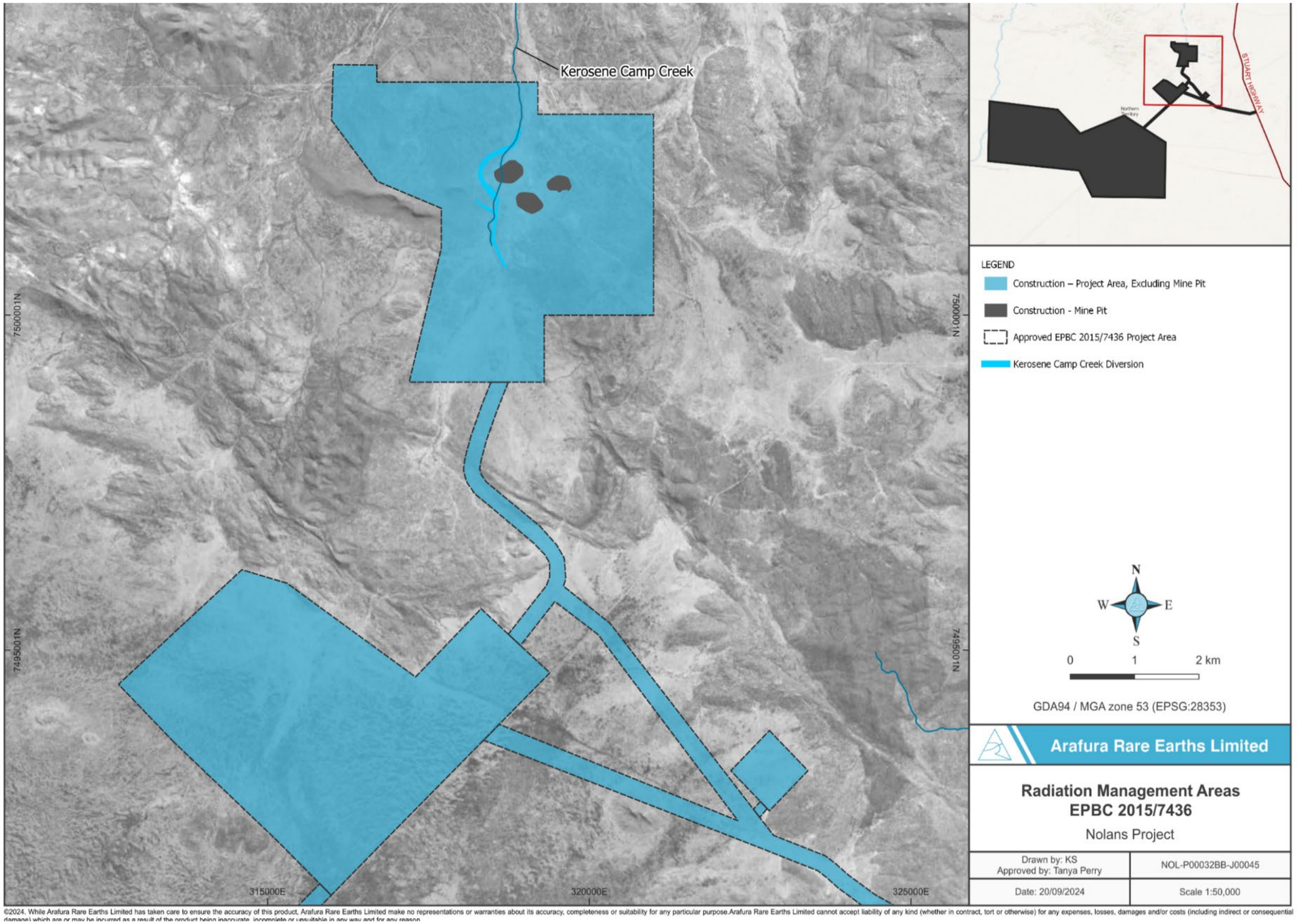
Table 8—1 Summary of Project Phases and Radiation Exposure

Project Phase	Activities	Occupational, Public or Environmental Exposure Due to Activities	Controls
Construction – all of site preparation and construction *(Excluding work on mine pit footprint)*	▪ Earthworks. ▪ Borefield development. ▪ Majority of the Kerosene Camp Creek diversion for mine site development. ▪ Flood protection bunds and channels to prevent water flow into the mine area. ▪ Mine area water collection ponds and other surface water management structures. ▪ Process Plant Construction. ▪ RSF Construction.	No occupational or environmental exposure.	See Section 8.4. Note that any activities on the mine pit footprints will result in implementation of the mining 'operational controls' (see Section 8.5). However, this is not planned to occur during this phase of the Project. Figure 8-2 and Figure 8-3
Construction – Mine Pit Development and Operations – Mining	▪ Finalisation of the Kerosene Camp Creek diversion. ▪ Removal of mine overburden (waste or spoil). ▪ Mining of mineralised material and unmineralised NORM. ▪ Development and management of WRD.	Occupational and environmental exposure.	See Section 8.5. Figure 8-4
Commissioning and Operations – Processing	▪ Commissioning and operations of the Process Plant. ▪ Commissioning and operation of the RSF.	Occupational and environmental exposure.	See Section 8.6.
Closure	▪ Site decommissioning. ▪ Closure of the RSF.	To be defined.	See Section 13.0.



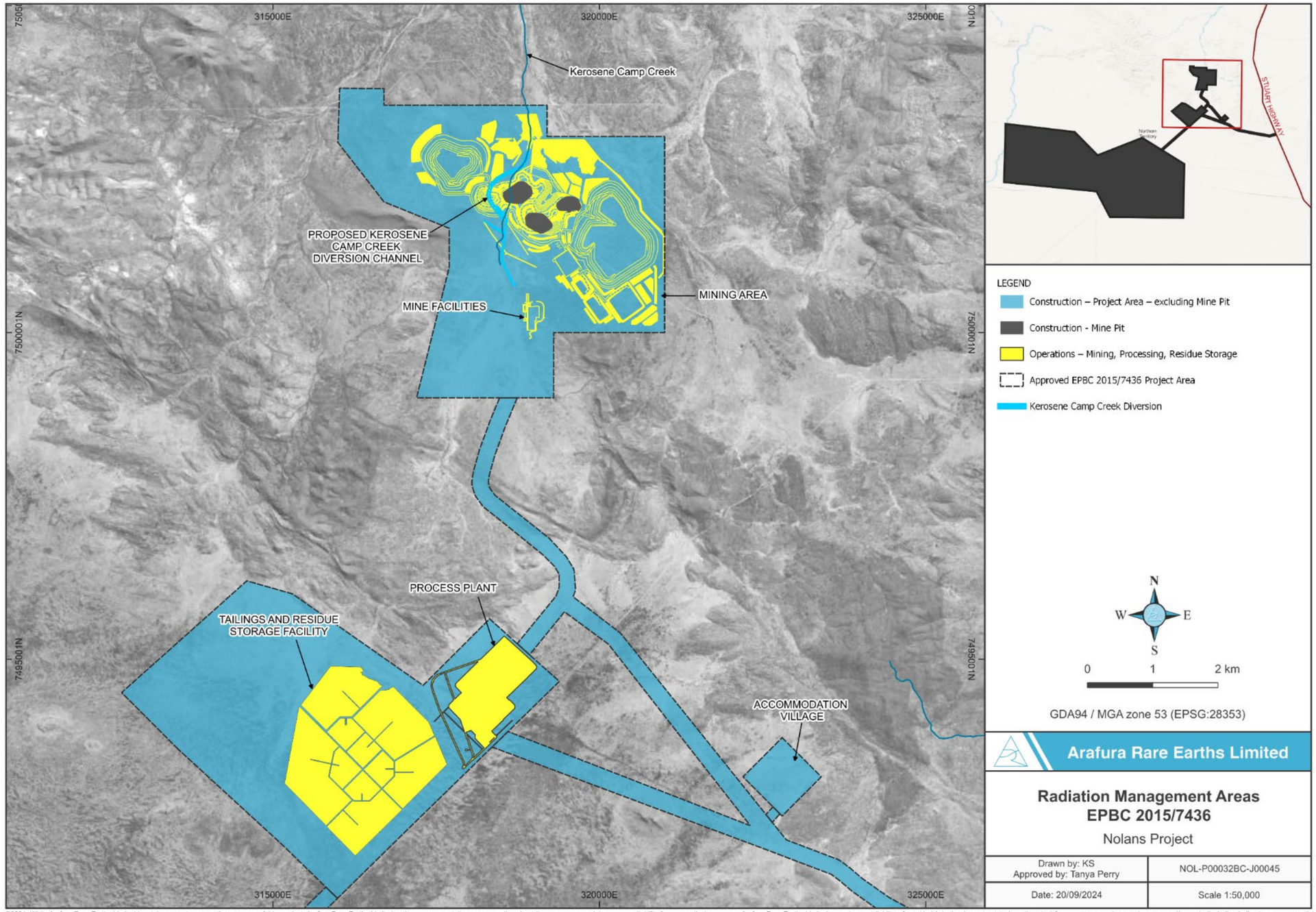
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Figure 8—2 Project Areas – Construction



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Figure 8—3 Project Areas – Construction, Closer View of Non-Borefield Areas



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Figure 8—4 Project Areas – Construction and Operations – Mining, Processing and Residue Storage

8.4 Activity Description and Controls: Construction – Project Area, Excluding Mine Pit

The first construction works at the Project site will involve a site preparation works phase, including earthworks, roadworks, initial foundation concrete pouring, communications infrastructure, and installation of further water bores in the borefield. An overview of the works is provided below.

The general radiation management controls that will be applied from the recommencement of site preparation work and will continue to apply through all construction and operational phases of the Project are also described below.

Construction works will recommence soon after the Project Financial Investment Decision (FID) is made.

8.4.1 Activity Description

Mining Area, Excluding Mine Pits

No construction activities will occur on the mine pit footprint during this phase of the Project (see Figure 8—2 and Figure 8—3).

Construction activities adjacent to the mine pit area will include site preparation of surface water management infrastructure, consisting of:

- Majority of the Kerosene Camp Creek diversion to enable mine site development.
- Flood protection bunds and channels to prevent water flow into the mine pit area.
- Mine area water collection ponds and other surface water management structures.

Construction activities within the area surrounding the mine pits are scheduled to commence approximately 9-12 months after the recommencement of construction.

The actual development of the mine (pre-stripping and building internal mine infrastructure (including explosives compound and haul roads) will be conducted by the mining contractor and is considered an operational mining activity (see Section 8.5).

Process Plant

The Process Plant will be constructed using a traditional method. Following cut to fill earthworks, a modular approach is used with concrete bases, structural steel support structures, various mechanical equipment, tanks, electrical instrumentation control services and interconnecting piping.

A fundamental design feature of the Process Plant is containment for potential spills. Process tanks and vessels will be located within concrete bunds for secondary containment. Extraction or containment will be used as design controls where dust generation is expected.

The key areas of the Process Plant are described below.

Beneficiation Plant

The Beneficiation plant will include crushing, grinding and classification, flotation, tailings dewatering, a process water pond and beneficiation reagents preparation infrastructure. Where necessary, bunding will be installed for spill containment.

Hydrometallurgical Process Plant

The Hydrometallurgical Process Plant includes the majority of the shared infrastructure and services. The main Process Plant is a series of complex processing areas where mechanical equipment, including pumps, tanks and agitators, pressurised and non-pressurised vessels and filters are utilised for extraction and separation processes to treat the concentrate from the Beneficiation Plant. The products will be Neodymium and Praseodymium oxide (NdPr), and mixed middle-heavy rare earths (SEG/HRE) oxides.

The key controls in this area of the plant are secondary containment for any spillages and containment of dust-generating activities. Enclosed structures will be either naturally or mechanically ventilated.

Sulphuric Acid Plant

The Sulphuric Acid Plant consists of solid sulphur receipt and handling, sulphur melting and filtration, contact and absorption processes, and product acid cooling. Sulphur is burned in pure oxygen, not air, and therefore, the plant area also includes a cryogenic oxygen plant, which consists of air intake, compression, purification, heat exchange, distillation, and heat exchange equipment.

No radiological controls are required in this area.

Non-Process Infrastructure

Non-process Infrastructure (NPI) relates to the infrastructure to support construction and mining activities and includes the development of infrastructure within the following areas:

- mine area offices
- accommodation village
- power supply and distribution
- water supply and distribution
- wastewater collection and treatment
- waste management
- fuel storage and distribution
- access roads and tracks
- vehicle wash down
- communications.

Additional water monitoring and abstraction bores are also planned to be installed in the borefield area.

During this construction phase, the following controls will be implemented. As noted, these controls will continue through the main construction and operations phases.

8.4.2 General Controls

8.4.2.1 Worker HSE Induction, Including Radiation Safety Induction

All employees and contractors will receive an induction upon commencement (with an annual refresher), informing them of the hazards associated with the workplace. The induction will include an introduction to radiation and the implementation of controls to ensure radiation safety for personnel. Specific training will be provided to personnel handling process materials containing elevated levels of radionuclides, including mine pit workers.

Managers and supervisors will receive additional training in the recognition and management of situations that have the potential to increase a worker's exposure to radiation.

Information on radiation will be made available to new workers as required, and a key role of the Radiation Safety Officer (RSO) and staff will be communicating all aspects of radiation. At the completion of each reporting year, workers will receive a formal communication about their radiation exposures for the previous year.

The inductions and training will be developed and undertaken by qualified trainers under the instruction of the Project RSO.

8.4.2.2 Site Access

Access to the main operational site will be through a secure site entrance (which may be a manned gatehouse or a remote-controlled recorded access/egress arrangement). The system will link to a record-keeping system to ensure that all personnel accessing the site have been appropriately inducted and trained.

8.4.2.3 Administrative

The development of operational administrative controls in this phase will include:

- Establishment of a pre-employment medical check program.
- Development of safe work procedures, including radiation safety requirements.
- Identification of requirements for personal protective equipment (PPE) and quality assurance systems, such as fit testing of respirators and face masks.
- Development and implementation of procedures to segregate, isolate and clean contamination or contaminated equipment.
- Mandatory use of personal hygiene facilities (such as boot wash and handwash facilities) at entrances to lunchrooms and offices.
- Procedures and licencing of any laboratory or field-based equipment that uses radiation (such as x-ray fluoroscopy and portable handheld XRF instruments).

The final engineering and detailed design for the plant was not complete at the time of preparation of this RPRWMP. However, it is expected there will be a number of radiometric density gauges installed throughout the Process Plant. The procurement, licencing, transport and installation of these gauges will comply with the relevant legislation. Once in service, the gauges will be monitored by the RSO and operated in accordance with the legislation.

8.4.2.4 Pregnant Workers

Specific procedures for pregnant workers will be developed and applied to workers who declare their pregnancies. The process will involve raising awareness through training and refresher training and moving them into areas or tasks that ensure that doses to the unborn foetus will be less than 1 mSv/y. This is based on the presumption that the foetus will be afforded the same level of protection as applies to a Member of the Public.

8.4.2.5 Radiation Safety Officer

Arafura will employ a suitably qualified and experienced radiation safety professional during the initial phase as the Statutory RSO.

The statutory role will transition from the part-time role currently undertaken by Arafura's Principal Geologist.

The Australasian Radiation Protection Accreditation Board will accredit the Statutory RSO and will be provided with appropriate equipment, staffing, and facilities to ensure the adequate implementation of their duties.

The Statutory RSO will directly advise the site General Manager and will be responsible for:

- Fulfilling the responsibilities of the Statutory RSO, as required by the regulatory authority.
- Overseeing the implementation of the RPRWMP and its procedures in collaboration with the Arafura Environment Team.
- Ensuring that all regulatory requirements for radiation protection are met and that related reports are submitted on time.
- Advising senior management on radiation protection requirements.
- Ensuring that the various radiation-related procedures and programs outlined in this RPRWMP are developed in accordance with the relevant standards.

8.4.2.6 Health, Safety and Environmental Management System

Arafura has developed a Health, Safety and Environmental Management Systems (HSEMS) for the construction and operations activities. Radiation is a hazard that is considered and addressed in the HSEMS.

The HSEMS includes (but is not limited to):

- Work Instructions (WI) for routine tasks, based on job hazard analysis and the identification and assessment of potential radiation hazards, will be considered in their development.

- Permit to Work (PTW) process to ensure that appropriate steps are taken to identify and mitigate hazards and risks to people, environment and equipment.
- Job Hazard Analysis (JHA) process for situations when a WI is not available. The JHA serves the same function as a WI, which is to document how to complete a task in a step-by-step process, with hazards and controls identified and documented for each step. Authorisation of JHA shall be gained before commencing the task.
- Radiation Clearance Procedure for machinery and equipment leaving site.
- Clearance check process for tools and equipment leaving the Project Area.

8.5 Activity Description and Controls: Construction and Operations – Mine Pit and Mining

8.5.1 Radiation Area Control Status

The three main exposure pathways for the mine are:

- *Gamma exposure:* from working close to exposed mineralisation. Workers on foot (drill and blast crews, grade control and some technical staff) will have real-time gamma monitors to control gamma doses. Mining equipment operators have shielding from their equipment.
- *Dust Exposure:* from dust generated from mineralised material. Dust suppression through use of water sprays and air-conditioned cabins on vehicles enclosed will control exposures.
- *Inhalation of the decay products of radon:* these are not expected to be significant due to natural ventilation. Air-conditioned cabins will provide control for equipment operators. Monitoring will be undertaken, and respiratory protection will be used if necessary.

The following area classifications will be applied to the mine area and controls implemented accordingly:

Radiation Supervised Area – will be implemented for the full operational mining area, including mine pits, stockpiles and surrounds, ore haulage route, maintenance areas and truck parking area (go-line), due to the potential for radiation doses to exceed 1 mSv/y.

Radiation Controlled Area – will be implemented for mine development, drilling and other in-pit operations associated with ore mining, due to the potential for radiation doses to exceed 5 mSv/y.

Controlled areas will also be implemented for specific locations associated with mineralised material, as identified by the Statutory RSO, in consultation with the Chief Geologist and Mine Manager.

Note that the controls outlined in Section 8.4 will continue to apply.

8.5.2 Activity Description

Mine development, followed by mining of ore, is expected to commence approximately 2 years after FID. The work will be conducted by a dedicated mining services contractor.

Once the mine development work commences, the mine will be considered operational and the controls in this section will apply.

Early mine development activities include clearing and grubbing, finalisation of the initial Camp Creek diversion, pre-stripping, and construction of haul roads and stockpiles. Additional grade control and resource in-fill drilling together with assay sample preparation could also be undertaken.

Mining will use conventional open pit mining methods including drill and blast, waste and ore mining with hydraulic excavators, rear dump trucks and Run of Mine (ROM) haulage activities to transport ore to the Process Plant, approximately 8.5 km to the south.

The mine is expected to have a life of 28 years, with processing of ROM stockpiles to continue until fully depleted for a further 10 years.

8.5.3 Classification of Mined Materials

Mined material will be trucked from the mining operations to one of four locations based on the classification of the material type:

- Ore will be placed on the ROM stockpile with designated zones for each ore type. The different material types will then be blended to produce an average product for processing.
- Material defined as low-grade mineralisation will be stockpiled separately for future processing.
- Material defined as NORM waste will be placed in the centre of the Waste Rock Dump (WRD), where it will be progressively covered by benign waste material.
- Material defined as benign waste will be used to form the outer cover of the WRD, with some separately stored for final closure cover material.

The estimated quantities of these four material types across the life of the mining operation are listed in Table 8—2.

Table 8—2 Classification of Mined Material

Material	Approx LOM Volumes (Mt)	Combined Activity Concentration (Bq/g)	Comment
Ore[9]	39.9	≈ 10Bq/g	Classified as *radioactive*
Low grade ore	1.0	> 1Bq/g and < ≈10Bq/g	Classified as *radioactive*
NORM Waste	90.8	> 1Bq/g and < ≈5Bq/g	Classified as *radioactive*
Benign waste	87.2	< 1Bq/g	Not classified as *radioactive*

Note that the definition of NORM waste (where NORM stands for Naturally Occurring Radioactive Material) is material with naturally occurring uranium and thorium concentrations that exceed 80 ppm and 240 ppm, respectively.

8.5.4 Controls

8.5.4.1 Handling of Mined Materials

A key control for operations (and later closure) is to ensure that mined material is properly sorted and that material with low uranium and thorium levels is segregated and stored. Segregation of mined materials is necessary to support the building of the waste rock stockpiles, which will encapsulate the NORM waste.

Scanning devices, such as gate portals, have been shown to be inefficient due to the low levels of radioactivity in the mined materials. Arafura will utilise in-mine management methods used at nearly all other mines (including those mining radioactive materials).

[9] Some areas of higher grade material will be mined and stored separately and blended for processing

A feature of the Nolans Bore deposit is that the geology and layout of mineralisation lends itself to bulk analysis of materials. This allows for sorting decisions to be made in the mine itself, with materials being visually identifiable.

The following controls will be implemented:

- The primary control will be geological modelling, resource estimation and detailed mine planning, which will identify areas where radioactive mineralised material, low-grade altered rock and potential host rock NORM exist. Confirmatory in-pit geological mapping, radiometric surveys, grade control, drilling, and analysis will complement the mine planning.
- Quality assurance measures, such as regular monitoring, will be used to confirm the sorting of the mined materials.
- Grade Control Technicians will follow a safe work procedure to monitor gamma levels at the dig face or on rock piles.

Arafura will utilise material and production management software to provide data support and track the placement of mined materials.

8.5.4.2 Change Rooms

The Project will have a change room arrangement to enable workers to change into work clothes at the commencement of their shift and then shower and change into casual clothes at the end of their shift, as per the routine site requirements. The changerooms will also enable workers in the mine to shower and change before entering clean workplaces (such as offices). This requirement will apply to workers in designated *Radiation Supervised* and *Radiation Controlled* Areas.

Dirty clothes will be laundered on site, and wastewater will be sent to the on-site water treatment plant.

8.5.4.3 Inductions, Training and Information

In addition to the standard site induction, (as noted in Section 8.4.2.1), the mining contractor personnel will have an additional mine-specific radiation induction to include the specific radiation hazards associated with the mining activities. This will cover:

- Requirements for radiation monitoring.
- Hygiene controls and the minimisation of the spread of contamination.
- Importance of dust controls.
- Worker responsibilities with regard to instructions issued by the Statutory RSO.

Mine supervisors will receive additional training in the recognition and management of situations that have the potential to increase a worker's exposure to radiation.

8.5.4.4 Mobile Equipment Specifications

All heavy mobile equipment will be air-conditioned. Operating practices will stipulate windows to be closed and air conditioning always on. The aim is to minimise the potential impacts of dust.

8.5.4.5 Dust Suppression

Dust will be minimised using standard dust suppression techniques around processing buildings and product and tailing stockpiles areas as appropriate, i.e. wetting of materials before handling, wetting of roadways and dust collection systems on drills. Wearing of respiratory protection will depend on the exposure risk.

8.5.4.6 Wash-Down Facilities

A separate wash-down pad will be established for vehicles intending to leave site. All vehicles or equipment leaving site that have been used in the mining area, mining operation or in the Process Plant will be required to be washed by the user. The vehicles and equipment will then be checked for radioactive contamination by suitably trained personnel.

If free from contamination, a certificate will be issued, and the vehicle/item will be allowed to be removed from site. Washing, cleaning, and obtaining a radioactive contamination clearance are the responsibility of the equipment users, whether they are company staff or contractors.

Plant, equipment or items that have come into contact with radioactive materials, will not be allowed to leave site without a certificate of clearance or documentation, as required by the Transport Code (ARPANSA 2019).

8.5.4.7 Transport of Ore to Process Plant

Trucks will transport ore from the mine to the Process Plant. The ore has yet to be crushed at this stage and is expected to generate minimal dust during transport. In the event that dust is generated, water sprays will be used as a control, with trucks required to drive through a water spray arrangement.

8.5.4.8 Radiation Clearance Certificates

Certificates will be issued for items that are permanently leaving site, such as hire equipment items being returned to owners, earthmoving equipment and departing drill rigs. Copies of the certificates will be kept on file for future reference.

An item will be defined as not contaminated when there is less than 0.4 Bq/cm^2 for beta and gamma emitters, and low toxicity alpha emitters and less than 0.04 Bq/cm^2 for all other alpha emitters, as defined in the ARPANSA Transport Code (ARPANSA 2019). Equipment that cannot be cleaned below this level will be subject to controls, as defined by the Statutory RSO.

Other controls are personal protective equipment, procedural changes, housekeeping and job rotation.

8.5.4.9 Occupational Radiation Monitoring

The full suite of radiation monitoring to be implemented for Operations – Mining, Processing and Residue Storage is covered in Section 11.0.

8.6 Activity Description and Controls: Operations - Processing

8.6.1 Radiation Area Control Status

The three main exposure pathways for the Process Plant are:

- *Gamma exposure:* identified locations in the plant (pipes and tanks) contain sufficient quantities of gamma-emitting materials to represent an exposure hazard. The engineering controls for these areas include shielding and implementation of access controls.
- *Dust Exposure:* identified locations in the plant (driers, dry storage vessels and dust collectors) have the potential for generation of dust-containing radionuclides. The controls for these include containment, access control and specifically designed ventilation systems (with baghouses, as necessary).
- *Spillage of process materials:* these can become dust hazards if allowed to dry, or sources of gamma radiation. Controls for spillage are focussed on ensuring any spillage is contained and able to quickly and efficiently be cleaned using wet methods (such as hosing down to a sump) before it dries out.

Figure 8—5 shows the entire Process Plant and areas where radiation will be present. It can be seen that the green icon identifies the areas where spillage controls are necessary. The yellow and red icons identify areas where gamma and dust controls are required.

Radiation Supervised Area – the entire Process Plant and RSF will be designated as a Radiation Supervised Area, from the commencement of commissioning onwards.

Radiation Controlled Area – the areas denoted by the red and yellow icons in Figure 8—5 will be designated as Radiation Controlled Areas. The Statutory RSO and Process Plant Manager will review these over time.

Note that the previously identified controls will continue to apply for this phase.

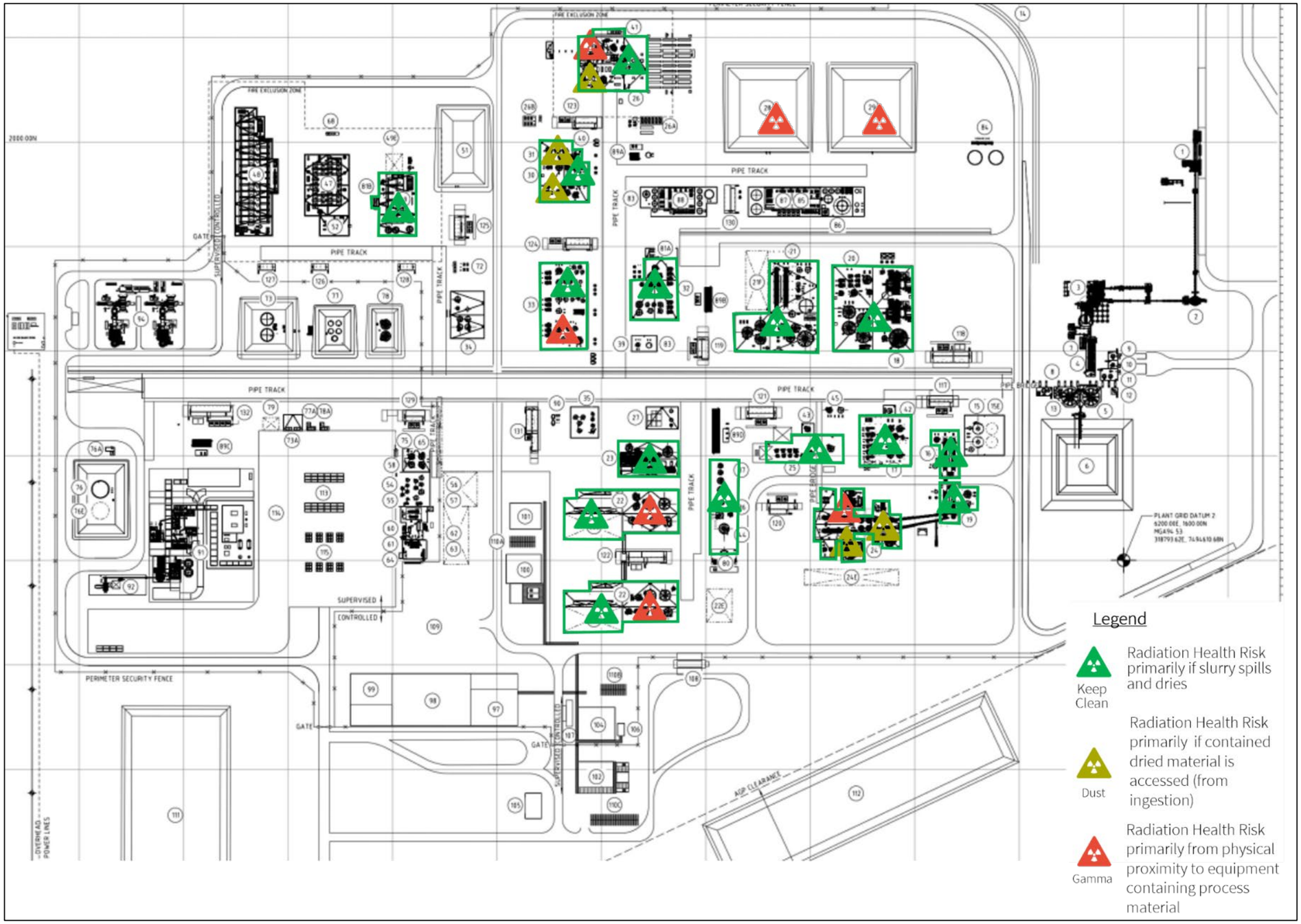


Figure 8—5 Radiation Control Areas of the Process Plant

8.6.2 Activity Description: Commissioning

Non-process infrastructure, namely buildings, wastewater treatment plant and other equipment, will be commissioned using industry-standard processes. Commissioning of the Process Plant will commence with mechanical completion testing, followed by energisation and testing with air and water. All equipment and control systems will be tested during this period.

The final stage of commissioning will involve the introduction of ore and chemical reagents. At this point, the Process Plant will effectively be live, and the risks associated with operations are assumed to be present. The risks of radiation exposure associated with the processing and refining of the ore will be managed and controlled from this point onwards.

8.6.3 Activity Description: Processing

At a high level, the process consists of the following production steps:

- Beneficiation.
- Phosphate extraction which consists of:
  - Pre-leaching the flotation concentrate in phosphoric acid.
  - Heating of the weak phosphoric acid to precipitate minor dissolved rare earths.
  - Separation of the pre-leach residue and precipitated rare earths for further processing in rare earth extraction.
  - Regeneration of the weak phosphoric acid with sulphuric acid, which is recycled from the rare earth extraction, to produce gypsum waste and strong phosphoric acid.
  - Purification of the excess phosphoric acid to produce a merchant-grade phosphoric acid for sale.
- Rare earth extraction, which further processes the rare earth-rich residue from phosphate extraction:
  - Acid baking in conventional paddle mixers with sulphuric acid at 250ºC, followed by water leaching of the discharge.
  - Precipitation of clean rare earth sulphate from the water leach liquor to produce a mixed acid, which is recycled to phosphoric acid regeneration.
- Rare earth processing, where the rare earth sulphate is dissolved in water before precipitation of the rare earths as a hydroxide using caustic soda. Followed by selective leaching of non-cerium rare earths with hydrochloric acid to produce a cerium-free rare earth chloride solution and a low-grade cerium stream.
- Cerium processing, where the low-grade cerium is dissolved in sulphuric acid before processing in a solvent extraction circuit to produce a high-grade cerium liquor and a raffinate stream containing the remaining rare earths. The cerium liquor is neutralised and sent to the RSF, and the raffinate is recycled to recover the rare earths.

- Separation, which consists of two sequential rare earth solvent extraction circuits, for the production of a SEG/HRE rare earth product and an NdPr product. Both of which are precipitated using oxalic acid, prior to calcining to produce oxides.

All by-products from processing are retained in the processing circuit until either reutilised in the process, distributed for sale, or transferred to the RSF via a closed-circuit system. The individual processing areas are interconnected through various mechanical, piping and conveyor systems to ensure effective handling of the materials.

8.6.4 Controls

The general controls for the entire Process Plant are listed below. They are focused on ensuring that any spillages are controlled, contained and easily removed.

- Crushers and conveyor systems fitted with dust control measures, such as dust extraction.
- Enclosed equipment for targeted areas, incorporated during design to minimise dust emissions.
- Use of scrubbers or bag houses, where appropriate.
- Bunding to collect and contain spillages from tanks containing radioactive process slurries, with bunding sized to contain at least 110% of the volume of the largest tank in the event of a catastrophic failure.
- Tailings and the tailings pipeline corridor to be bunded to contain any spillage.
- Sufficient access and egress for mobile equipment to allow cleanup where large spills are possible.
- Wash-down water points and hoses supplied for spill cleanup.
- Procedures to control exposures during the maintenance of ventilation systems.

For the Radiation Controlled Areas (identified by the yellow and red icons on Figure 8—5), design reviews have been conducted and specific controls included:

- increased pipe and tank wall thicknesses, shielding or separation from walkways to reduce gamma radiation levels.
- restricted access - in some cases, key card access will be required.
- installation of dedicated extraction/ventilation systems.
- online monitoring.

The radiation monitoring program will assess worker and public doses. It will also be used to determine the effectiveness of the design and operational controls. See Section 11.0.

8.6.4.1 Radiation Clearance Certificates

Certificates will be issued for items that are permanently leaving site, such as hire equipment items being returned to owners, earthmoving equipment and departing drill rigs. Copies of the certificates will be kept on file for future reference. An item will be defined as not contaminated when there is less than 0.4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters and less than 0.04 Bq/cm^2 for all other alpha emitters, as defined in the ARPANSA Transport Code (ARPANSA 2019). Equipment that cannot be cleaned below this level will be subject to controls, as the Statutory RSO defines.

8.6.4.2 Occupational Radiation Monitoring

The full suite of radiation monitoring to be implemented for Operations – Mining, Processing and Residue Storage is covered in Section 11.0.

9.0 RADIOACTIVE WASTE MANAGEMENT

Arafura does not intend to transport radioactive waste from the Nolans Project Area. The mining, processing and waste management will all occur on site.

9.1 Storm and Wastewater Management

Water that has come in contact with mineralised material, such as stormwater runoff from the ore stockpile or Process Plant, may contain entrained radioactive materials. The aim of site design is to collect and contain all surface water. The method of control involves the construction of sedimentation dams, from which water can be reclaimed, and appropriate collection bunds and channels. Sedimentation and spillages of mineralised materials will be reclaimed when safe to do so.

Wastewater from wash-down areas and cleanup water will be captured for treatment, reuse, or evaporation.

9.2 Process Residue Management

The Process Plant will produce three individual residue streams:

- beneficiation residue (tailings).
- gypsum residue (gypsum).
- water leach residue (WLR).

All waste streams generated from the Process Plant will be pumped as a slurry to the RSF - a purpose-built, long-term, earth-fill, lined containment facility. The RSF footprint has been designed for the entire life of mine (LoM) and will be a permanent facility that will be closed and rehabilitated on site without the need for any further residue handling (see Site Closure Section 11.0 below).

The RSF will have a decant pond for liquor evaporation which may have a build-up of radioactive sediments over time. The pond will be excavated from time to time depending on the operational requirements.

The RSF will be constructed in a series of stages over the LoM. Each stage will comprise two individual cells, which are constructed and operating concurrently - one cell to store the beneficiation tailings stream and the second cell for the combined gypsum and WLR streams.

The beneficiation tailings cell will have a soil liner and full basin underdrainage system. The gypsum/water leach residue cell will be lined with a high-density polyethylene (HDPE) geomembrane located above a soil liner with underdrainage system, leakage control and recovery system. In total, 10 cells (five beneficiation tailings cells and five gypsum/water leach residue cells) will be constructed to store the LoM residue production of approximately 20.6 Mt.

Each cell will operate for approximately seven to nine years and will then be decommissioned and capped in preparation for rehabilitation, which will occur concurrently with ongoing operations for the first four cells (the final two immediately post-closure). See Section 13.0 for details regarding Site Closure.

Subsequent cells will be constructed immediately adjacent to the initial structure. In addition to the volume occupied by the residue, each cell can contain rainfall runoff due to the extremely short duration of storms experienced in Central Australia.

9.3 Contaminated Waste Management

In this document, radioactively contaminated waste is defined as material that is itself not radioactive but is contaminated by radioactive material, such as process materials. In many cases, this material can be decontaminated and recycled. In some cases, this is unable to occur, and disposal is required.

Radioactively contaminated waste materials generated by the Project are expected to include equipment and wastes from operational areas, including equipment, steel, discarded conveyor belts, rubber lining material, pipes, filter media and used protective equipment that is contaminated with radioactive ores or process materials.

The criteria for a waste to be defined as radioactively contaminated waste is when the material exceeds the operational surface contamination clearance standard (see APPENDIX G of this document) or has a total radionuclide concentration of more than 1 Bq/g.

Where practical, radioactively contaminated waste will be decontaminated and disposed of via normal waste disposal methods or sent for recycling. Where this is not possible, and depending on the nature of the radioactively contaminated waste, several disposal options would be available as follows:

- Incorporation into the waste rock dump.
- Disposal in a dedicated contaminated waste on-site landfill facility (note that this may be a separate area of the site landfill).
- Disposal into the mine at the end of operations.

The Project will capture and retain records of the disposal, including type of material, quantities and locations of radioactively contaminated waste.

Arafura will document and implement a contaminated waste management procedure (refer to APPENDIX K), which aims to minimise the quantities of waste to be disposed of.

Arafura recognises that additional waste disposal licences are required under the *Northern Territory Radiation Protection and Control Act 2004* and Regulations 2007. These will be obtained prior to commencement of the Construction – Mine Pit phase.

9.4 Additional Controls

The current proposal for the Nolans Project does not include the transport of radioactive products or waste offsite. Radioactive samples may require transport off site, in which case Arafura will engage a qualified service provider to transport the materials. Arafura's Radiation Transport Requirements are specified in APPENDIX B and an associated Radiation Material Transport Procedure in APPENDIX C, in accordance with the ARPANSA Transport Code (ARPANSA 2019). These documents will be implemented as part of Arafura's Health and Safety Management System.

The Radiation Transport Requirements will be provided to any service provider engaged by Arafura to transport radioactive materials offsite. The document details the management requirements that the service provider must meet and have appropriately reflected in their Transport Management Plan.

To support the RPRWMP, the following procedures have been developed and included as appendices of this Plan:

- Radioactive Materials Transport Management Requirements (APPENDIX B)
- Radiation Transport Management Procedure (APPENDIX C)
- Gamma Radiation Monitoring Procedure (APPENDIX D)
- Long Lived Radionuclides in Dust Sampling Procedure (APPENDIX E)
- Radon Decay Product Sampling Procedure (APPENDIX F)
- Thoron Decay Product Sampling Procedure (APPENDIX G)
- Radiation Surface Contamination Monitoring Procedure (APPENDIX H)
- Radiation Gauges and Sealed Sources of Radiation Management Procedure (APPENDIX I)
- Dose Assessment Procedure (APPENDIX J)
- Radiation Equipment Clearance Procedure (APPENDIX K)
- Radioactively Contaminated Waste Procedure (APPENDIX L)
- Environmental Radiation Monitoring Procedure (APPENDIX M)

The procedures are integrated within and support the Project's HSEMS.

10.0 DEMONSTRATION OF COMPLIANCE

Compliance requirements for radiation impacts relate to dose limits for workers and members of the public and screening levels for non-human biota as outlined in Section 6.1 (Approach to Radiation) and 12.2 (Impacts to Non-Human Biota). Ongoing monitoring aims to ensure that impacts do not exceed compliance levels and that action levels are established to provide timely alerts when doses may be approaching compliance levels. In Section 16, the company commits to providing a statement of compliance as part of the annual report submitted to DCCEEW. See APPENDIX M.

11.0 OCCUPATIONAL RADIATION MONITORING

The purpose of the occupational radiation monitoring program is to achieve three key aims:

- To provide raw data for the assessment of worker and public doses. The calculated doses are then compared to the recognised dose limits and the internal Arafura dose constraints. As noted in Table 11—3, doses for workers will be assessed on a three-month basis and compared to pro-rata three-month limits and constraints.
- To identify unexpected changes in the radiation levels, which will act as initiators of further investigations. Table 11—3 provides the formal defined action levels.
- To ensure that controls are effective as designed and continue to operate as required.

Upon commencement of commissioning of the Process Plant, a two-stage monitoring program will be implemented for all personnel working in the process and waste storage facilities, as described below.

The first stage will focus on start-up and commissioning, with the twin aims of confirming the preliminary dose estimates and ensuring that the installed radiation controls are effective. The second stage will be focused on routine operations.

11.1 Commissioning

The Commissioning Radiation Monitoring Program is outlined in Table 11—1 and is expected to run for approximately three to six months or when the process is deemed to be stable. Once this point has been reached, a review of all monitoring will be undertaken, and a decision will be made on implementing the Operations Radiation Monitoring Program, as outlined in Table 11—2.

A key part of the commissioning monitoring program is assuring that the design controls (such as tank wall thicknesses and access controls) are effective. As areas of the Process Plant are commissioned, specifically the controlled areas identified in Figure 8—5, routine monitoring will occur, with results documented. A review will be undertaken where controls are not achieving the desired outcomes.

Table 11—1 Commissioning Radiation Monitoring Program

Radiation Exposure Pathway and Monitoring Method	Mine	Process Plant	Administration and Workshop Areas
Gamma radiation Survey with handheld monitor.	Weekly surveys in mining operations areas, including: ▪ Mine pit. ▪ Truck unloading areas. ▪ Go-line. ▪ Maintenance and office areas. ▪ Sample layout and preparation areas. Monitoring to commence once the ore body is contacted or when drilling commences.	▪ Weekly walkthrough survey of all plant areas.	Monthly area surveys
Gamma radiation Personal OSLD badges.	▪ Real-time monitoring of workers in mine pit. ▪ Monthly OSLD badges on all production miners (those involved with ore). ▪ Monthly OSLD badges on selected development miners (those not involved with ore). ▪ Monthly OSLD badges on selected support staff (such as maintenance personnel).	▪ Monthly OSLD badges on all Process Plant workers. ▪ Monthly OSLD badges on selected support staff (such as all maintenance personnel).	*Not applicable*
Airborne dust Sampling pumps with determination filter paper, dust mass and gross alpha.	Five times per week sampling of personal dust monitors [Note 1] for: ▪ Equipment operators ▪ Maintenance personnel	▪ Ten times per week sampling of personal dust monitors [Note 1]. ▪ Ten fixed location samples each week in selected work areas.	Monthly area samples
Radon and Thoron Decay Products Sampling using the appropriate method.	Selective, real-time continuous monitoring in mining area. Daily radon and thoron decay product sample in each mining area.	▪ Weekly grab samples in Process Plant.	*Not applicable*

Radiation Exposure Pathway and Monitoring Method	Mine	Process Plant	Administration and Workshop Areas
Surface Contamination Surface alpha and beta monitoring.	Weekly survey of: ▪ Workshop ▪ Offices ▪ Lunchroom ▪ Change room	Monthly survey of: ▪ Process Plant ▪ Workshop ▪ Offices ▪ Lunchroom ▪ Change room	Monthly area survey

Note 1: Personal dust monitors are portable devices attached to individuals to assess an individual's exposure levels to dust. A random subset of personnel will be selected each week (5 from mining area, 10 from processing area) to wear the devices.

11.2 Operations

Table 11—2 Operations Radiation Monitoring Program

Radiation Exposure Pathway and Monitoring Method	Mine	Process Plant	Administration and Workshop Areas
Gamma radiation Survey with handheld monitor.	Monthly areas surveys in mining operations areas, including: ▪ Mine pit. ▪ Truck unloading areas. ▪ Go-line. ▪ Maintenance areas. ▪ Geological sample layout and preparation areas – when in use	Monthly walkthrough survey of all Process Plant areas, including conveyors.	Quarterly area surveys
Gamma radiation Personal OSLD badges	▪ Real-time monitoring of workers in pit. ▪ Quarterly OSLD badges on production miners (those involved with ore). ▪ Quarterly OSLD badges on selected development miners (those not involved with ore). ▪ Quarterly OSLD badges on selected	▪ Quarterly OSLD badges on all Process Plant workers. ▪ Quarterly OSLD badges on selected support staff (such as maintenance personnel).	*Not applicable*

Radiation Exposure Pathway and Monitoring Method	Mine	Process Plant	Administration and Workshop Areas
	support staff (such as maintenance personnel).		
Airborne dust Sampling pumps with radiometric and gravimetric analysis of filters.	Five times per week sampling of personal dust monitors [Note 1] for: ▪ Equipment operators ▪ Maintenance personnel ▪ Geological sample layout and preparation areas – when in use	▪ Ten times per week sampling of personal dust monitors [Note 1]. Ten fixed location samples each week in selected work areas.	Monthly area samples
Radon and Thoron Decay Products Sample using the appropriate method.	Selective real-time continuous monitoring in mining area. Daily radon and thoron decay product grab sample in each mining area.	Monthly grab samples in concentrator area and hydrometallurgical area.	*Not applicable*
Surface Contamination Surface alpha and beta monitoring.	Monthly survey of: ▪ Workshop ▪ Lunchroom ▪ Offices ▪ Change rooms	Monthly survey of: ▪ Plant ▪ Workshop ▪ Lunchroom ▪ Offices ▪ Change rooms ▪ Laundry	Quarterly area survey

Note 1: Personal dust monitors are portable devices that are attached to individuals in order to assess an individual's exposure levels to dust. A random subset of personnel will be selected each week (5 from mining area, 10 from processing area) to wear the devices.

An overview of the monitoring methods is provided below, and monitoring methods and training will be developed to ensure that staff undertake monitoring in the correct manner.

Gamma radiation:

- Survey with handheld gamma monitor.
- Personal gamma radiation badges.
- For identified tasks, real-time electronic gamma dosimeters will be used to provide immediate and detailed information for task management.

Radionuclides in airborne dust:

- Low-volume air sampling pumps with inhalable sampling heads will be used to collect an air sample onto a filter paper - which would then be gross alpha counted to determine the alpha activity concentration in air. The collected mass would also be measured to determine the mass concentration in the air.

Radon and thoron decay product concentrations:

- Grab a sample using the Borak method (note that there are a range of methods available (DMP 2010)).

Ingestion of radionuclides:

- Walkthrough surveys of workplaces, change rooms and offices will be conducted using a surface contamination probe.

11.3 Action Levels

The company has established action levels (also known as investigation or trigger levels) to identify radiation levels requiring investigation and additional controls. The action levels do not represent an immediate danger to life and health; rather, they are a leading indicator for management. The action levels are based on published recommendations and amended to take into account the particular exposure pathways for the operation. With the aim of identifying when exposures, if left unattended, may lead to doses that exceed the annual dose limits (Department of Mines and Petroleum 2010). Managing Naturally Occurring Radioactive Material (NORM) in mining and mineral processing guideline. NORM Reporting requirements: Resources Safety, Department of Mines and Petroleum, Western Australia).

If radiation measurements are at or above Arafura's Action Levels, then the responses detailed in Table 11—3 shall occur immediately. Note that the intention of the Action Level is to initiate an investigation, with the aim of identifying root causes. The method of investigation to be applied must align with the requirements of the HSEMS.

Table 11—3 Site Wide Radiation Action Levels

Radiation Measurement Type	Action Level	Response
Gamma radiation (handheld)	5 µSv/h	▪ Investigate and identify source. ▪ Consider additional shielding. ▪ Provide real-time electronic monitoring.
Gamma radiation (real-time monitors) - external gamma radiation	100 µSv/day	▪ Investigate. ▪ Consider worker rotation, where exposure management is required.
Gamma radiation (OSLD) (monthly result)	1 mSv/month	▪ Investigate and identify source. ▪ Consider worker rotation, where exposure management is required.
Radon/thoron decay product concentrations	2 µJ/m^3	▪ Increase monitoring – if levels do not reduce, consider PPE or ventilation.
Surface Contamination	Visual contamination and/or 0.4 Bq/m^2 (α+β)	▪ Immediate clean up in "clean" areas. ▪ Notification to work area supervisor
Airborne Dust	0.2Bq/m^3	▪ Identify source and review controls. ▪ Investigate additional controls.
Total Dose	2.5 mSv per quarter	▪ Investigate exposure pathways and review controls.

11.3.1.1 Monitoring Equipment and Support

Arafura will source monitoring equipment that is approved for use by the NT Regulator.

Table 11—4 provides a typical list of monitoring equipment.

In addition, the monitoring programs will ensure the following:

- Recognised sampling methodologies are documented and regularly reviewed, including pre-operational checks.
- Procedures for routine instrument calibration, including regular traceable calibration checks and more frequent on-site calibration checks.
- Spare instruments are used for redundancy and when equipment is undergoing off-site calibration.
- The results of all calibrations of radiation monitoring equipment are recorded and registered by the Statutory RSO.
- The calibration records will contain the instrument type, model and serial number of the instrument, the date of the calibration and the particular radiation source used.

- An instrument maintenance and repair program are developed.

Arafura will establish quality assurance in the context of the broader health, safety and environmental management plan, and in accordance with Australian Standards. Radiation protection requirements will be part of this system.

Table 11—4 List of Typical Equipment Required for Occupational Radiation Monitoring

Radiation Measurement Type	Sampling Methods and Equipment
Gamma radiation	▪ Handheld gamma radiation monitor. ▪ Electronic dosimeters.
Personal gamma monitor	▪ OSLD badges (provided and analysed by a service provider).
Airborne Dust	▪ 2 L/min personal dust pumps fitted with approved inhalable filter holders. ▪ Microbalance for weighing filters. ▪ Alpha slide drawer assembly and rate-meter.
Radon and Thoron Decay Products	▪ Real-time radon and thoron detectors. ▪ 2 L/min personal dust pumps fitted with approved inhalable filter holders. ▪ Portable alpha slide drawer assembly and rate-meter.
Surface contamination	▪ Surface contamination probe and rate-meter.

11.3.1.2 Dose Assessment Method

The method for calculating worker and public doses will be in accordance with the recognised international methods outlined by the ICRP (ICRP 2007), the IAEA (IAEA 2014) and in Australia by ARPANSA (ARPANSA 2005). A summary is provided below.

The total dose is calculated as the sum of the committed effective doses from each of the exposure pathways, which are:

- Irradiation by gamma radiation.
- Inhalation of the decay products of radon and thoron.
- Inhalation of radionuclides in dust.

11.3.1.3 Gamma Radiation

OSLD badges will be provided to individuals in workgroups and the average will be applied across the entire workgroup. When the results for an entire workgroup are not available (for example, through a mass loss of badges), then estimates will be made based on the previous set of results. The estimates will be made by the Statutory RSO, who will take into account the work conditions during the period when monitors were not available. All assumptions will be recorded.

Individual results that are anomalous may be excluded from the overall workgroup average, if there is good reason and this reason is formally justified and noted. For example, an outlier may be due to identified variances in work, tasks, hours or incidents, which do not reflect the overall workgroup. Therefore, after investigation, the Statutory RSO may exclude this result and record the justification for its exclusion.

11.3.1.4 Radionuclides in Dust

The assessment of dose from the inhalation of radionuclides in dust can be complex. The recognised process considers factors such as the radionuclide composition of the dust and its characteristics (including particle size, solubility, and biokinetics). Summary dose conversion factors (which are factors that convert an intake into a dose) are provided in Table 11—5 and are based on the most conservative solubility values provided by ICRP (ICRP 2017) and the relative radionuclide activity concentrations.

Note that dose conversion factors are provided for two particle sizes. The dose assessment is anticipated to use the more conservative 1 µm factors. However, there may be circumstances where the factors for 5 µm may be used. These will be determined and justified by the Statutory RSO.

Table 11—5 Dust Dose Conversion Factors

Dust Type	Dust Dose Conversion Factor (µSv/αdps*)	
	AMAD** = 1 µm	AMAD = 5 µm
Ore dust	6.0	3.5
Beneficiation tailings	6.2	3.6
Beneficiation concentrate	5.9	3.4
Processing residue	5.4	3.1

* The unit αdps refers to '*alpha disintegrations per second*' and is measured during gross alpha counting of dust filters.

**AMAD = Activity Median Aerodynamic Diameter

When calculating a dust dose, the following steps will be undertaken:

- Determine an average long-lived radionuclide concentration in air (in units of αdps/m^3) by averaging the activity concentrations for a number of dust samples for a particular workgroup.
- Multiply the average concentration by the exposure period in hours to determine exposure (in αdps h/m^3) for the exposure period.
- Multiply by the standard breathing rate of 1.2 m^3/h to give an intake (αdps) for the exposure period.
- Multiply by the dust dose conversion factor to give a dose (µSv) for the exposure period.

11.3.1.5 Radon and Thoron Decay Products

The general method for calculating doses from exposure to radon and thoron decay products is based on determining exposure and then applying a dose conversion factor. The ICRP has recently adopted a new dose conversion factor for radon and thoron decay products, and these are listed in Table 11—

6. Note that a calculated average is included in this table, as the ICRP dose conversion factors do not cover all workplace types.

Table 11—6 Radon and Thoron Decay Product Dose Conversion Factors

Project Area	Dose Conversion Factor (mSv per mJ.h.m^{-3})	
	Radon (Rn222) Decay Products	Thoron (RN220) Decay Products
Mining environment	3.1	1.4
Indoor Workplaces	5.7	1.6
Average	4.4	1.5

When calculating radon and thoron decay product dose, the following steps will be taken:

- Determine average radon and thoron decay product concentration in air (in units of μJ/m^3) by averaging the activity concentrations for a number of filter samples for a particular workgroup. The sampling methods are detailed above.
- Multiply the average concentration by the exposure period in hours to determine exposure (in μJ.h/m^3) for the exposure period.
- Multiply by the standard breathing rate of 1.2 m^3/h, to give an intake (μJ) for the exposure period.
- Convert μJ to mJ and apply dose conversion factor to give dose (mSv) for the exposure period.

12.0 ENVIRONMENTAL MONITORING – CONSTRUCTION AND OPERATIONS

12.1 Monitoring Program

Arafura has undertaken environmental baseline monitoring since the commencement of exploration and has a detailed database of results (as summarised in Section 7.0).

A fixed network of eight (8) Environmental Radiation Monitoring Locations (ERMLs) was installed by Arafura in 2020 for the purposes of further baseline radiological assessment. The baseline program is intended to transition to an operational monitoring network.

The purpose of the ERML network is to provide a standard and regular method to monitor potential increases in environmental radioactivity due to the operation of the Project. The monitoring results will be compared to the pre-operational results and reported annually. On a rotational basis, a high-volume sampler may be used, where power is available.

The ERMLs will continue to function through the operation phase and then continue post-closure. This will provide a continuous record of any impact the Project has on the environment.

The pre-operational baseline data will also provide the naturally occurring radiation levels that will be subtracted from the member of public dose estimates to ensure that only the Project increment is being reported.

Figure 7—4 shows the locations of existing environmental dust monitoring sites, which are the locations of the ERMLs. Table 12—1 outlines the monitoring that will be undertaken at each ERML, together with the timing for implementation. This monitoring will build from the earlier baseline data collected.

Table 12—1 Environmental Radiation Monitoring Location Program

Medium	Analysis Parameter	Monitoring at each ERML	Use	Timing for implementation
Air	Ambient gamma radiation levels.	At each ERML - handheld gamma meter	Identification of Changes	Area survey prior to the recommencement of construction. Once every 3 years at the ERMLs.
	Radon and Thoron concentrations in air.	Quarterly passive detectors for radon and thoron.	Identification of Changes to Public Dose Assessment.	Implement for commencement of Construction – Mine Pit.
	Dust concentrations in air and radionuclide analysis of collected dust for the long-lived	High Vol Sampler (power required) established at the camp.	Public Dose Assessment.	For recommencement of construction.

Medium	Analysis Parameter	Monitoring at each ERML	Use	Timing for implementation
	radionuclides of U and Th decay chains.	(Location to be considered following initial data collection).		
Dust - naturally depositing from air	Dust deposition from air and analysis for long-lived radionuclides in the U and Th decay chains.	Quarterly passive deposition gauge and analysis of annual composite for mass and radionuclides.	Identification of Changes Non-human biota assessment.	Dust collection and analysis to continue, as described in Section 7.3 (baseline). Non-human biota assessment to follow commencement of Operations – Mine and Process Plant.
Soil	Radionuclides in soils and analysis for long-lived radionuclides in the U and Th decay chains.	Surface and 15cm soil samples and at the location of ERML and prior to closure.	Identification of changes. Identification of any post-contamination (for closure).	Prior to commencement of Operations – Mining. Prior to commencement of site closure.
Groundwater (GW)	Gross α + Gross β.	Consistent with existing monitoring program (see Section 7.3.2).	Identification of Changes.	Continue current annual sampling.
	Elemental U and Th.			
	Radionuclides - long-lived U and Th decay chains.	One-off selected bores.		Prior to commencement of Operations – Mining.

Note: For dust deposition, elemental analysis of the dust can also assist in providing an indication of the source of the deposited dusts.

12.2 Impacts on Non-Human Biota

The recognised method for determining the impacts on non-human biota (NHB) is the ERICA assessment method (where ERICA is short for Environmental Risk from Ionising Contaminants: Assessment and Management). ARPANSA notes that the ERICA Software Tool is applicable for use in Australia for assessing radiological impacts to NHB (ARPANSA 2010). The software uses changes in media radionuclide concentrations and species-specific whole-body concentration ratios to provide a standardised measure of radiological impact to reference species.

The latest version of the ERICA software was released in June 2023 (version 2.0) (ERICA 2023).

Arafura undertook predictive ERICA modelling for the EIS, which indicated that radiological impacts to non-human species would be low. To confirm the modelling and provide ongoing monitoring, Arafura will undertake ERICA assessments for standard species, including Australian-specific species that have published concentration ratios.

ARPANSA notes that a screening level for non-human biota of 10 µGy/h is appropriate and that exceedances of this level should initiate a more detailed investigation (Reference: Guide for Radiation Protection of the Environment, Guide G-1 ARPANSA 2015).

Assessments will be undertaken at locations defined by the location of the ERMLs. This is because the *media concentration* data, which is the foundation of an ERICA assessment, would be derived from annual composites of dust deposition monitoring results at the established ERMLs.

Established natural background radionuclide concentrations will be subtracted from the sample results to ensure that only project-originated materials are considered in the impact assessment.

ERICA assessments will commence once the operations phase commences and be conducted annually initially, with the intention to reduce the frequency of assessment if the collected data supports a lower-risk monitoring program.

13.0 SITE CLOSURE

As described in Section 9.2, Project closure planning will be progressive over the life of the Project to meet the required actions, following baseline and operational monitoring. This is a standard industry practice, allowing the Project to adapt to changes in the Project Plan and a continuously growing database fed by operational monitoring activities.

As described in Section 17.0 below, an annual review of this RPRWMP will be conducted to identify improvement opportunities. In addition, a 5-year external audit of the implementation of this RPRWMP will be conducted. The audit will be used to consolidate collected information and, where appropriate, provide additional inputs for the closure planning.

13.1 Overview

The closure and final rehabilitation of the Project are governed by the Mine Closure Plan (MCP). However, it is acknowledged that radiation-related criteria form one part of the overall closure management for the site. The RPRWMP is intended to be a stand-alone document that informs the radiation management requirements of the MCP. The plans are necessarily linked, and any changes to final closure options in the MCP must be made in consideration of the requirements detailed in the RPRWMP, and the RPRWMP revised accordingly, where required. Note that all closure options relevant to radiation management are included for completeness in this RPRWMP. All future development of mine closure planning will lead from the content and requirements described within this RPRWMP (and associated references provided).

From a radiological perspective, the closure and rehabilitation aim is to ensure that the radiation levels in the Project Area and surrounding areas are consistent with the pre-development levels post-closure.

Arafura conducted a post-closure radiological risk assessment, focussed on potential failures of controls for the RSF. In addition, the gaps in existing knowledge have been identified and will continue to be reviewed and addressed throughout the operational phase of the Project.

Waste management decommissioning/closure activities are to comply with commitments in the approved EIS, relevant Northern Territory and Commonwealth legislative requirements, including the guidance provided in ARPANSA, Radiation Protection Series 9 - Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing, 2005.

At closure, contaminated plant and equipment will be cleaned and decontaminated (where possible) and moved off site for recycling. Procedures will leverage those developed for the construction and operational phases as described in Section 9.3. Where this is not possible, it would be safely and securely encapsulated and disposed of in the RSF or waste rock facility.

The major rehabilitation feature from a radiological perspective is the RSF. The major earth-moving activities will involve benign material that is not classified as radioactive and therefore won't be subject to any radiological controls upon closure.

An evaluation of alternative closure and rehabilitation strategies for the mine pit and RSF was undertaken for the Nolans Project as part of the drafting of the EIS Supplementary Report submitted

to the NT government in 2017 (Section 4.1.1, page 281). Options for closure included encapsulation of NORM (not backfilling the pit) and backfilling of the open pit, and these were evaluated based on minimising short and long-term financial risk. The EIS Supplementary Report (2017) provides the detailed evaluation completed by Arafura; however, a summary of the key conclusions is provided in Table 13—1 below.

Table 13—1 Evaluation of alternative rehabilitation and closure strategy of backfilling pits (EIS Supplementary Report 2017)

Aspect of closure and rehabilitation strategy	Detail
Potential Benefits – Backfilling Pits	
Reduced visual impact	▪ Size of final WRDs will be significantly reduced if waste material is backfilled
Reduced post-closure footprint	▪ Size of final WRDs will be significantly reduced if waste material is backfilled, footprint required for final landform will, therefore, be significantly reduced.
Reduced exposure of WRDs to weather elements over 1,000 years	▪ EIS Supplementary Report considered post-closure exposure scenarios, which included the failure scenario of erosion of TSF/RSF/WRD walls ▪ Risk assessment considered potential radiological impacts to be minor compared to other impacts of failure (refer to Table 4-11, Section 4.9, page 323 of the EIS Supplementary Report, 2017).
Potential Negatives – Backfilling Pits	
Not able to access ore beneath final pit void for future mining	▪ Full extent of additional mineral resource beyond the deposit at depth is currently unknown. ▪ Similar resources and grades have been identified below the current pit limits ▪ Backfilling reduces potential to extend the life of mine of the Project beyond the current 38 years.
Increased environmental risk	▪ Increased risk of impacts to environmental aspects such as surface water and groundwater and increased dust if WRDs are not progressively rehabilitated. ▪ Increased management requirements during operations to ensure environmental impacts are minimised, avoided and/or mitigated.
Waste rock stored (i.e. not rehabilitated) until closure	▪ WRD left as open dumps at natural angle of repose until closure. ▪ WRD left unshaped and un-contoured are more susceptible to wind and water erosion. ▪ Leaving TSFs and RSFs uncovered until end of mine life poses significant risks.

Aspect of closure and rehabilitation strategy	Detail
Significant cost of 'double-handling' waste rock	▪ Cost of removal of all facilities, returning them to a single pit is estimated at $900M. ▪ Cost of this magnitude would likely make the Project unviable, or, at the least, have a significant impact on the life of the Project because the lower grade material would be far less economic. ▪ Progressive backfill can be undertaken if multiple pits are in operation, however the Nolans Project is a single pit operation.
Limiting potential opportunity to reprocess tailings, a potential future resource	▪ Although not included in the scope of this Project, the beneficiation tailings represents a potential resource which may be exploited in the future. ▪ Backfilling this material would limit this opportunity.
Limited progressive closure throughout operations	▪ Arafura's objective is to progressively rehabilitate disturbed areas as soon as they are available, making it likely that most WRDs will be closed, rehabilitated and stable well before mine closure. ▪ Backfilling the pit would require disturbing areas that have been demonstrated as already safe and stable. ▪ Also proposed to progressively cover TSFs and RSFs, to re-disturb these facilities would increase the potential risk of release and substantially increase the post-closure monitoring period of the Project.
Tailings and residues moved to Ti Tree Basin Catchment	▪ In response to stakeholder concerns about the processing facility in the Ti Tree basin catchment, Arafura has proposed a two-site option with residues located approximately 8 km south of the open pit. ▪ The risks associated with disturbing the residue material to transfer it back to the pit would increase significantly as it the material would have to be re-slurried to pump back to the open pit. ▪ Deposited material would then require a period of settlement and dewatering before rehabilitation could safely occur.
WRDs will still exist post-closure	▪ The total volume of materials extracted from the open pit will not fit back in the mined-out pit void. ▪ The beneficiation process and subsequent rare earths processing will increase the mined quantity of ore due to the addition of reagents, water, etc. ▪ Waste rock is estimated to have a swell factor of 30%. ▪ Approximately 150 Mt will exist above the pit or remain as a remnant WRD.

Based on the above considerations, leaving the WRDs/TSF/RSF in situ and capping at closure was the preferred option based on acceptable residual risks and being economically viable.

Note that standard industry practice has adopted encapsulation of NORM as a low-risk option, where relevant to the aspect of closure. This approach is aligned with the WA NORM Guidelines (DMP 2010).

13.2 Closure Design

This section details the closure design and considerations associated with closure domains that require measures to manage radiation. Details with respect to generic mine closure for these domains (e.g. seeding, ripping, slope design, etc.) are outlined in the MCP and are not covered in this document.

The closure domains considered in this RPRWMP are the:

- Waste rock dumps – WRD
- Residue storage facility – RSF
- Process plant
- ROM pad
- Mine pit.

13.2.1 Waste Rock Dumps

The two WRDs at Nolans have been designed and scheduled to ensure encapsulation in a staged development and rehabilitation approach across the LoM schedule (refer to Appendix N).

Overburden and waste rock will be deposited in two purpose-constructed WRDs over the LoM, with a final waste rock quantity of 178 Mt (71 Mbcm), consisting of 49% benign and 51% NORM by volume. The two WRDs will hold waste volumes built to a relative level (RL) of 720 m, with a height of 60 m above natural surface, which is consistent with the local topography. Each of the two waste dump locations is divided into a number of discrete dumps to allow staged encapsulation and progressive rehabilitation (see Figure 13—1 and Figure 13—2).

NORM waste will be encapsulated within the WRD by separating the NORM waste and placing centrally within the dump. Benign waste will be placed on the outer embankments and/or stockpiled to cover NORM waste cells as mining progresses.

The waste landforms designed have sufficient capacity to store all the waste mined from the pits.

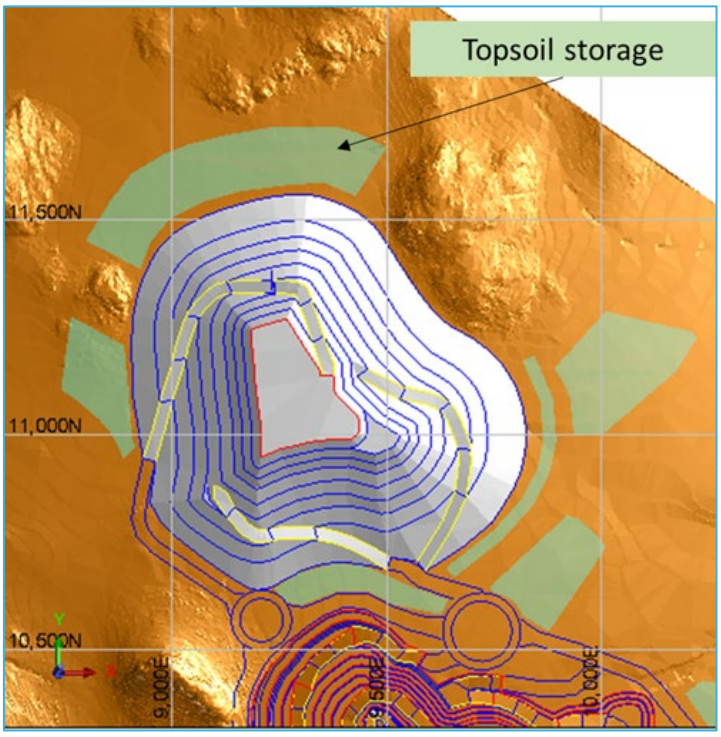


Figure 13—1 Northern Waste Dump (Final Surfaces) and Topsoil Stockpiles

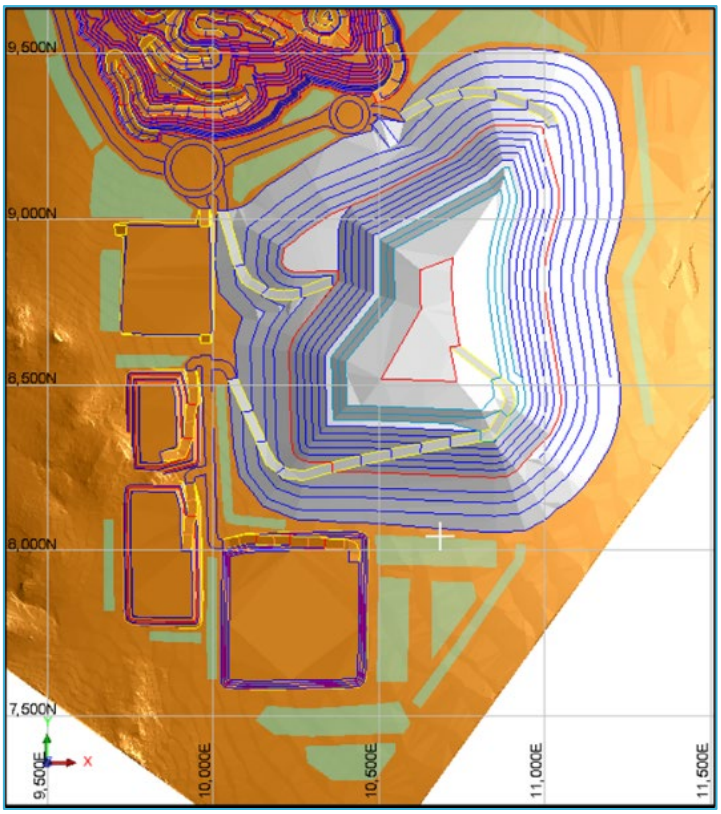


Figure 13—2 Southern Waste Dump (Final Surfaces), and Topsoil and Long-Term Stockpiles

The southern WRD is the largest WRD (approximately 1 km by 1.25 km) split up into five stages with a total capacity of 69.2M cubic meters. The final stage contains the majority of the volume capacity (63%), consisting of entirely benign waste to encapsulate the previous four stages.

The northern WRD is smaller (approx. 1 km by 750 m) and split up into three stages to ensure encapsulation requirements, with a total capacity of 22.2M cubic meters.

Progressive reprofiling of the completed WRD stage annulus' will be achieved with dozer push. This will be followed by other rehabilitation requirements, as described in the Mine Closure Plan, including topsoil placement, contouring and seeding.

Waste separation and management is covered in Section 9.0 above.

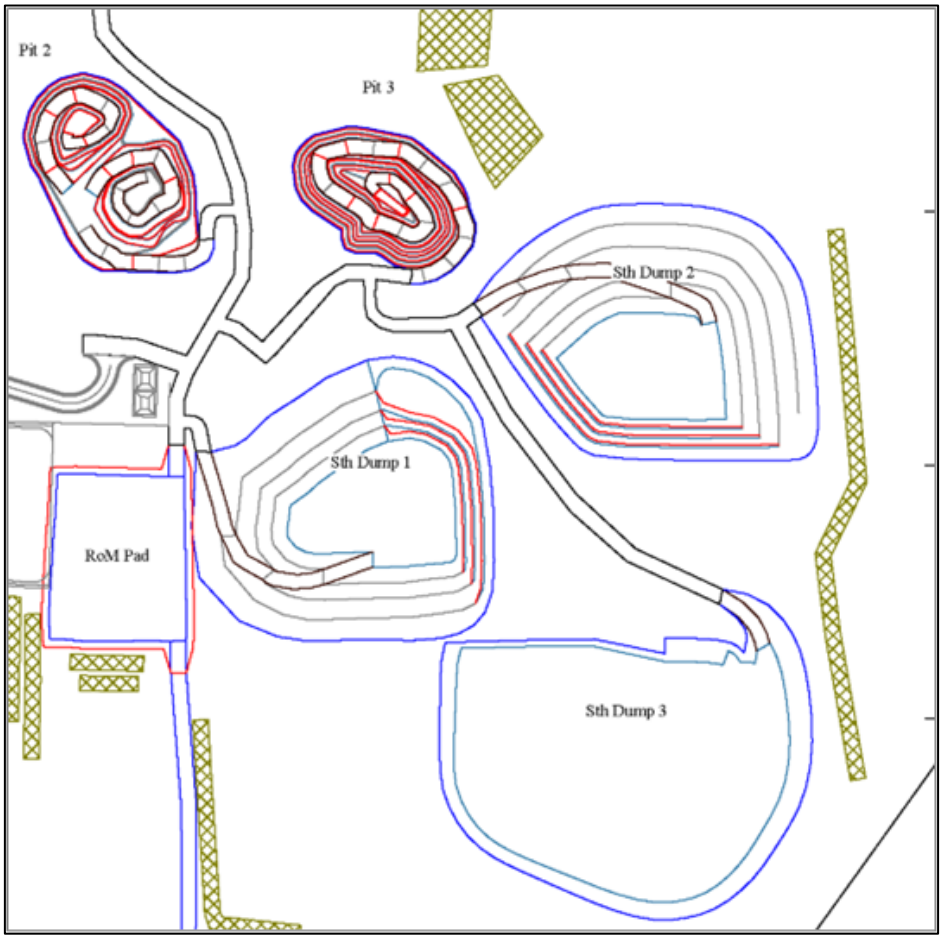


Figure 13—3 Example of the Southern WRD Staged Development and Rehabilitation Plan (Year 7)

The following rehabilitation measures are proposed with respect to the WRDs:

- A minimum encapsulation thickness of 3.5 m has been recommended from a geotechnical stability standpoint covering the outside annulus, to ensure a minimum of 2 m thickness be maintained from any face sloughing.

- The minimum 2 m benign thickness ensures benign volumes can be effectively used to achieve all encapsulation requirements, given the similar volumes of both NORM and benign waste over the LoM plan.
- Detailed staged encapsulation and progressive rehabilitation plans will be prepared during future Operational Mine Planning work.

As per approval conditions under the Mine Management Plan (approved by the Northern Territory regulator), the WRD stage development and rehabilitation plans will be reviewed by an independent engineer, before operations commence and as rehabilitation progresses.

13.2.2 RSF

Deposition during the final stages of operation will be adjusted to develop the final residue surface profile, with a gentle slope towards the closure spillway. This will minimise the re-shaping of the residue surface required to ensure it drains freely prior to capping.

This section focuses on the management of NORM material in the RSF.

Underdrainage system

Underdrainage from the RSF is unlikely to have elevated levels of radionuclides, due to their insolubility. To confirm, radionuclide levels will be monitored during the operations phase.

Elevated NORM levels are most likely to be associated with high sediment levels, if unplanned build up occurs in the underdrainage system. Prevention of sedimentation in the system will be considered through the RSF design phases. It is a closure risk that will be further defined during the operations phase.

The underdrainage system will continue to operate for some time after completion of capping and re-vegetation, to drain excess water from the residue deposit. The quantity of water recovered from the underdrainage system is expected to reduce with time. Experience with similar facilities suggests that water recovery may continue for a period of several years following decommissioning. During this time, water from the underdrainage will be pumped back to the Process Plant for recycling or treatment. After the flow ceases, the underdrainage pumps will be removed and the underdrainage tower/riser pipe backfilled and sealed as part of the rehabilitation process.

Beneficiation RSF

The final cover for the residue surface, subsequent to decommissioning, will be confirmed during the operations phase based on ongoing operational residue geochemistry test results. The following cover design for the residue beach is currently envisaged:

- general fill layer (500 mm)
- low permeable soil liner (300 mm)
- general fill as store and release layer (1,000 mm)
- topsoil/growth medium layer (100 mm)

- re-vegetation of area
- erosion protection material to be placed in dedicated flow path as required, to reduce erosion before vegetation is re-established.

Gypsum and water leach residue RSF

The final cover for the residue surface, subsequent to decommissioning, will be confirmed during the operations phase based on ongoing operational residue geochemistry test results. The following cover design for the residue beach is currently envisaged:

- general fill layer (500 mm)
- low permeable soil liner (300 mm)
- 1.5 mm geosynthetic HDPE liner
- liner protection soil layer (500 mm)
- general fill layer (1,000 mm)
- topsoil/growth medium layer (100 mm)

Closure spillway

The RSF closure spillway will be excavated during the rehabilitation works of the RSF, subsequent to decommissioning of the individual cells. The closure spillway will be excavated from the final supernatant pond location through the perimeter embankment and a discharge channel constructed.

Individual spillways will be constructed for each cell to reduce the risk of concentrated flow causing excessive erosion. The spillway will be sized to safely manage a probable maximum precipitation rainfall event.

Due to the staging of the individual cells, experience with the performance of the closure spillway constructed for the first cells can be used to improve the design for the following cells. At final closure of the facility (Process Plant expected to run for approximately 38 years and the final RSF stage to be completed after approximately 41 years), it is expected that the adopted design will have demonstrated that it is stable over the long-term.

The currently proposed cover design is as follows:

- A capillary break layer of coarse gravel/rockfill material to block migration of any salts from the residue into the upper layer of the cover. This layer will also provide a working base for the additional cover construction works, as well as a shielding layer to any radiation emitted from the tailings.
- A 300 mm low permeable fill layer to minimise infiltration into the residue mass and therefore limit the possibility of seepage from the facility.
- In addition to the low permeable soil layer, a 1.5 mm HDPE cover layer will be installed over the Gypsum and Water Leach Residue Cells, as well as a 500 mm protection layer above the geosynthetic layer to minimise the risk of punctures.

- A store and release layer of between 500 mm and 1000 mm thickness comprising suitable borrow material that is both erosion resistant and provides suitable storage characteristics.
- A growth medium surface layer. The upper 150 mm to be lightly ripped topsoil and non-reactive material reclaimed from stockpiles to form a rock mulch and promote vegetation growth.

It is expected that the quantities of material required for the cover system will be readily available from topsoil, non-mineralised surficial alluvial material, and from local borrow areas.

13.2.3 Process Plant

The Process Plant will require decontamination prior to decommissioning and removal from site for resale, reuse or disposal. The decontamination process will be directly related to the removal of material within and around the Process Plant.

At closure, a decommissioning plan will be developed that outlines the specific cleaning measures, location of residue collection, contamination management and quality assurance processes for disposal offsite.

Closure management measures associated with elevated radioactivity during the decommissioning process are:

- Sediment contained within the sumps within the Process Plant footprint shall be disposed to the RSF. HDPE liners shall be removed and disposed to the RSF cells for encapsulation.
- All equipment shall be cleaned prior to removal from site.
- Decontamination residues shall be disposed to the RSF for encapsulation.
- Material that cannot be cleaned sufficiently or disposed of offsite shall be disposed either to the mine pit, WRD or RSF.
- Monitoring shall occur around the Process Plant to identify areas for decontamination. Where elevated levels occur, materials will be removed and disposed to either the WRD or RSF for encapsulation.

13.2.4 ROM Pad

The ROM Pad has the potential to have elevated levels of radioactive materials, due to residual ore and dust occurring over the area. As such, the area will be rehabilitated to remove radioactive materials. The low-grade ore stockpile footprints may have similar contamination to the ROM pad. The low-grade stockpiles are intended to be encapsulated at the end of mine life with benign waste due to their proximity to the southern waste rock dump. Alternatively, they will be rehabilitated in the same way as the ROM pad.

The following closure measures are proposed:

- Removal of top 500 mm of material from the operating footprint of the ROM pad and disposal within either the WRD NORM cells or RSF.
- Monitoring to confirm effectiveness of the cleanup.

13.2.5 Mine Pit

The following closure strategy to manage radiation risk for the open pit domain includes:

- Pit walls will be retained at the final batter angles, provided these are geo-technically stable.
- Installation of pit abandonment bunds. This involves positioning the abandonment bund beyond the zone of potential geotechnical instability to ensure that any subsidence of the pit walls does not affect the integrity or effectiveness of the bund. The bund will also be constructed of competent rock that can withstand the long-term effects of erosion and weathering.
- The safety bund will also restrict inflow to the pit lake, resulting in the lake being below the surrounding groundwater level.
- The road access into the pit will be blocked by placing rock windrows at the top of the original ramps.
- Groundwater inflow from the pit walls will be allowed to collect within the pit and evaporate. It is anticipated that a small pit lake will develop, but the depth, quality and rate of filling is yet to be scientifically modelled. Water quality is expected to deteriorate over time due to the evapo-concentration of salts and other elements.
- Signage will be installed to warn people of the risks associated with the open pit void. The need for signage will be discussed with stakeholders prior to closure.

13.3 Radiological Closure Criteria

The specific radiation closure objectives and completion criteria for the Project are as follows:

- Radiation exposures to members of the public are less than 1 mSv/y (above natural background levels).
- Post exposures to flora and fauna will not exceed the recognised screening dose rate of 10 uGy/h as a result of operational and closure activities.
- Radiation levels are consistent with the levels that existed prior to operations.
- All containment systems are safe, stable and non-eroding.

To achieve the criteria, the aim is to ensure that the post-closure radiation levels (including ambient gamma radiation, radon and thoron concentrations in air, dust deposition, radionuclides in airborne dust and radionuclides in ground and surface water), are consistent with the pre-operational levels as shown in the EIS (Arafura 2016) and updated in this RPRWMP.

The post remediation radiation monitoring program will continue for a period of at least 10 years and will include the Project Area and adjacent areas to the Project, in line with the current network of installed ERMLs (Figure 7—4) to confirm that the closure criteria are achieved and maintained.

Table 13—2 Environmental Radiation Monitoring Program at each ERML

#	Aspect	Risk Pathway	Closure Outcome	Completion Criteria	Measurement Tool
1	Rehabilitation and Mine Closure	Infrastructure left at closure does not align with Post-Mining Land Use.	No general waste shall remain upon completion of mining and closure activities.	All waste is removed and disposed of appropriately.	Closure audit completed that includes a summary of infrastructure retained.
			No infrastructure is left on site unless Regulators and post-mining land managers/owners agree to it.	The landholder has accepted the responsibility for the ongoing management, maintenance and final disposal of infrastructure that will be left in place post-closure.	Agreement with Landholder prior to closure outlining what infrastructure shall remain. Details of the agreement will be presented as part of the approved MMP.
			Disturbed surfaces rehabilitated to facilitate future specified land use.	Liabilities of any infrastructure to be retained are defined and approved by relevant key stakeholders prior to any asset transfer taking place.	Signed asset transfer agreement in place prior to transfer of legal responsibility.
2	Rehabilitation and Mine Closure	Inappropriate design and/or poor construction & rehabilitation practices. Legacy tailings disposed of inappropriately. Residual contamination from historical tailings material remains at Project completion.	No NORM contamination shall remain upon completion of mining and closure activities.	Soils with elevated NORM levels are cleaned up and remediated at the completion of mining.	Prior to closure, a contamination survey of infrastructure areas, where ore and elevated NORM material were handled, shall be completed.
			No contaminated infrastructure or soils remain on site.	All potentially contaminating material is disposed to the RSF or WRD and encapsulated.	Closure audit that delineates where all material is disposed at closure. Any known or potentially contaminated sites are recorded, reported & remediated.
				All infrastructure is appropriately cleaned prior to disposal offsite.	All infrastructure appropriately cleaned and certified as clean prior to disposal offsite.

#	Aspect	Risk Pathway	Closure Outcome	Completion Criteria	Measurement Tool
			Constructed Landforms (WRD, TSF, ROM pad) will be non-polluting/ non-contaminating, and toxic or other deleterious materials will be permanently encapsulated to prevent environmental impacts.	NORM material is suitably encapsulated to ensure that there is no measurable impact on the surrounding environment measured 10 years after closure.	Soil and groundwater chemical concentrations do not exceed ARPANSA 'environmental investigation levels' or pre-mining average background concentrations, whichever is the greater.
				At the cessation of mining, all elevated NORM material is encapsulated fully within the WRD or RSF.	Closure audit to ensure elevated NORM material is fully encapsulated within the WRD or RSF.

13.4 Radiological Control in Closure Decision Making

The final closure options are outlined in the MCP and will be verified through the additional work to be undertaken during the operations phase, as described in the MCP. When environmental, policy or engineering data is obtained that alters the current knowledge regarding rehabilitation options, it will be considered and risk assessed to ensure that the optimal remediation and closure options are implemented. This will also be the case for radiation-related aspects. If the options for closure alter, a radiation risk assessment would be conducted.

A key part of the closure planning and review involves the incorporation of the outcomes of the 5-yearly audit of the implementation of this RPRWMP.

13.5 Post-closure Radiological Risk Assessment

The major rehabilitation feature from a radiological perspective is the RSF.

Table 13—3 Exposure Scenarios from Features Events Processes (FEP)-Style Assessment

Exposure Scenario	Dose Pathway and Potential Dose
Long-term degradation of the RSF	▪ Residue/tailings contaminate traditional or future food sources, leading to an increase in human doses. ▪ Considered to be unlikely in the near term due to rehabilitation performance targets. ▪ Potential doses likely to be less than 1 mSv/y due to: – Low radionuclide content of residue/tailings (consistent with naturally occurring concentrations found in some regions of the world) Relatively low abundance of natural food sources in the region.
Inadvertent intrusion into RSF	▪ Information on the final location of the RSF is lost. For example, in future drilling exploration programs or earth moving programs. ▪ Potential doses are likely to be low due to identifying residue/tailings or waste material once uncovered. This assumes that if there is sufficient technology for drilling or earthmoving, then there would be technology to identify hazards. ▪ An additional scenario is that residue/tailings are mined as resources – in this case, it is appropriate to assume that protection mechanisms would be in implemented.
Seepage from residue/tailings to groundwater which expressed in potable water supplies	▪ Modelling shows that radionuclides are unlikely to be mobilised with any seepage. ▪ The concentration of radionuclides in any seepage would be further diluted by pre-existing groundwater. ▪ Level of potential contamination is likely to be undiscernible from naturally occurring variations in groundwater radionuclide concentrations.

13.6 Radiation Specific, Closure Knowledge Base Considerations

Radiation protection is a key consideration in closure, and Arafura will continue to collect data and undertake radiation-related test work during the operations phase to inform final closure and remediation decision-making. The data and information will also be used to verify the conclusions of the radiological risk assessment. All closure options relevant to radiation management are included for completeness in this RPRWMP. All future development of mine closure planning will lead from the content and requirements described within this RPRWMP (and associated references provided).

Key work to be undertaken to address knowledge gaps relating to radiation, identified from the closure risk assessment and detailed in the Project MCP, will include:

- Monitor for any operational impacts through monitoring undertaken at the ERML locations (see Section 12.0). This information will be compared to the baseline results to determine whether any changes occur and if they result in impacts. The results will be used in radiological impact assessments of flora and fauna and for impacts on members of the public.
- Conduct ongoing test work to optimise the selection and segregation of benign waste for final rehabilitation. As well as characterising the cover material, the testing will also provide information on the optimal depth of cover materials for the tailings and NORM materials. As noted previously, the post-closure targets for radiation levels are based on the premise of ensuring that the post-closure levels are consistent with the pre-operational level.
- Monitoring the extent of soil contamination from radiation. This is likely to only be apparent close to closure. Contaminated soil investigations will be undertaken where potentially contaminative activities have taken place. Where contamination is identified, appropriate remedial actions will be implemented.
- Ongoing review of operational monitoring data to identify any trends that may impact on the post-closure radiation environment.
- Ongoing refinement of cover design for encapsulation cells, including the design of capillary breaks and assessment of cover volumes, to ensure suitable risk management whilst providing an effective soil depth to maximise vegetation cover growth.

The full suite of knowledge gaps identified during the closure risk assessment completed as part of drafting the MCP for the Project have been provided as Appendix O for reference only.

14.0 QUALITY ASSURANCE

Arafura has established a site-wide health, safety, environmental and operational quality management system. The quality assurance aspects for radiation protection are integrated into the site HSEMS.

The key considerations for a radiation protection quality assurance program are outlined in ARPANSA (2005) and include compliance with relevant Australian Standards and traceability of radiation measurements, calibration documentation and auditing systems.

The RPRWMP, monitoring program, operating procedures, monitoring results and administrative practices will be formally reviewed annually (as outlined in Section 17.0) and an independent external review will be conducted every five years in accordance with timeframes at similar operations in Australia.

The practical considerations of the quality assurance program include:

- Ensuring that all radiation monitoring equipment and instrumentation is fit for purpose and considered to be industry standard.
- Ensuring that technical staff are trained in the correct use of monitoring equipment and that audited procedures are established for undertaking monitoring tasks (see appendices).
- A prescribed program of instrument maintenance by a suitably qualified instrumentation technician.
- A program of instrument calibration involving off site calibration of key instruments against primary standards and routine checks against on site secondary standards.
- During the annual reviews (as noted above), conducting a check on key instruments to ensure traceability of performance to national standards (for example, checking against appropriate Australian Standards).
- Maintaining documentation, covering records of instruments, their calibrations and maintenance log and any changes due to equipment upgrades.

15.0 RECORD KEEPING

An online data management system will be used to store and manage all information relating to radiation management, monitoring and worker doses.

Periodic reports will be prepared from information stored in the electronic database. Regular dose reports will be provided to workers and upon request.

All new workers will be asked about previous experience in radiation workplaces, and a record of any previous exposures will be obtained where appropriate.

All records will be maintained for the life of the operation.

16.0 ACCIDENT, INCIDENT AND EMERGENCY RESPONSE

The Project will establish and maintain a site-wide Emergency Response Plan, which will be further developed as the Project progresses. This plan will contain provisions for responding to accidents and incidents involving radioactive materials, including density probes and density gauges.

It should be noted that it is highly unlikely that there would be an incident resulting in harm due to radioactivity due to the relatively low concentration of radioactivity in the ore and products.

Potential incidents have been identified as follows:

- Radiation monitoring, either routine or investigative, identifying elevated radiation levels, which would be considered an incident within the Arafura incident management process and, therefore, be investigated, with remedial actions implemented.
- Loss of containment of radioactive tailings or residues resulting in environmental contamination. The potential radiological risk from such an event is very low and was assessed by Arafura during the EIS process.
- Density probe stuck in the drill hole, resulting in a temporary or permanent loss of control of a strong radioactive source by the geophysical contractor.

Where an incident occurs that results in an exposure to a worker, an incident dose assessment will be made by the Statutory RSO. This will involve the RSO investigating the incident and determining a conservative dose estimate. If the incident involved a worker, then the incident dose estimate will be filed with the workers' dose records.

17.0 SYSTEM REVIEW

A review of the RPRWMP will be undertaken annually or whenever there is a significant change in the operation or the waste management system, following the recommencement of construction activities, and include the following:

- Assessment of the monitoring results and review of the monitoring program.
- Consideration of any changes that have occurred over the previous 12 months and potential radiological impacts.
- Review of the effectiveness of the radiation protection controls.
- Confirmation of work area classifications.
- Identification of any improvement opportunities.

The annual review will be an internal review with a summary provided to the relevant regulatory authority. Any changes to the RPRWMP identified through the review would be subject to regulatory authorisation.

Arafura will undertake an external audit of the RPRWMP every five years. A recognised radiation protection practitioner would conduct the external audit.

Any revisions of the RPRWMP that involve aspects of mine closure will be correspondingly addressed in a revision of the MCP, with the revised MCP provided to DCCEEW for information purposes following its approval under the *Environment Protection Act 2019*.

18.0 REPORTING

The following will be reported through existing reporting obligations to the relevant regulators:

- summary of monitoring results
- discussion on trends in the data
- investigation reports into anomalous monitoring
- details of any incidents or accidents
- details of any changes in monitoring or monitoring methods
- outcomes of any reviews.

If required, worker dose information will be made available to the ARPANSA National Dose Registry on an annual basis.

As part of the annual report to DCCEEW, the company will provide a statement of compliance. This will describe and outline the average and maximum doses received by the workers, as well as the public and non-human biota, as a result of operational activities.

In the event of a non-compliance (i.e., radiation levels exceed statutory limits), the company will provide electronic notification to the Department of Climate Change, Energy, the Environment and Water (DCCCEEW) within 2 business days of becoming aware of the non-compliance, as per Condition 42 of EPBC2015/7436. Further details of the event, including corrective measures and results of any investigations conducted, will be provided in writing to DCCEEW within 12 business days of identification of the non-compliance (Condition 43 EPBC2015/7436).

19.0 REFERENCES

DMP, 2010. *Managing Naturally Occurring Radioactive Material (NORM) in mining and mineral processing guideline.*

DoIR, 1997. *Safety Bund Walls around Abandoned Open Pit Mines*

GHD, 2016. *Nolans Project, Environmental Impact Statement (EIS), Arafura Resource Ltd, February 2016.*

GHD, 2017. *Nolans Project, Environmental Impact Statement (EIS) – Supplementary Report, October 2017.*

GHD, 2019. *Arafura Resources Ltd, Nolans Project Section 14A Notification, June 2019.*

IAEA, 2004. *ISAM 2004 Safety Assessment Methodologies for Near Surface Disposal Facilities, Volume 1, 2004, IAEA.*

UNSCEAR, 2000. *Report Vol. I Sources and Effects of Ionising Radiation.*

APPENDIX A RESUME FOR MR JIM HONDROS OF JRHC ENTERPRISES

Jim Hondros
Director – JRHC Enterprises Pty Ltd
CV - 2025

Email : jim@jrhc.com.au
Phone: 0439 348 922

PO Box 372,
Stirling, SA 5152

Qualifications:

- Bachelor of Applies Science (1984)
- Graduate Diploma in Occupational Hazard Management (1987)
- Master of Applied Science (1991)

Professional Affiliations:

- Certified Radiation Safety Advisor – Australasian Radiation Protection Accreditation Board (ARPAB)
- Member - Australian Radiation Protection Society (ARPS)
- Member – Australian Institute of Occupational Hygienists (AIOH)
- Member – Environmental Institute of Australia and New Zealand (EIANZ)

Experience Summary

- 1984 – 1995 Operational experience in operational and senior management roles covering radiation monitoring, government liaison (State and Federal), resource and project management, in the areas of Radiation, OH&S, Environment and Emergency Response
- 1995 – 1996 Corporate Policy Adviser – Environment
- 1997 – 1998 Senior Manager Community Relations and Environment
- 1999 – 2002 Group Manager – Occupational Health and Safety
- 2002 – now Self Employed at JRHC Enterprises Pty Ltd. Work includes:
    - Policy advice and direction in relation to radiation for various companies whose materials and products contain Naturally Occurring Radioactive Materials (NORM).
    - Occupational and environmental radiological impact assessment for numerous projects (both uranium and non-uranium) as part of State and Commonwealth approvals.
    - Specific radiation, OH&S and environmental project work, both nationally and internationally, (including advice on design, development of practical management measures and competency development).
    - Provision of ongoing radiological advice and support to numerous companies (including mentoring and training of technical staff, technical advice, development of management systems, establishing design criteria, working with design teams, monitoring, waste management, transport of radioactive materials, and nuclear fuel cycle implications).
    - Establishment and management of baseline environmental radiation monitoring programs and designing and implementing occupational radiation monitoring and training.
    - Facilitation of workshops for industry, regulators and community on radiation protection and OH&S.
    - Review and interpretation of specialised technical reports.
    - OH&S audits, Research & development road-mapping.
    - Liaising with First Nation Australians, companies, regulators and communities (including public forums) on radiation protection.
    - Working with operations staff and First Nation Australians community groups on the development of engagement strategies, developing partnerships, and mentoring.

Governance

2024 – now	Immediate Past President of the Australasian Radiation Protection Society
2023 – now	Vice President of the Asia Oceanic Radon Association
2022 – 2023	President of the Australian Radiation Protection Society
2020 –now	Member of ARPANSA Radiation Health Advisory Council
2019 – now	Co-chair of International Radiation protection Association working group on NORM
2014 – now	Member of the Australian Radiation Protection Society Executive Committee
2006 – 2009	Member - Radiation Health Committee and Nuclear Safety Committee, ARPANSA
2006 – 2008	Chair – Trust for Nature (Victoria)
2004 – 2006	Trustee – Trust for Nature (Victoria)
2004 – 2012	Director – Parakeelya Foundation
2002 – 2006	Honorary Lay Person - Deakin University Research Ethics Committee
1999 – 2002	Chairman – Lawn Hill and Riversleigh Pastoral Holding Company
1998 – 2002	Director – Aboriginal Development Benefits Trust
2000 – 2002	Director – World Alliance for Community Health
1997 – now	Member – Minerals Council of Australia – OHS Taskforce

Development

- Involvement in expert missions and conducting training for the International Atomic Energy Agency in Pakistan, Mongolia, Bulgaria, Jordan, Indonesia, Thailand, Brazil, Australia.
- Regular invited speaker on radiation protection at conferences conducted by the International Atomic Energy Agency (IAEA), the International Commission on Radiation Protection (ICRP), Asia Oceanic Congress on Radiation Protection (AOCRP), The International Radiological Protection Association (IRPA) and the Australasian Radiation Protection Society (ARPS).
- Developer of a series of OHS and radiation safety lectures for IAEA "The Uranium Production Cycle" series for and E-Learning program
- Guest lecturer for the University of Adelaide Centre for Radiation Research Education and Innovation Graduate Certificate in Radiation Management
- Author on several IAEA publications, including radon in workplaces, controls for radioactively contaminated lands and NORM residue management.
- Industry representative on the development of documentation on the implementation of the ICRP60 recommendations.
- Detailed site familiarity visits to numerous national and international mineral sand, rare earth, base metals, and uranium mines and processing facilities and nuclear facilities.
- Co-Chair of the IRPA NORM Task Group
- Team Member of Research on Improving the Relevance of International Radiological Risk Assessment Tools to Australian Arid Environments (through Flinders University)
- Numerous radiation safety publications

APPENDIX B RADIOACTIVE MATERIALS TRANSPORT MANAGEMENT REQUIREMENTS

RADIOACTIVE MATERIALS TRANSPORT MANAGEMENT REQUIREMENTS

PREFACE

Arafura Rare Earths Limited (Arafura) is intending to develop the Nolans Project in the Northern Territory of Australia.

It is intended that all final products that leave the operation will not be defined as radioactive. The radiological characteristics of the Nolans Project and the products are defined in the body of the Radiation Protection and Radioactive Waste Management Plan (referencing data presented in the Environmental Impact Statement for the Project). To take into account the transport of samples for analysis, this Radioactive Materials Transport Management Plan requirements document has been prepared as part of the Radiation Protection and Radioactive Waste Management Plan.

Transport of radioactive materials throughout Australia is subject to local radiation protection Acts and Regulations. This means that different licences may be required in different States and Territories, depending upon transport routes and destinations. However, all transport of radioactive materials in Australia is underpinned by the Australian Radiation Protection and Nuclear Safety Agency - ARPANSA Code for the Safe Transport of Radioactive Material – also known as the Transport Code (ARPANSA 2019).

When transporting radioactive materials that are defined as radioactive, Arafura will use the services of a licenced dangerous good transport service provider (TSP).

Arafura expects certain standards to be established and maintained during the transport of any radioactive materials and this document outlines the Arafura requirements for transport of the material.

This document does not, in any way, remove the responsibility of the transport service provider to transport the material in accordance with all legislative requirements and obtain all necessary licences for any jurisdiction through which the material is transported.

This document is the Arafura Radioactive Materials Transport Requirements and is abbreviated to RMTR for the rest of this document.

INTRODUCTION

Purpose

The purpose of this Radiation Management Transport Requirements (RMTR) is to outline the minimum Arafura requirements for the Transport Service Provider (TSP) in relation to their operational Transport Management Plan to ensure the safe and efficient transport of radioactive materials.

In this RMTR, radioactive materials mean:

- Ore, process material, products or samples that contain more than 1 Bq/g of any of the naturally occurring radionuclides from the uranium and thorium decays chains [IAEA 2014].

It is the responsibility of the TSP to develop their Transport Management Plan, with the following objectives:

- To ensure the protection of workers, the public and the environment from any harmful effects of radioactivity during the transport of radioactive materials.
- To ensure compliance with the requirements of the various jurisdictional Radiation Act and Regulations.
- To ensure that the transport of radioactive materials complies with the requirements of the ARPANSA Code for the Safe Transport of Radioactive Material, RPS C-2 (Rev. 1) (commonly referred to as the Transport Code).

Note that when transporting radioactive materials, the other potentially hazardous properties of the materials (such as acidity) must be taken into account during transport. The material may be subject to other dangerous goods classification.

Scope

This requirements document refers to the road, rail and sea transport of radioactive materials from the Nolans Project.

This document covers:

- Characteristics of radiation containing materials.
- Roles and responsibilities.
- Specific packaging requirements for radioactive material to be transported, including labelling, certification and documentation.

Roles and Responsibilities

The key responsibilities relating to the RMTR are outlined in Table 1—1.

Table 1-1 Roles and Responsibilities for the RMTR

Role	Responsibility
Transport Service Provider (TSP)	Defined as the "contract carrier" who is transporting radioactive material on behalf of the "consignor" or "shipper". The TSP will be responsible for developing their own Transport Management Plan (TMP).
The consignor or shipper	Arafura as the consignor or shipper. Responsible for ensuring that the TSP has an adequate and approved TMP, that meets the requirements defined in this RMTR.
Statutory Radiation Safety Officer	As employed by Arafura. Ensure that all packages of radioactive materials comply with the requirements of the ARPANSA Transport Code.

REGULATORY REQUIREMENTS

State Requirements for Transport of Radioactive Materials

Arafura may require transport of radioactive material within Australia to a number of States or Territories. It is the responsibility of the TSP to identify the specific legal requirements for the transport of the radioactive materials through the various States and Territories. Arafura requires that the TSP will have reviewed all appropriate legislation and obtained all necessary licences and approvals.

Table 2-1 provides a summary of the potential legislation that is applicable.

Table 2-2: Transport Requirements

Jurisdiction	Act/Regulation	Is the ARPANSA Transport Code Applicable (Y/N)
South Australia	▪ *Radiation Protection and Control Act 2021* ▪ *Radiation Protection and Control Regulations 2022*	Y
Western Australia	▪ *Radiation Safety Act* ▪ *Radiation Safety (Transport of Radioactive Substances) Regulations 2022*	Y
New South Wales	▪ *Protection from Harmful Radiation Act 1990* ▪ *Protection from Harmful Radiation Regulation 2013*	Y
Northern Territory	▪ *The Radioactive Ores And Concentrates (Packaging And Transport) Act 1980* ▪ *The Radioactive Ores And Concentrates (Packaging And Transport) Regulations 1980*	Y (2008 edition)
Queensland	▪ *Radiation Safety Act 1999* ▪ *Radiation Safety Regulation 2021*	Y
Victoria	▪ *Radiation Act 2005* ▪ *Radiation Regulations 2017*	Y

Standards for Transport of Radioactive Materials

The basis of regulation of transport of radioactive materials in Australia is the ARPANSA Transport Code, which is based on the International Atomic Energy Agency (IAEA) regulations for the Safe Transport of Radioactive Materials. The latest version of the ARPANSA Transport Code is from 2019 and is based on the 2018 version of the IAEA document.

A relevant aspect of the Transport Code is under clause 107(f). It states that the requirements of the Transport Code do not apply for materials (which may have been processed) containing naturally occurring radionuclides up to ten times the criteria.

TECHNICAL INFORMATION FOR TRANSPORT

Transport Activities

Radioactive products or samples that are subject to the requirements of the Transport Code will be packaged on site in IP-1 packaging (see Appendix B.1).

Material to be Transported

All materials from the project are defined as "Low specific activity material" (LSA), which is radioactive material that by its nature has a limited specific activity (see clause 226 of the Transport Code). Clause 409 of the Transport Code notes that uranium and thorium ores and concentrates of such ores, and other ores containing naturally occurring radionuclides are defined as LSA-1.

The radionuclide content of any radioactive samples will need to be determined by Arafura prior to transport in order to ensure that the correct transport requirements are met.

In the event that the radionuclide content and concentration of materials is not known, the Arafura Statutory Radiation Safety Officer shall make an assessment which will be based on alpha, beta and gamma measurements, together with information from process metallurgists and chemists.

Where a material is reasonably considered to be in secular equilibrium, the elemental uranium and thorium concentrations can be used to estimate the radiological characteristics of the material for transport. Where the material has been subject to chemical or thermal processing, the individual radionuclide concentrations shall be determined and a "basic radionuclide value (BRV)" shall be calculated in accordance with the equations provided in the Transport Code (ARPANSA 2019).

Clause 107(f) of the Transport Code notes that the requirements of the Code do not apply for a material containing naturally occurring radioactive materials, if the total activity concentration is less than ten times the calculated BRV.

Packaging

Radioactive materials for transport must be securely packaged in accordance with the Transport Code requirements (see Attachment 1).

In addition, a gamma measurement will be taken on the outside surface of the container to confirm that levels are less that 5uSv/h.

For a radioactive material subject to the Transport Code, the package will be required to have on each of the four vertical sides a 'Class 7' placard. Although an alternative is to place the UN number on the container (UN2912). Each individual package is required to also have a placard.

Note that the container may be required to have additional non radiation related dangerous goods placarding as required under the Australian Dangerous Goods Code, depending upon the hazard assessment of the product.

Transport Requirements

The general classification requirements for radioactive materials are shown in Table 3-1 below.

Table 3-3: Transport Classification

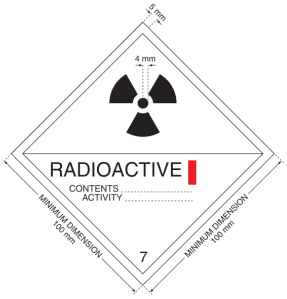
Transport Code Reference(s)	Criteria	General Requirements for Transport of Materials with NORM
Clause 401 Table 1	UN Number and Proper Shipping Name	UN2912 – Radioactive Material, Low Specific Activity (LSA-1)
Clause 409 (iv)	Classification of Material	LSA-1
Clause 521 Table 5	Industrial Packaging Requirements	IP-1 (see Attachment 1)
Clause 529	Category	I-White based on a measurement of gamma doserate of 0.4µSv/h from the package

Each radioactive package will require a label as shown in Table 3-2 below, with the following:

- *Content: LSA-1 – [Insert name of material]*
- *Activity: [To be calculated based on activity concentration and mass of material in package]*

Transport of any radioactive package will also require appropriate transport documentation and a surface contamination check.

Table 3-4: Placarding and Labelling Requirements

Package type	Placard/Label
Shipping container	 
Radioactive package	

TRANSPORT MANAGEMENT PLAN

This section provides Arafura's requirements for the Transport Management Plan (TMP) that will be developed by the TSP.

Induction, Training and Information

The TSP must ensure that all staff involved in the transport of radioactive materials are suitably trained in the transport of radioactive materials.

It is expected that the TSP training covers:

- Information on the legal requirements.
- Responsibilities and duties under the legislation.
- Information on radiation.

Truck drivers should be Dangerous Goods certified and trained on what to do in the event of an incident during transport of the radioactive materials. All vehicles should also be registered for the transport of dangerous goods.

Duties of Workers

All TSP workers shall be aware of the requirements of the TMP for the transport of radioactive materials. Specific requirements should include:

- Compliance with relevant transport regulations (see Table 2-1 of this document).
- Ensuring that all notices and signs related to radiation are complied with.
- Ensuring that work is conducted in a manner that prevents a radiation incident from occurring.
- Understand the information available in the Safety Data Sheet (SDS).
- Immediately reporting any fault or defect that may result in a radiation incident to their supervisor.
- Following procedures and instructions to control and assess exposure to radiation in the workplace, including:
  - Complying with the instructions on radiation protection.
  - Participating in inductions, training and implementing learnings.
  - Wearing required personal protective equipment (PPE).
  - Taking care of any monitoring equipment provided.

Radiation Monitoring

As part of the operational RPRWMP, an appropriate worker radiation monitoring programme may be considered.

Safety Equipment in Good Order

For routine transport operations, it is unlikely that there would be a requirement for additional PPE. Standard safety equipment will be required for all transport work related activities in accordance with the TSP's operational safety management plan.

In the event of an incident resulting in spillage of materials, dust masks, goggles, gloves and white coveralls and a P2 disposable dust mask will be required to be worn when minimising the spread of material.

Record Keeping

The TSP will maintain records of transport and worker information including:

- Records of qualifications, training and competencies of all persons involved with the transport of radioactive materials.
- Details of all incidents and accidents and the remedial action to prevent recurrences. Reports should be provided to Arafura.
- Results of all monitoring and exposure records for each worker.
- Records of crew and drivers when radioactive material is being transported.
- Manifests, transport documentation and safety data sheets.

Operational Changes

From time to time, operational changes will be necessary. This could include last minute changes to routes, change of drivers and unplanned temporary storage. For any event or change outside of the routine transport conditions, the TSP driver will contact the TSP Logistics Manager, who will record the change and make an informed decision on whether the Arafura representative will be notified.

Review of the TMP

The TSP will regularly review their TMP, with any changes reported to Arafura.

Overview of Quality Assurance

In the TMP, the TSP is to provide an overview of their logistics management and their consignment tracking and chain of custody process.

Roles and Responsibilities for the TMP

The roles and responsibilities for both the TSP and the consignor should be outlined in the TMP and consider the following, as outlined in Table 4-1 below.

Table 4-5: Consideration for TMP roles and responsibilities

Role	Responsibility
Producer of Radioactive Material and Consignor (Arafura)	▪ Defining the characteristics of the material to be transported, identifying the receiving facility and making prior arrangements with the facility. ▪ Developing a safety data sheet (SDS) for the material. ▪ Packaging, labelling, and documenting the details of the material to be transported. ▪ Verifying the implementation of the provided TMP. ▪ Verifying packaging, labelling and documentation provided by the TSP. ▪ Notifying any changes in product specifications prior to transporting. ▪ Ensuring a safe load of the material within the Nolans Project.
Transport Service Provider (TSP)	▪ Preparing the TMP, achieving necessary approvals and implementing the TMP. ▪ Safely transporting the material to the described facility. ▪ In the event of an accident or emergency, implementing Arafura's Emergency Response Plan. ▪ Maintaining all road equipment (i.e. prime movers and trailers) to the manufacturers' specifications . ▪ Securing and maintaining valid permits and approvals from Australian, state and territory regulators. ▪ Ensuring required training is completed and licenses secured, with regular refresher/updates for transport personnel. ▪ Conducting surface contamination checks on containers prior to leaving the Nolans Project site.

RADIATION INCIDENTS CONTINGENCY PLAN

Overview

The loss of containment and the presence of radioactive material should not prevent qualified people such as emergency services personnel from undertaking rescue operations, including attending to the injured or fighting fires.

The Arafura radioactive materials will be classified as a low specific activity material and detailed incident response information is provided in the safety data sheet.

The incident and emergency response would be similar to that required when responding to transport incidents involving other types of metal concentrates.

Any incident involving a loss of containment or damage to a container of material should be reported to Arafura who have qualified personnel to provide assistance to on-site personnel regarding radiation and decontamination procedures.

Appropriate information shall be immediately available (as provided in the manifest) at all times for use in response to accidents and incidents involving dangerous goods in transport. The information shall be available away from the packages containing the dangerous goods and immediately accessible in the event of an incident (for example, the drivers' cabin).

Overall Approach

Overall, the radiation risks are very low and concerns regarding radiation should not get in the way of attending to immediate people safety and environmental protection. The basic measures to be adopted at the incident site include:

- Do not panic and stay calm.
- Assess the incident and gather facts – radiation is not an immediate problem, due to the low specific activity of the material.
- Determine if there are any other dangerous properties of the material that you need to be aware of (check the SDS).
- The main priorities are: rescue, life-saving, first aid, fire control and managing other hazards that may be present (for example, oncoming traffic).
- Do not try to clean up any spill.
- Isolate the spill or leak area with barricades to exclude members of the public.
- Escalate as necessary, dialling 000 if necessary, and follow any instructions provided.
- Keep unauthorised people away until emergency services arrive.
- Remain upwind 25m away and be aware of dust – be alert but not alarmed.

Incident reporting

If an incident occurs the following information will be documented:

- Nature and time of incident.
- Precise location.
- Quantity and condition of material involved.
- Details of any other particular hazards that may be present.
- Details of container number.
- Extent of damage or security breach.
- Sequence of events leading to the incident.
- Action taken.
- Notifications to consignee, regulatory authority, competent authorities, shipping line.

In the event of an incident, details shall be reported to the appropriate authority in accordance with licence conditions.

The TSP will conduct a review or investigation into each incident, in agreement with Arafura as Consignor, depending on the severity of the incident or near miss.

REFERENCES

International Codes and Standards

Title	Document Number
Code for the Safe Transport of Radioactive Material Radiation Protection Series C-2 (Rev. 1) March 2019	ARPANSA 2019
Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards	IAEA 2014
Regulations for the Safe Transport of Radioactive Materials (also known as the Transport Regulations)	IAEA 2018

ABBREVIATIONS AND DEFINITIONS

Abbreviation	Meaning
Arafura / ARU	Arafura Resources Limited
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ERICA	Environmental Risk from Ionising Contaminants
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
NORM	Naturally Occurring Radioactive Material
RMTR	Radioactive Materials Transport Requirements
RP Act	Radiation Protection Act
Statutory RSO	Statutory Radiation Safety Officer
TMP	Transport Management Plan
TSP	Transport Service Provider
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
Bq/cm^2	Becquerel per square centimetre
m^3/h	Cubic meters per hour
mSv/y	Millisievert per year

APPENDIX B.1 INDUSTRIAL PACKAGING-1 (IP-1) REQUIREMENTS

The following table outlines the requirements for IP-1 packaging from the Transport Code:

Transport Code	Clause
534(a)	An IP-1, IP-2 or IP-3 design shall be legibly and durably marked on the outside of the packaging with "TYPE IP-1", "TYPE IP-2" or "TYPE IP-3", as appropriate.
636	The smallest overall external dimension of the package shall not be less than 10 cm.
623	A Type IP-1 package shall be designed to meet the requirements specified in paras 607–618 & 636
607	The package shall be so designed in relation to its mass, volume and shape that it can be easily and safely transported. In addition, the package shall be so designed that it can be properly secured in or on the conveyance during transport.
608	The design shall be such that any lifting attachments on the package will not fail when used in the intended manner and that if failure of the attachments should occur, the ability of the package to meet other requirements of these Regulations would not be impaired. The design shall take account of appropriate safety factors to cover snatch lifting.
609	Attachments and any other features on the outer surface of the package that could be used to lift it shall be designed to either support its mass in accordance with the requirements of para. 608 or shall be removable or otherwise rendered incapable of being used during transport.
610	As far as practicable, the packaging shall be so designed that the external surfaces are free from protruding features and can be easily decontaminated.
611	As far as practicable, the outer layer of the package shall be so designed as to prevent the collection and the retention of water.
612	Any features added to the package at the time of transport that are not part of the package shall not reduce its safety.
613	The package shall be capable of withstanding the effects of any acceleration, vibration or vibration resonance that may arise under routine conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole. In particular, nuts, bolts and other securing devices shall be so designed as to prevent them from becoming loose or being released unintentionally, even after repeated use.
613(A)	The design of the package shall take into account ageing mechanisms.
614	The materials of the packaging and any components or structures shall be physically and chemically compatible with each other and with the radioactive contents. Account shall be taken of their behaviour under irradiation.
615	All valves through which the radioactive contents could escape shall be protected against unauthorized operation.
616	The design of the package shall take into account ambient temperatures and pressures that are likely to be encountered in routine conditions of transport.
617	A package shall be so designed that it provides sufficient shielding to ensure that, under routine conditions of transport & with the maximum radioactive contents that the package is designed to contain, the dose rate at any point on the external surface of the package would not exceed the values specified in paras 516, 527 & 528, as applicable, with account taken of paras 566(b) & 573.
618	For radioactive material having other dangerous properties, the package design shall take into account those properties (see paras 110 and 507).

APPENDIX C RADIATION MATERIAL TRANSPORT PROCEDURE

RADIOACTIVE MATERIAL TRANSPORT PROCEDURE

Introduction

Ores and process materials at the Arafura Nolan Bore Project contain elevated concentrations of thorium and uranium. The concentrations of uranium and thorium exceed the levels at which a material is defined as radioactive.

While Arafura does not intend to initially transport final products that are defined as radioactive, there will be occasions when radioactive materials are transported, most likely for the purposes of sample analysis.

This procedure outlines the requirements for radioactive material transport.

Overall Performance Requirement

In accordance with the Radiation Protection and Radioactive Waste Management Plan (RPRWMP), any radioactive materials that require transport from the site (for example, samples for analysis) will be transported in accordance with the ARPANSA Transport Code [ARPANSA 2019] (referred to as the Transport Code).

Transport of radioactive materials will only be undertaken by the appropriately qualified officer of the company.

Implementation

The transport of radioactive material consists of two main processes:

- Radiation contamination clearance,

Radioactive material transport in accordance with the Transport Code.

Radiation contamination clearance is addressed in the Radiation Surface Contamination Monitoring Procedure (APPENDIX H).

Transportation of radioactive materials must meet authorisation, documentation, packaging, placarding and storage requirements in accordance with the Transport Code and Northern Territory requirements (*Northern Territory Radioactive Ores and Concentrates (Packaging And Transport) Act 1980* and *Northern Territory Radioactive Ores and Concentrates (Packaging And Transport) Regulations 1980*).

The key requirements are:

The company (consignor) is to ensure that the receiver (consignee) is able to accept the consignment under state and federal regulations.

- The material must be accompanied by a completed Dangerous Goods consignment declaration form, Safety Data Sheet (SDS) for the material, and emergency arrangements.

Materials must be packaged in accordance with the Transport Code Section 6 and the 'package' labelled and placarded in accordance with Radiation Protection Series C-2 (RPSC-2) Section 5 clause 534 – 548.

The above conditions do not apply to materials that are deemed to be exempt under RPSC-2 Section 4 clauses 401 – 406. Exempted and Excepted packages do not require a consignment declaration form.

Authorised transport service providers will be used for the transportation of the material. Service providers must demonstrate that their Radiation Transport Management Plan meets the requirements of Arafura's Radiation Transport Requirements (APPENDIX A).

- Radioactive samples and test material originating from the operation will be returned to site and disposed of in the TSF or held as geological/metallurgical records in a secure location.

References

ARPANSA Code for the Safe Transport of Radioactive Material, RPS C-2 (Rev. 1) (commonly referred to as the Transport Code)

Northern Territory Radioactive Ores and Concentrates (Packaging And Transport) Act 1980 (in force as of 1 July 2011)

Northern Territory Radioactive Ores and Concentrates (Packaging And Transport) Regulations 1980 (in force as of 1 January 2010)

APPENDIX D GAMMA RADIATION MONITORING PROCEDURE

GAMMA RADIATION MONITORING PROCEDURE

Introduction

Ores and process materials at the Arafura Nolan Bore Project contain elevated concentrations of thorium and uranium. This may lead to elevated gamma radiation levels in workplaces, resulting in worker exposure.

For occupational exposure, workers are allocated to workgroups and personal dosimeters are issued as required.

The purpose of this procedure is to conduct workplace area monitoring to confirm already identified areas of elevated gamma radiation, to ensure that controls remain effective and that levels remain controlled, and to identify any changes in gamma radiation levels that may occur due to changes in processes or process materials.

The general guidance for gamma radiation is that radiation levels should not change with time, and the monitoring technician should make notes during the survey.

The recognised action level for gamma radiation in any occupied workplace is 5 µSv/h. This value may be exceeded in some areas, and this should be noted. This may not be a concern if the area is not an occupied workplace.

If a gamma measurement exceeds 25 µSv/h, the Statutory Radiation Safety Officer (RSO) must be alerted immediately.

Overall Performance Requirement

The approved Radiation Protection and Radioactive Waste Management Plan outlines the gamma monitoring schedule. A suitably trained technician will take measurements according to the schedule.

Measurements will be undertaken in accordance with this procedure and regularly audited.

Implementation

Note that the exact method of measurement depends on the instrument used, and the general method is outlined below.

Instrument Preparation:

- Gamma surveys must be conducted at locations and times as specified in the Radiation Management Plan.
- Collect gamma monitor.

Ensure the survey meter has a good battery life and observe the background reading over a period of one minute and record.

Performing gamma surveys:

Go to the monitoring location and commence the survey.

- Hold the gamma meter at waist height and take measurements at the predefined locations.

- Record all results (maximums and averages), including any areas of high gamma radiation.
- All data shall be entered into the site radiation database at the end of monitoring.

APPENDIX E LONG LIVED RADIONUCLIDES IN DUST SAMPLING PROCEDURE

LONG LIVED RADIONUCLIDES IN DUST SAMPLING PROCEDURE

Introduction

Airborne dust monitoring includes both personal sampling and locational sampling. It is conducted to determine the exposure to workers and to also check on the effectiveness of control measures.

The primary purpose of this sampling procedure is to collect information on long-lived radionuclides in dusts that workers may inhale.

Radioactive dust sampling consists of two main components:

- Taking a representative air sample, which involves drawing air through a pre-weighed 25mm filter paper for a defined period at a defined flow rate, using a calibrated dust pump.
- Analysing the content of the sample for long-lived radionuclides, which involved placing the filter into an alpha counting slide drawer assembly and "alpha counting" for a prescribed time.

The first part of the method is conducted in accordance with Australian Standard AS3640-2004 (see reference). The radiometric analysis is defined in detail in this procedure,

Radiation inhalation dose mainly comes from the long-lived alpha-emitting radionuclide in airborne dust. For the dusts generated in the Nolan Bore Project, the ratio of long-lived alpha radiation will vary depending upon the particular area.

This must be taken into account when assessing doses from the inhalation of dusts (see Dose Assessment Procedure, APPENDIX I).

Overall Performance Requirement

The approved Radiation Protection and Radioactive Waste Management Plan outlines the schedule for occupational dust monitoring. A suitably trained technician will take measurements according to the schedule.

Measurements will be undertaken in accordance with this procedure and regularly audited.

Implementation

1. Filter pre-weighing:
    - Collect filters to be weighed and a corresponding number of clean petri dishes. Label each of the dishes with a unique sample identifier.
    - Weigh each filter using a calibrated microbalance and write the weight of the filter onto the petri dish. Cover and then place the filter into the dish. Complete the pre-weighing for the required number of filters for the monitoring event.
    - The filters will be 25mm 0.8 micron (pore size) Millipore filters.
    - Record the initial filter masses on the Airborne Dust Monitoring Sheet.

2. Sample head preparation:
    - Dismantle the inhalable sampling filter holder (also known as the sampling head) and using contact cleaner and lint free tissues; remove any dirt from the head body, supporting mesh and O-rings.
    - Assemble the sampling head by placing a clean O-ring followed by a dry supporting mesh inside the body of the head. Position a pre-weighed filter with a Teflon O-ring laid on top, onto the mesh. Firmly screw on the top section of the head and secure by using electrical tape to join the two sections of the head.
    - On the Airborne Dust Monitoring Sheet record the number of the sampling head, the pre-weighed filter mass and the filter sample number.
    - Attach the sampling head to a SKC AirChek Sampler that has been on charge for at least 24 hours. Record the AirChek Sampler number on the Airborne Dust Monitoring Sheet.

3. Pre-setting the Airchek Sampler used for area monitoring
    - Remove the clear plastic cover from the AirChek sampler controls by undoing the screw at the centre bottom of the plastic cover.
    - Turn the 'ON/OFF' switch from on to off to on again.
    - When the pump is running, press the 'START/HOLD' button.
    - Press the 'SET-UP' button for the display to indicate a delayed start. The first digit of the display will start to flash. Calculate the time in minutes until the sampler is required to start. Set that number of minutes on the display using the 'DIGIT SET' button to change the value of each digit. The 'DIGIT SELECT' button is used to change digits on the display. The 'DIGIT SET' button will change the flashing digit.
    - When the correct delay start time is displayed, press the 'MODE' button once. The sampling period can now be set. The display should indicate 'SAMPLING PERIOD', and the first digit should be flashing.
    - A sampler period of seven hundred (700) minutes should be set. This sampling period is twelve (12) hours, corresponding with a shift's duration. Use the 'DIGIT SELECT' and 'DIGIT SET' buttons to set the sampling period.
    - Once the sampling time is set, press the 'START/HOLD' button once. 'DELAYED START' should be flashing in the bottom left-hand corner and the delay start time should be visible. Once the sampler counts down the set delay time, the sampler will automatically run for the set sampling period.
    - Replace the plastic cover.

4. Pump flow rate calibration
    - Prior to pre-setting the sampling time and placing the sampler, operate the AirChek sampler with a sample head attached for two (2) minutes. After the sampler has warmed up, check the flow rate using the DC-Lite primary flow meter. If the flow rate is not 2.0 +/- 0.1 lpm, adjust the flow rate of the AirChek sampler using the 'FLOW ADJUST' screw on the front panel of the sampler. Adjust this screw until the flow rate is 2.0 +/- 0.1 lpm. Turn the screw clockwise to increase the flow rate and counterclockwise to decrease the flow rate.

- The control filters should be placed in sample heads on a pump. The pumps with control filters should then undergo a flow rate check. This is so that the control filters are subject to the same non-sampling procedures as the sample filters.

5. Distribution of sampling equipment
   - In accordance with the dust monitoring program specified in the RPRWMP, distribute sampling pumps to the personnel or areas to be monitored at the commencement of shift. Start personal pumps, and any area pumps that do not have a delayed start set. Record the sampling head number, start time and details of the monitored personnel or areas in the Airborne Dust Monitoring Sheet.
   - Arrange a collection point for personal pumps with individual wearers.
   - After returning to the radiation laboratory, record the information in the Airborne Dust Monitoring Sheet.

6. Collection of sampling equipment
   - Collect the pumps the following morning or towards the end of shift. Ensure that the wearers of personal pumps have a good understanding of how to turn the pump off. Arrange a point where the wearer can leave their personal pump to be collected. Collect and return the pumps to the radiation laboratory.
   - Record the pump run-time in the appropriate column of the Airborne Dust Monitoring Sheet in the corresponding row for each pump.
   - For personal samples, record comments from the operator regarding their activities during the day.
   - For area samples, record any observations about the workplace that may have affected the sample result (for example, "windy day with excessive environmental sand in the area").

7. Dust filter weight analysis
   - Separate the sampling head from each pump.
   - Disassemble the sampling head and place the filter in the correct petri dish.
   - Weigh the filter and record the mass on the petri dish and in the Airborne Dust Monitoring Sheet.

8. Dust filter radiometric analysis
   - Do not alpha count the filter until at least 48 hours after the end of the sampling time. This gives time for any radon decay products to decay away. Counting the filter immediately will also result in short-lived alpha emissions being counted.
   - Count the filter in a Ludlum alpha particle counter for a time interval of one hundred minutes. (Note delayed time for counting may apply).
   - At the completion of counting, record the number of counts and the counter number in the appropriate column of the Airborne Dust Monitoring Sheet.
   - Repeat the above steps for all pumps that are collected.

9. Enter results
   - Once the sample has been counted, enter all data into the Radiation Monitoring database

- The database will provide notification of any further actions that may be required (for example, if the dust activity or dust concentration is above the reporting level).

10. Alpha counter considerations
    - Perform a background count (BC) for 100 minutes once each day. Record results in the daily monitoring form.
    - Perform a calibration check using an alpha calibration source each week and record in the monitoring database.
    - Make sure that the filters are counted for 100 minutes. To determine "nett" counts, subtract the latest background count from the gross count and record it in the Radiation Monitoring Database.
    - Clean the alpha counter sample tray with alcohol (swab) in between each count.

References

AS 3640-2004 – Workplace atmospheres – Method for sampling and gravimetric determination of inhalable dust

APPENDIX F RADON DECAY PRODUCT SAMPLING PROCEDURE

RADON DECAY PRODUCT SAMPLING PROCEDURE

Introduction

This procedure refers to the sampling procedure for radon decay products.

Ores and process materials at the Arafura Nolan Bore Project contain elevated concentrations of thorium and uranium. Both of these radionuclides decay through to the element radon. For uranium, the isotope of radon is Rn222 (commonly known as "radon"), and for thorium, the isotope is Rn220 (commonly known as "thoron").

Both of these decay isotopes are radioactive and decay to their respective decay products. The decay products are relatively short-lived (compared to the long-lived radionuclides), and therefore, it is important to assess their inhalation hazard.

Monitoring provides the basis for compliance testing and dose assessment.

Radon and thoron decay product sampling consists of two main components:

- Taking a representative air sample, which involves drawing air through a pre-weighed 25mm filter paper for a defined period at a defined flow rate, using a calibrated dust pump.
- Analysing the content of the sample for short-lived radionuclides, which involved placing the filter into a portable alpha counting slide drawer assembly and "alpha counting" for a prescribed time. Because of the different half-lives of radon and thoron and their decay products, the "timing" of various aspects of this sampling method is different.

A primary exposure pathway for workers is the inhalation of the short-lived decay products of the isotopes of radon (Rn222) and thoron (Rn220). Air sampling is conducted, and a strict counting time arrangement is applied in order to measure the dominant short alpha emitters in the respective decay chains. The methods are based on published papers and general guidance.

The assessment of doses from the measured concentration of the decay products in air is outlined in the Dose Assessment Procedure (APPENDIX I).

Many different methods exist for measuring radon and thoron decay products (see DMP 2010). Arafura uses the Borak method for radon decay products.

Overall Performance Requirement

The approved Radiation Protection and Radioactive Waste Management Plan outlines the schedule for occupational radon decay product monitoring. A suitably trained technician will take measurements according to the schedule.

Measurements will be undertaken as per this procedure and will be regularly audited.

Implementation

For radon decay products, the preferred method is the Borak method (also known as the "3-3-3" method), and the timing is as follows:

- Air sampling – 3 minutes
- Wait time before counting – 3 minutes
- Count time – 3 minutes

The method for analysis is detailed below:

- Place a Type A/E Glass Fiber Filter using tweezers into the sampling head.

Set the pump to run for 3 minutes at 2 litres per minute (refer to SKC 224-XR AirChek 52 Sample Pump manual for the operation of the pump).

- Note the start time and the sampling location.

The filter paper with the filtered decay products is then placed into the alpha counter, and a delay period of 3 minutes occurs before "counting" of the filter.

After the delay period, the filter paper is gross alpha counted for a period of 3 minutes.

A background count is usually conducted prior to the filter count.

The count data is then used to calculate the radon decay product concentration using the following equation:

- RDP ($\mu J/m^3$) = (Counts x 0.2237) ÷ (Counter Efficiency)

The counter efficiency is located on the side of the Ludlum 2241.

References

DMP 2010 - Managing Naturally Occurring Radioactive Material (NORM) in mining and mineral processing guideline NORM 3.4 Monitoring NORM airborne radioactivity sampling
https://www.dmp.wa.gov.au/Documents/Safety/MSH_G_NORM-3.4.pdf

APPENDIX G THORON DECAY PRODUCT SAMPLING PROCEDURE

THORON DECAY PRODUCT SAMPLING PROCEDURE

Introduction

This procedure refers to the sampling procedure for thoron decay products.

Ores and process materials at the Arafura Nolan Bore Project contain elevated concentrations of thorium and uranium. Both of these radionuclides decay through to the element radon. For uranium, the isotope of radon is Rn222 (commonly known as "radon"), and for thorium, the isotope is Rn220 (commonly known as "thoron").

Both of these decay isotopes are radioactive and decay to their respective decay products. The decay products are relatively short-lived (compared to the long-lived radionuclides), and therefore, it is important to assess their inhalation hazard.

Monitoring provides the basis for compliance testing and dose assessment.

Radon and thoron decay product sampling consists of two main components:

- Taking a representative air sample, which involves drawing air through a pre-weighed 25mm filter paper for a defined period at a defined flow rate, using a calibrated dust pump.
- Analysing the content of the sample for short-lived radionuclides, which involved placing the filter into a portable alpha counting slide drawer assembly and "alpha counting" for a prescribed time. Because of the different half-lives of radon and thoron and their decay products, the "timing" of various aspects of this sampling method is different.

A primary exposure pathway for workers is the inhalation of the short-lived decay products of the isotopes of radon (Rn222) and thoron (Rn220). Air sampling is conducted, and a strict counting time arrangement is applied in order to measure the dominant short alpha emitters in the respective decay chains. The methods are based on published papers and general guidance.

The assessment of doses from the measured concentration of the decay products in air is outlined in the Dose Assessment Procedure (APPENDIX I).

There are many different methods for measuring radon and thoron decay products (see DMP 2010). Arafura uses the Rock method for thoron decay products.

Overall Performance Requirement

The approved Radiation Protection and Radioactive Waste Management Plan outlines the schedule for occupational thoron decay product monitoring. A suitably trained technician will take measurements according to the schedule.

Measurements will be undertaken as per this procedure and will be regularly audited.

Implementation

The procedure for thoron decay monitoring is outlined below:

- Place a Type A/E Glass Fiber Filter using tweezers into the sampling head.

Set the pump to run for 20 minutes at 2 litres per minute (refer to SKC 224-XR AirChek 52 Sample Pump manual for the operation of the pump).

- Note the start time and the sampling location.

The filter paper with the filtered decay products is then enclosed in a plastic container for a delay period of 5 hours.

After the delay period, the filter paper is gross alpha counted for a period of 10 minutes.

A background count is usually conducted prior to the filter count.

The count data is then used to calculate the thoron decay product concentration using the following equation:

$$Thoron\ Decay\ product\ Concentration\ (\mu J/m^3) = \frac{[(C_S - C_B)\ \text{x}\ 20.8]}{(\text{E x f x V x T})}$$

Where:

- Cs = gross count in interval T
- CB = background count in interval T

E = efficiency of detection equipment expressed as a fraction (cps/dps)

- f = conversion factor, (13.2 for this sampling and counting arrangement)
- V = volume of air sampled
- T = counting time in minutes
- 20.8 - factor to convert from WL (working level) to µJ/m^3.

References

DMP 2010 - Managing Naturally Occurring Radioactive Material (NORM) in mining and mineral processing guideline NORM 3.4 Monitoring NORM airborne radioactivity sampling
https://www.dmp.wa.gov.au/Documents/Safety/MSH_G_NORM-3.4.pdf

APPENDIX H RADIATION SURFACE CONTAMINATION MONITORING PROCEDURE

RADIATION SURFACE CONTAMINATION MONITORING PROCEDURE

Introduction

Ores and process materials at the Arafura Nolan Bore Project contain elevated concentrations of thorium and uranium, and when plant and equipment come in contact with the ores or process materials, there is a chance that they may become contaminated with radioactive materials.

Similarly, dust may deposit from the air and process materials (such as muds) may be carried into "clean" areas through workers' clothing, boots or contaminated equipment. The Radiation Protection and Waste Management Plan requires that surface contamination monitoring be conducted to identify where contamination has occurred and ensure that "clean" workplaces are not contaminated.

It is important to ensure that plant, equipment or clothing does not become contaminated and, therefore, potentially radioactive. Good cleaning practices will enable the return of items to a non-contaminated state. In some cases, the costs of the cleaning may make it prohibitive, for example, in the case of ingrained rust, requiring that the item be disposed of as radioactively contaminated waste. In these cases, the radioactive contamination is referred to as "fixed contamination" and does not represent a health risk due to its immobile state.

The main aim of this procedure is to provide a method for surface contamination monitoring.

The general guidance for surface contamination is that if the item "looks dirty", then it is likely to be contaminated. Therefore, surface contamination monitoring is really a check for the cleanliness of items and workplaces.

The recognised standard for what is considered surface contamination are levels of:

Over 3,700 Bq/m^2 – For all monitored areas excluding workshops

Over 37,000 Bq/m^2 – For workshops

Where readings above this level are recorded, the corresponding item or area must be cleaned or disposed of as radioactively contaminated waste.

Overall Performance Requirement

The schedule for surface contamination monitoring is outlined in the approved Radiation Protection and Radioactive Waste Management Plan. Measurements will be taken by a suitably trained technician in accordance with the schedule.

Measurements will be undertaken in accordance with this procedure and regularly audited.

Implementation

Note that the exact method of measurement depends on the instrument used; however, a generalised method is outlined below:

- For this procedure, use of the Ludlum 2241-3 Survey Meter with alpha probe (Model 43-65) is assumed.

- Move the control switch on the survey meter to "Surface Alpha" position.

Confirm the LCD display is NOT showing the battery icon; otherwise, consult a qualified technician to replace the batteries before commencing.

- Ensure the following switches are set:
  - "AUD" switch to "ON" position
  - The response switch to "S" position

The mode switch on "RATE" mode.

- Proceed to the location to be surveyed, as outlined in the Radiation Protection and Radioactive Waste Management Plan.

Hold the probe (with the very sensitive mylar window) toward the sun or light source and perform a light leak check. If the meter responds abnormally or starts repeatedly beeping, there is an error, likely a hole in the MYLAR film. Return the meter to a qualified technician for repair.

If no error sounds, hold the probe within 0.5cm of the selected surface and observe the reading. The reading will fluctuate on display; use a by-eye assessment and get the average result.

- Record results in the Radiation Monitoring Data Sheet.
- Move to the next surface and locations and repeat until all the monitoring is complete.
- Switch off the instrument and return to the office at completion of monitoring.

APPENDIX I RADIATION GAUGES & SEALED SOURCES OF RADIATION MANAGEMENT PROCEDURE

RADIATION GAUGES AND SEALED SOURCES OF RADIATION MANAGEMENT PROCEDURE

Introduction

Note that the design of the Arafura Processing Plant has yet to be finalised and there is uncertainty whether radiation density gauges will be used for process control. In the event that density gauges are to be used, this procedure will apply to those gauges.

This procedure applies to the management of radiation gauges and sealed radiation sources. This includes:

- the purchasing or taking receipt of radiation gauges
- work on or around radiation gauges
- use of radioisotopes in laboratories, and
- emergency response involving radiation gauges.

Radiation Gauges contain a small, intense radioactive source enclosed within a radiation shield. When a gauge is mounted in its normal working position or when removed but with the shutter locked in the "Off" position, radiation levels are low and within recognised regulatory limits.

If there is any sign of damage to a radiation gauge or radioisotope, or it has been dropped or incorrectly installed, the SRSO must be informed immediately.

Overall Performance Requirement

The SRSO will maintain a record of all radiation density gauges and radioisotopes installed and utilised at the Project and is responsible for ensuring that all are appropriately licenced. A register of the location of all radiation gauges on site will be stored in the occupational hygiene office. Personnel must complete maintenance logs during every inspection, and a copy forwarded to the SRSO.

Annual audits of density gauges and radioisotopes will be conducted.

Implementation

1. Procuring, Receipt and Notification

No radiation gauge or sealed source is permitted to be brought to site without the formal approval of the Statutory Radiation Safety Officer (SRSO).

All radiation density gauges and radioisotope sources require a "licence to possess" in accordance with the Northern Territory Radiation Protection Regulations.

- Upon arrival of the radiation gauge at the operation, the SRSO must:
  - Ensure that the documentation matches the label on the gauge
  - Conduct a gamma survey
  - Check the gauge is working correctly

- Check for any damage
- Ensure that signage is correct

The shutter or source control mechanism is operating correctly.

If the gauge is not to be installed when first arriving on site, it will be relocated by suitably trained personnel to a secure locked area until it is required. Only appropriately trained radiation personnel are authorised to access this area.

2. Installation and Maintenance

- No work can occur on a radiation gauge or sealed source without the formal authorisation of the SRSO.

A detailed installation plan will be established for each density gauge and be approved by the SRSO. Once installed, the gauge will be inspected by the SRSO to ensure that it is safe and secure and that all precautions are in place.

A regular gauge maintenance program will be established that includes:

- Cleaning radiation gauges of any contamination.
- Inspection and immediate reporting of any visible damage to the radiation gauge to the SRSO.
- Replacement of any missing or damaged radiation signage.

Where work is to be conducted in the vicinity of a gauge, it must be isolated in accordance with the procedure below.

3. Radioactive Gauge Clearance

Prior to work on and around radiation gauges, a Permit to Work must be completed.

A Radiation Gauge Clearance must be completed when a person is required to carry out work on a radiation gauge or any work in the vicinity of a gauge.

The Radioactive Gauge Clearance is issued in conjunction with the Permit to Work.

The SRSO or Authorised Officer are the only personnel authorised to isolate gauges.

4. Isolation of Gauges

The SRSO must accompany the worker who holds the Permit to Work to isolate the gauge and complete a Radioactive Gauge Clearance. The SRSO will turn the radiation gauge's shielding to the "beam off" position and lock it out using a safety padlock and attaching an isolation tag.

The SRSO is the only person who can authorise the work and the only person authorised to return the radiation gauge back to the "beam on" position. The key to locking the beam out must be held by the SRSO.

- After the radiation gauge has been switched to the "beam off" position and locked out, the SRSO will perform a gamma survey around the gauge to confirm the beam is off and record the results on the Radiation Gauge Clearance Certificate.

5. Recording

- Whenever a radiation gauge is moved temporarily or permanently, it must be logged by the SRSO.

6. Emergency Procedure

- An Emergency is defined as: any loss of control of the gauge, or any incident involving direct exposure of a person to the radiation beam. This may include but is not limited to:
  - A radiation gauge falling from its proper working position
  - A radiation gauge being removed from its position without authority
  - Any situation which damages, or may have damaged a radiation gauge
  - A radiation gauge found to be missing.

The SRSO is responsible for making an immediate assessment of the nature and scope of the hazard following any incident involving radiation gauges. They may call upon Emergency Services personnel and, depending on the nature of the incident, may:

Secure the area and establish control measures over access to the area

- Complete radiation monitoring survey
- Apply a shield to the radioactive source
- Remove the radiation gauge to the Radiation Store.

Following an emergency the SRSO will conduct an investigation into the incident. Estimates will be made of any possible radiation exposures.

APPENDIX J DOSE ASSESSMENT PROCEDURE

DOSE ASSESSMENT PROCEDURE

Introduction

This procedure describes the method used to calculate total effective dose for workers based on doses from the three main radiation dose pathways.

- Irradiation by external gamma radiation;
- Inhalation of Long Live Radionuclides in Airborne Dust (LLRD);

Inhalation of Radon and Thoron Decay Product (RnDP and TnDP).

The doses calculated for these three main pathways are then added together to calculate the total effective dose, according to the formula:

Total Effective Dose = Gamma dose + LLRD dose + RnDP and TnDP dose, where:

Gamma dose = personal gamma dosimeter readings OR Work Group Average (WGA) (in µSv)

LLRD Dose = WGA activity concentration in Bq/m^3 x hrs onsite x 1.2 m^3/hr breathing rate x DCF (in µSv)

- RDP dose = personal dosimeter OR

Area WGA RDP concentration in □J/m^3 x hrs onsite x for each individual x DCF for RDP (in µSv)

Overall Performance Requirement

Doses for workers will be calculated:

- Quarterly and compared to the quarterly dose constraint and limit
- Annually and compared to the annual dose constraint and limit

Where a quarterly workgroup dose exceeds the pro-rata quarterly dose constraint or dose limit, an investigation must be conducted.

Where an annual workgroup dose exceeds the annual dose constraint or dose limit, an incident will be logged into the internal incident management system for formal investigation.

Results of annual dose assessments are to be summarised into a report for internal distribution and review.

The respective limits are shown in Table A below.

Table A: Dose Investigation Levels

Criteria	Level (mSv)	Action
Quarterly Dose Constraint	2.5	Investigate exposure pathways & review controls
Quarterly Dose Limit	5	Immediate review and implement improvements
Annual Dose Constraint	10	Investigate exposure pathways and implement appropriate controls

Criteria	Level (mSv)	Action
Annual Dose limit	20	Statutory exceedance

The dose assessments will be conducted by the Statutory Radiation Safety Officer.

Implementation

1. Gamma Dose
    - Personal gamma exposure will be determined from the individual gamma monitors each quarter.
    - Workers who are not issued with personal gamma monitors will have their gamma exposure calculated from a combination of Work Group Averages (WGA) and individual time on site.
    - Where a worker or a group of workers has been identified to have been exposed to an incident dose, the incident dose is to be added to their final dose calculation.

2. LLRD Dose
    - LLRD area and personal monitoring data will be used to calculate the WGA for each similar exposure group (SEG).
    - Individual LLRD doses are calculated with a combination of WGA, individual time on site, and the relevant LLRD dose conversion factor.
    - Where a worker or a group of workers has been identified to have been exposed to an incident dose, the incident dose is to be added to their final dose calculation.

3. RnDP and TnDP Dose
    - Area RnDP and TnDP monitoring results will be utilised to calculate WGA, which will then be applied to each worker in that SEG.
    - Area RDP dose will be calculated from a combination of RDP district average, individual time on site, and the RDP dose conversion factor.
    - Where a worker or a group of workers has been identified to have been exposed to an incident dose, the incident dose is to be added to their final dose calculation.

APPENDIX K RADIATION CLEARANCE OF MACHINERY AND EQUIPMENT PROCEDURE

RADIATION CLEARANCE OF MACHINERY AND EQUIPMENT PROCEDURE

Introduction

The main aim of this procedure is to ensure that machinery and equipment that has come into contact with radioactivity is decontaminated and cleaned, prior to removal from site. This procedure recognises the surface contamination clearance levels outlined in the ARPANSA Transport Code which form the formal basis of the performance requirements for this Procedure.

Radioactive material is generally defined as follows:

material that contains more than 80ppm of naturally occurring uranium

material that contains more than 240 ppm of naturally occurring thorium

material that contains more than 1Bq/g of any radionuclide.

It is important to note that a piece of equipment cannot "become radioactive". What occurs is that the piece of equipment is contaminated with radioactive material (such as uranium dust or ore), and the aim is then to remove this contamination.

Overall Performance Requirements

All plant and equipment that leaves the main mining and processing area where:

- it has been in contact with radioactive material (such as a pump for radioactive slurries)
- it may have been subject to dust deposition (such as storage containers next to an ore crushing facility)
- it could be contaminated (such as a vehicle from the mine pit).

Must be inspected for cleanliness and subject to a radiation clearance before leaving the particular site.

It is the responsibility of the person authorising the removal of that piece of equipment from the site to ensure that the piece of equipment is checked and decontaminated, where required, before the equipment leaves site.

The critical requirement is to ensure that a piece of equipment is clean so that it can be freely transported and used elsewhere. To achieve this, the ARPANSA Transport Code (see reference) is usually used for guidance. This document defines 'contaminated equipment' as follows:

"The Contamination shall mean the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm2 for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm2 for all other alpha emitters." (Clause 214)

Implementation

Prior to a piece of equipment being presented for final clearance, it should have already been physically cleaned and allowed to dry.

Physical cleaning can completed using a range of techniques, including, but not limited to:

- washing with a high-pressure hose
- scrubbing with a brush to remove caked-on mud or materials
- use of cleaning agents (solvents or acids)
- sandblasting
- flushing of some equipment (such as a pump)
- dismantling of certain equipment (where the inside is inaccessible, and contamination exists inside).

All cleaning must be undertaken in a nominated decontamination area or appropriately bunded area with a wastewater capture system.

Once a piece of equipment is cleaned and dry, it can then be inspected. There are two methods of checking the cleanliness of equipment:

1. A visual inspection (note that if a piece of equipment looks dirty, and even if it does not trigger the performance limit, it is not good practice for it to be sent from site).

2. A surface alpha contamination check using an appropriate monitor can be conducted on the dried surfaces of the equipment.

For the alpha check, it is important to check the internals or "out of sight" areas of equipment. For example, when inspecting a vehicle, it is important to be able to identify if there is contamination under the vehicle. Similarly, for equipment like pumps, it may be necessary to strip down the pump and clean before sending off site.

Equipment that is cleared to leave the site must be documented and signed off by the person who conducted the decontamination check and is authorising the removal of the equipment offsite.

References

Code for the Safe Transport of Radioactive Material (2019) https://www.arpansa.gov.au/regulation-and-licensing/regulatory-publications/radiation-protection-series/codes-and-standards/rpsc-2

APPENDIX L RADIOACTIVELY CONTAMINATED WASTE PROCEDURE

RADIOACTIVELY CONTAMINATED WASTE PROCEDURE

Introduction

Ores and process materials at the Arafura Nolan Bore Project contain elevated concentrations of thorium and uranium.

For radioactively contaminated waste, Arafura will implement a program that initially aims to minimise waste to be disposed of. Where practical, radioactively contaminated waste will be decontaminated and then disposed of via appropriate waste channels or recycled. Where this is not possible, alternative disposal options include:

- Incorporation into the waste rock stockpile.
- Disposal in a dedicated contaminated waste on-site landfill facility (note that this may be a separate area of the site landfill).
- Stored in a secure storage area until end of mine life and incorporated into the Project decommissioning plan.

Overall Performance Requirement

The Statutory Radiation Safety Office (SRSO) will conduct regular audits of radioactively contaminated waste. Areas to be audited include:

- Clear assignment and communication of responsibilities
- Education and engagement of the aspects of this procedure

Effectiveness of reporting, feedback and corrective measures

Implementation

Arafura will aim to minimise the amount of radioactively contaminated waste in accordance with the waste hierarchy.

- Minimise the waste generated throughout the operation and maximise the reuse and recycling of waste materials produced.
- Safely and securely store, handle, transport, and dispose of waste.

Implement effective recording, monitoring and tracking systems.



1. Approach
   - All members of the operations team will strive to minimise waste.
   - Every effort will be made to recycle, recover or reuse waste where possible.
   - All personnel will be required to make reasonable efforts to ensure that waste is properly segregated at the source.
2. Administration Controls
   - Radioactively contaminated waste volumes are to be collated monthly and consolidated into a monthly report.
   - A system of regular auditing will be established.
3. Waste Classification and Segregation
   - All radioactively contaminated waste will be identified at the source and sorted into different skips or stockpiles.
   - Waste materials that are contaminated with process materials are to be washed down in dedicated bunded areas prior to being placed as waste. The aim is for the waste item to be clean of removable contamination.
4. Waste Collection
   - Radioactively contaminated waste will be delivered to the appropriate waste disposal area in a safe and secure manner.
   - Bins, including location and collection schedule, is to be established and communicated to all supervisors and contractors by the nominated waste management resource.
5. Removal of Waste from Site
   - In general, radioactively contaminated waste will be disposed of on site.
   - Where required, radioactive contaminated waste may be disposed of in an offsite facility. This will only occur under the direction of the SRSO.
   - All waste leaving the site will be transported appropriately (using suitably permitted waste transport contractor(s), where required) and only taken to a licenced waste disposal facilities.
   - All waste radioactive contaminated waste leaving the site will be documented and accounted for.

- If waste material is to be removed from site once it has been decontaminated, the regular site contamination clearance will be undertaken.

6. Reporting
   - Waste types and volumes are to be recorded.
   - Generated waste types and volumes are to be collated monthly and consolidated into a monthly report for internal distribution to management.
7. Bunded Wash-down Areas for Cleaning
   - A bunded wash-down area will be required to clean waste that is contaminated.
   - A wash-down area will also be established for cleaning waste that is leaving site.
8. Radioactively Contaminated Materials
   - An item of material is defined as radioactively contaminated when:
     - The item, equipment or material exceeds the surface contamination clearance level.
     - The item, equipment or material is calculated to contain, on average, a radionuclide concentration that exceeds 1Bq/g, or 10 Bq/g for some individual radionuclides (as assessed by a SRSO).
9. Radioactively Contaminated Waste
   - Where plant, equipment or items cannot be sufficiently cleaned and are classified as radioactively contaminated waste for disposal, the following options shall be considered:
     - Incorporation into the waste rock stockpile
     - Disposal in a dedicated contaminated waste on-site landfill facility (note that this may be a separate area of the site landfill)
     - Stored in a secure storage area until end of mine life and incorporated into the Project decommissioning plan.
10. Radioactive Process Material
    - Process materials include slurries, dusts, accretions, process liquors and reclaimed sump liquids.
    - The defined disposal method for this material is either to recycle the material back into the process or transfer to the TSF dam. Disposal into the TSF will require authorisation by the TSF manager.

APPENDIX M ENVIRONMENTAL RADIATION MONITORING PROCEDURE

ENVIRONMENTAL RADIATION MONITORING PROCEDURE

Introduction

Ores and process materials at the Arafura Nolans Project contain elevated concentrations of thorium and uranium. The conduct of the operations may result in offsite radiological impacts. Monitoring is required to identify changes in natural background levels and determine the effectiveness of emission controls.

Arafura has previously conducted baseline monitoring to determine the region's naturally occurring background radiation levels. The baseline monitoring will continue until operations commence.

Once operations commence, the monitoring program will transition to an operational environmental monitoring program.

Overall Performance Requirement

The approved Radiation Protection and Radioactive Waste Management Plan outlines the environmental monitoring schedule. A suitably trained technician will take measurements according to the schedule.

Measurements will be undertaken in accordance with this procedure and regularly audited.

Implementation

The monitoring methods are outlined in Table B below.

Table B: Environmental Radiation Monitoring Methods

Radiation	Measurement Method	Location and Frequency
Gamma	Passive environmental gamma monitors	OSLD or TLD badges (provided and analysed by service provider) located approximately 1m above the ground. Can be taped to the support stand, with quarterly changeover, at each monitoring location.
	Gamma survey	Handheld gamma survey of monitoring location.
Radon concentration	Passive environmental radon monitors	Passive radon detector placed one meter above the ground in protective housing (pipe with one open end to the ground), with quarterly changeover, at each monitoring location.
Dispersion of dust containing long-lived radionuclides	Passive dust deposition gauges	Continuous sampling at each monitoring location - changeover quarterly or more frequent as determined by rainfall. Samples for each monitoring location composited for one year then radiometrically analysed. Summary method is: ▪ 5 L dust jars with funnel and bird deterrent mount approximately 2m above ground away

Radiation	Measurement Method	Location and Frequency
		from trees. ▪ Copper sulphate solution placed in jar to prevent organic growth. When jar is collected, distilled water is used to wash any dust on funnel into bottle. Used bottle is capped and new bottle is placed in holder.
Radionuclides in surface and groundwater	Environmental water sampling	Annual long lived radionuclide analyses of water samples taken as part of the routine environmental water monitoring program.
Soil sampling for radionuclides	Sample collected and analysed for long-lived radionuclides	One sample collected prior to commencement of operations at each monitoring location.

APPENDIX N LIFE OF MINE SCHEDULE

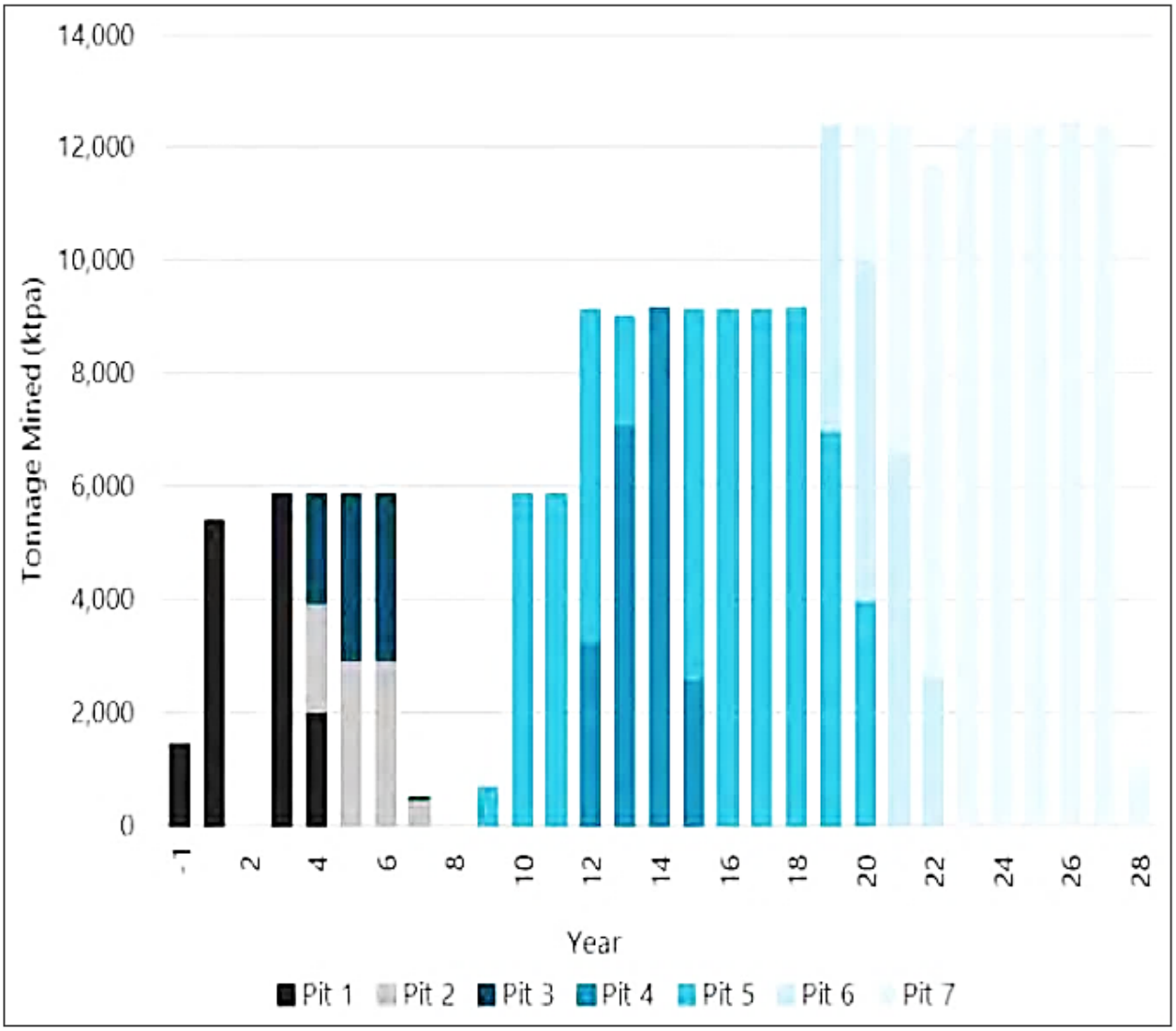


Figure 1-2 Mining Schedule (Mining Inventory)

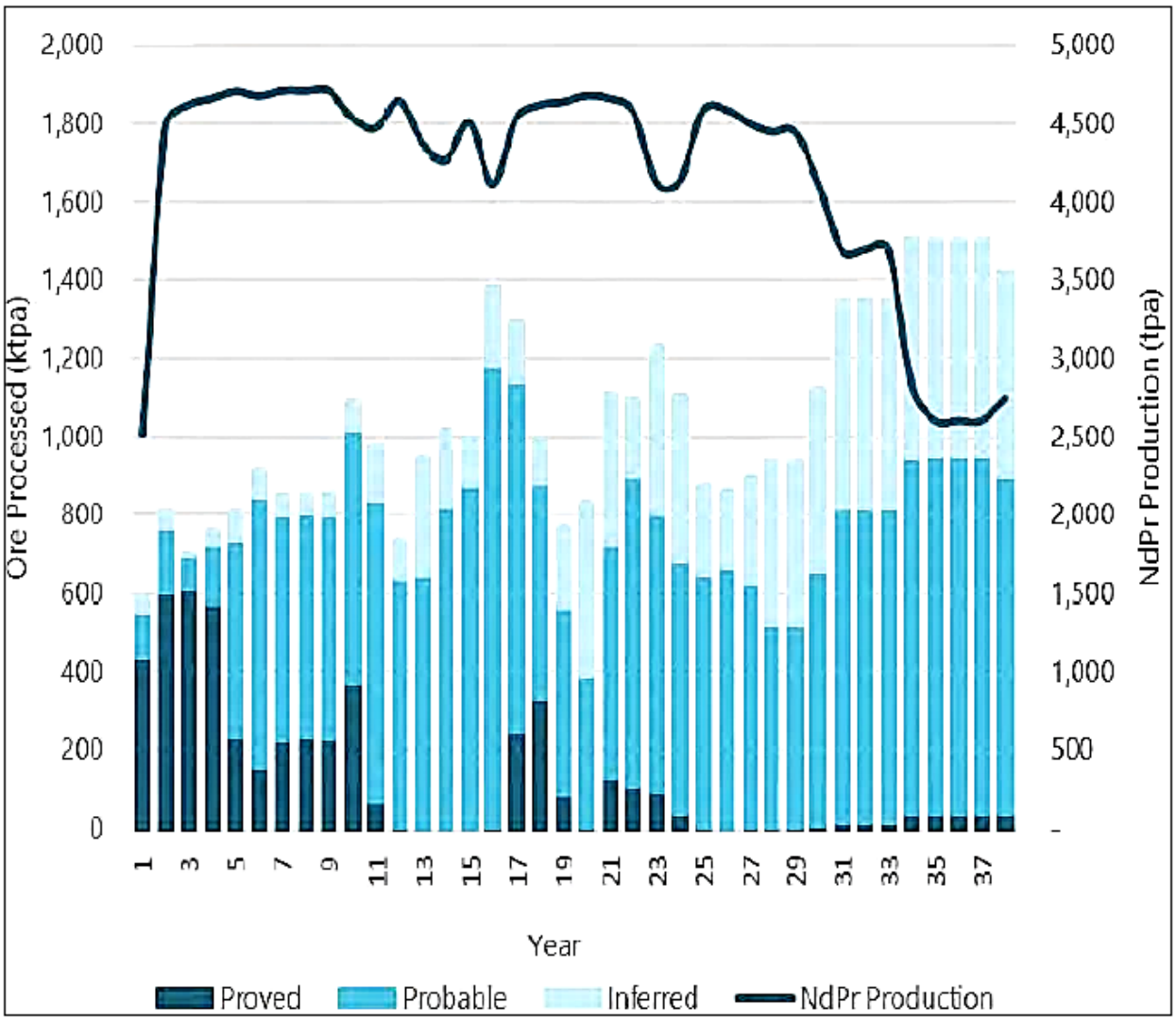


Figure 1-3 Production Schedule (Mining Inventory)

APPENDIX O CLOSURE KNOWLEDGE GAPS

MINE CLOSURE PLAN KNOWLEDGE GAPS

The risk assessment completed for the Project MCP identified a number of knowledge gaps that will be addressed through the initiation of technical investigations and rehabilitation trials.

A number of trials and investigations are to be carried out during the operational life of mine. The results of these trials will be used to inform final landform designs and rehabilitation proposals. Table C below summarises the currently envisaged program. This is to be reviewed and updated as part of triennial reviews of Project MCPs during the operational phases of the Project.

Table C: Pre-closure trials and investigations to address knowledge gaps

Topic	Information Gap / Uncertainty	Description
Vegetation Trials	Optimum seed planting mixes for rapid establishment under local climatic and soil conditions and on post-closure landforms.	Undertake trials of soil covers and vegetation recruitment on WRDs and other disturbed surfaces. Undertake topsoil stockpile seedbank trials.
Progressive Rehabilitation Trials	Optimum WRD cover design for maximum stability and vegetation establishment success.	Large-scale field trials of soil profile, erosion and vegetation recruitment.
Rehabilitation and closure materials	Availability of suitable cover material for closure.	Cover materials resource assessment: Undertake further detailed geotechnical and geochemical studies to locate and characterise sufficient quantities of rehabilitation cover materials. This should include timing of material availability in relation to progressive rehabilitation.
Residue Storage Facility Covers and Rehabilitation	Stable covering for RSF appropriate to determine appropriate capping design.	Trials of rehabilitation vegetation and soil types on capped and covered surfaces.
Waste	Opportunities for material and equipment reuse.	Investigate the potential for sale and/or transfer of plant and equipment.
Geochemical studies	Ongoing sampling and NAPP/NAG testing of tailings and process residues and selected waste rock lithologies.	Ongoing kinetic leach tests of waste products in WRD and RSF. Ongoing NAF/PAF and compositional analyses.
Radiological testing	Suitability of encapsulation design of radioactive materials in the long-term.	Operational phase monitoring associated with radiation, which can be applied to closure designs. Monitoring will include gamma shine and inhalation as per type and frequency listed in the RPRWMP.

Topic	Information Gap / Uncertainty	Description
Groundwater Resources	Impact on groundwater levels and chemistry.	Ongoing monitoring of groundwater levels and chemistry and reviewing of model predictions over time.
Long-term Pit Lake Behaviour	Overall water balance.	Ongoing review of predicted pit lake levels to address any modification of rehabilitation options.
Ecology and Weeds	Assess quality of remaining vegetation communities and fauna habitat in and around site to target ecological rehabilitation.	Conduct pre-closure ecology condition survey. Assess analogue sites for post-closure rehabilitation monitoring and assessment. Conduct detailed assessment of weeds in all domains. Planned periodic surveys of site fauna to assess Project impacts.
Soil Contamination	The extent of soil contamination and remediation will only be apparent close to closure.	Conduct contaminated soil investigation of all domains where potentially contaminative activities have taken place.
Kerosene Camp Creek Diversion	Performance and impacts of the diversion in relation to hydrology, erosion/sedimentation processes and long-term stability.	Hydrological assessment of diversion performance informed by planned monitoring of water and stream bed load behaviour. Planned periodic surveys of site fauna to assess Project impacts.

GROUNDWATER SAMPLING AND DATA COLLECTION PROCEDURE

Document No: NRE-0000-H-PRO-N-0003 Rev 1

Project Name: Nolans Rare Earths

REVISION HISTORY

Date	Revision	Description	Prepared	Reviewed	Approved
05/08/2024	Rev 1	Submit to DEPWS with groundwater monitoring program	Yemaya Smythe McGuinness S. Environmental Scientist	Gloria Calderon Environmental Scientist	Daniel Jordan Manger Environment
16/11/2023	Rev B	Prepared for internal use	Gloria Calderon Environmental Scientist	Yemaya Smythe McGuinness S. Environmental Scientist	In development
30/08/2023	Rev A	Prepared for internal use	Gloria Calderon Environmental Scientist	GHD	In development

RECORD OF CHANGES

Revision	Reason for Change	Page Number(s)
Rev B	Updated with feedback from review – including advice from GHD regarding methodology for the use of HydraSleeves, and QA/QC requirements.	Whole Document
Rev 1	Updated to include pumping methodology from the Mine Site Groundwater Sampling Procedure. Level of detail and content adjusted for support of the groundwater Monitoring Program rather than for internal use.	Whole Document

DOCUMENT HOLDS

Number	Reason for Hold	Section(s)

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ABBREVIATIONS AND DEFINITIONS

Abbreviation	Meaning
Arafura	Arafura Rare Earths Limited
CoC	Chain of Custody
DO	Dissolved Oxygen
EC	Electrical Conductivity
GPS	Global Positioning System
LDPE	Low Density Polyethylene
LED	Light-emitting diode
L10013	Groundwater Extraction Licence L10013 granted to Arafura Nolas Project Pty Ltd 20 March 2023, and amended 8 August 2023.
Nolans	Nolans Rare Earths Project
ORP	Oxidation-Reduction Potential
pH	Potential of Hydrogen
Project	Nolans Rare Earths Project
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
Shall / Must	A requirement is mandatory
TDS	Total Dissolved Solids
ToC	Top of Casing
TSS	Total Suspended Solids

1.0 INTRODUCTION

1.1 Background

Arafura Rare Earths Limited (Arafura) is developing the Nolans Rare Earths Project (Nolans, or the Project) which is a rare earths mine targeting NdPr located approximately 135 km north-northwest of Alice Springs in the Northern Territory.

Arafura has been granted two licences to extract groundwater for the Project, one (L10010) for the purpose of dewatering the mine pit; and one (L10013) for the purpose of providing project water supply. These licences require a robust groundwater monitoring program to be undertaken by Arafura to monitor for any potential impacts of Arafura's water extraction on the environment, and on the water supply of surrounding groundwater users.

The groundwater monitoring program is detailed in the Nolans Borefield Monitoring Program (GHD 2024a); and the associated management actions in the Nolans Borefield Adaptive Management Plan (GHD 2024b). Key requirements of the monitoring program include monitoring of groundwater levels, water extraction rates, and groundwater quality. Monitoring results need to be accurate and reliable to inform meaningful management of the borefield area.

1.2 Purpose

The purpose of this document is to define the procedures to be followed while undertaking groundwater monitoring activities for the Nolans Project. To ensure the sampling methods deployed are accurate, reliable, consistent, undertaken in a safe manner, and follow best-practice procedures in accordance with relevant Australian standards. This document provides a guideline for the intended methodology and steps to achieve quality monitoring results – details may change over time as relevant to improved knowledge, any relevant changes to the sampling requirements, guidelines and standards – as intended through the process of adaptive management and continual improvement.

The scope of this document includes procedures relating to monitoring of groundwater levels, water extraction rates, and groundwater quality. With steps outlined for these monitoring activities from planning and preparation; mobilisation to field; sample and data collection; sample dispatch and transport; to data management (see Figure 1—1 below). This document has been prepared to align with and expand upon the previously prepared Mine Site Groundwater Sampling Procedure.



Figure 1—1 Aspects of the groundwater sampling procedure

2.0 PLANNING AND PREPARATION

Regular groundwater monitoring will be undertaken by Arafura in accordance with the Nolans Borefield Monitoring Program (GHD 2024a). Planning and preparation for monitoring activities includes the steps below.

1. **Confirm monitoring requirements**
   - Review the monitoring requirements in the Nolans Borefield Monitoring Program (GHD 2024a) to understand what type(s) of monitoring needs to be undertaken and the required cadence
   - Plan at least 3 months in advance for the upcoming required monitoring activities
   - Plan travel, site and safety logistics one to three months in advance as appropriate.
2. **Prepare a monitoring plan for each trip**
   - Determine all monitoring activities required for the planned dates
   - Determine all equipment and field supplies required
   - Determine all monitoring locations
   - Prepare a field plan considering the mobilisation times and distances from one monitoring site to another; the time required to undertake monitoring activities at each location; and required sample holding times prior to dispatch
   - Ensure all required field sheets and forms are prepared
   - Ensure all monitoring methods are well understood
   - Ensure any required training is undertaken in advance.
3. **Confirm adequate stock of monitoring supplies**
   - Review the groundwater monitoring equipment check lists in Table 2—1 below to understand what is required for the monitoring to be undertaken
   - Confirm sufficient supplies are in stock (refer to Table 2—1 below)
   - It is recommended this is undertaken at least one month in advance of the planned monitoring to allow time to source additional supplies if required
   - Order additional supplies if required.
4. **Check monitoring equipment**
   - Check all equipment is available for use on the planned monitoring dates
   - Check and confirm all equipment are in good working condition
   - Check the calibration log and ensure all equipment are up to date with any calibration requirements
   - Conduct calibrations if required.
5. **Confirm laboratory arrangements**

- In all cases where water quality samples are being taken, ensure an up-to-date laboratory arrangement is in place for the receival, processing and analysis of samples. Including current costing and payment arrangements.
- Ensure all aspects of sample handling, preservation, preparation, transportation, and holding times are well understood for the types of samples/analytes being taken. Enquire with the laboratory to clarify any unknown aspects
- Ensure the relevant sample submission and chain of custody (CoC) forms are prepared.

6. Notify any relevant stakeholders

- Notify any relevant stakeholders of the planned monitoring activities including landholders.
- This is relevant where activities may interact with other land user's activities; where monitoring locations are located outside of Arafura's mining tenure; when monitoring bores are owned by other parties (e.g. pastoralists or Power and Water Corporation); or activities may interact or affect tradition owner use of the land.
- In any such cases notification and/or consultation may be appropriate in advance to advise of and determine:
  - Planned monitoring locations
  - Planned monitoring activity type(s)
  - Accessibility of roads/tracks
  - Any third-party induction requirements
  - Any supervision, approval or permission requirements.

7. Prepare ready for mobilisation

- Prior to sampling, prepare the field equipment and sample bottles ready for mobilisation
- Details of the indicative steps are provided in Section 2.1 below, this may be adjusted as appropriate to the monitoring activities being undertaken at the time.

The below equipment check lists can be used to aid with the planning and preparation for monitoring activities (Table 2—1).

Table 2—1 Groundwater monitoring equipment check lists

HydraSleeve water quality sampling equipment check list	
Water quality meter (calibrated and fully charged)	
Water quality meter calibration solutions (depending on the meter usually pH, EC and ORP)	
Labelled sample bottles (ensure there is enough for blanks, duplicates and triplicates) with spare bottle sets in case replacements are required	
Sample cup and bucket (20 L)	
Hydra sleeves, collars, weights and clips (require cable for deployment)	
Syringes threaded 5mL (with luer-lok nozzle) and filters 0.45 µm	
Syringes catheter 5mL, GoPro filters and endline filter	
Sampling gloves – disposable, nitrile, powder-free	
Clamps	
Scissors/multi-tool	
Clipboard, pens/pencil and permanent marker (and spares)	
Ziplock bags for each set of bottles (if the lab does not provide them)	
Camera/phone to take photos	
Esky (with ice or ice bricks to keep the samples chilled)	
Bailers (if applicable)	
Decontamination spray bottles (1 filled with DI water and 1 filled with 2-5% Decon detergent)	
Tape and security seal for eskies	
Spare batteries and/or charger for water quality meter, camera, GPS, field test meters and water level meters	
Bore padlock keys and tools to remove well caps	
Field folder, pencils and pens with relevant printed forms including: • Field sheets/ field records • Laboratory CoC forms • Relevant procedures • Site safety information including emergency contact details, site maps, Job Hazard Analysis, etc.	
Pumping water quality sampling equipment check list	
Water level gauge or interface probe	
Water quality meter (calibrated and fully charged)	
Low-flow sampling pump/equipment	
Disposable low-flow sampling tubes	
0.45 µm water filters and suction pump	
Eskies and cool bricks	
Laboratory sample bottles	
Sampling gloves	
Decontamination plastic or stainless-steel bucket and container of 2-5% Decon detergent mixture to fill	
Decontamination spray bottles (1 filled with DI water and 1 filled with 2-5% Decon detergent)	
Bore padlock keys and tools to remove well caps	

Permanent marker for writing on bottle labels	
Field folder, pencils and pens with relevant printed forms including: • Groundwater Gauging sheet • Groundwater Purging sheet • Field record sheets • Laboratory CoC forms • Relevant procedures • Site safety information including emergency contact details, site maps, Job Hazard Analysis, etc.	
Standing water level equipment check list	
Water level meter (dipper) calibrated	
Spare batteries for water level meter	
Tablet with Win-Situ Software full charged (login details required)	
Docking station for Rugged TROLL and BaroTROLL	
USB cable for Level TROLL	
Spare automatic water level loggers	

2.1 Prepare ready for mobilisation

Once arriving to site, and before mobilisation to the field, prepare all required monitoring equipment and sample bottles. This is recommended at least one day prior to sampling. Indicative guidance is provided below based on current monitoring requirements; this may change over time.

2.1.1 Sample bottle preparation

- When undertaking water quality monitoring, prepare and label the set of sample bottles required
- Prepare the sample bottles with any preservatives required (if not already prepared by the laboratory)
- As per current laboratory requirements for general water quality parameters at monitoring bores, a set of five (5) sample bottles are required for each monitoring bore to be sampled (see Figure 2—1 below)
- As per current laboratory requirements for radionuclides analysis, a set of four (4) sample bottles are required for each monitoring bore to be sampled (see Figure 2—1 below)
- Extra bottles should be prepared for duplicate and rinsate/blank samples, as required to meet the QA/QC requirements (see Section 4.3 below for details)
- Each sample bottle should have a waterproof label attached appropriate for the required labelling details (see Figure 2—2 below for an example). Information on the labels can be handwritten in the field, or labels can be pre-printed with some of the required information to reduce error.
- An indication of sample volume, preservation and holding times to meet laboratory requirements relevant to the current groundwater quality parameters being sampled is shown in Table 2—2 below.



Figure 2—1 Example of bottle set prepared for: general parameters (left); and radionuclides analysis (right).

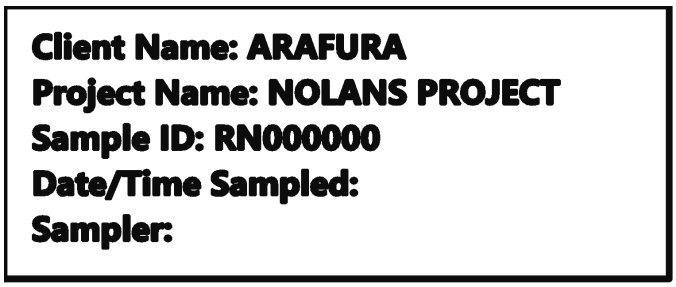


Figure 2—2 Example of sample container label

2.1.2 Equipment preparation

- Ensure all equipment to be used is in good working order, and fully charged.
- Pack all essential items and equipment required to take to the field. Place all essential items for the water sampling into one field box for easy access and time management, and all spare items in a second one. Use the appropriate checklists for reference (Table 2—1 above).
- If ice bricks are to be used for water quality sample preservation in the field, ensure they are placed in the freezer. Alternatively, ensure the ice machine is switched on and working.
- Ensure freight has been booked for the day of sampling, with all required instructions given to the freight company relating to sample handling and transport. Print out the consignment note and transport labels to be attached to each parcel.

2.1.3 Transport Booking

In all cases where water quality samples are being taken:

- Check freight/courier arrangements available to ensure samples will meet required holding times
- Ensure the freight/courier is aware of and able to meet the handling requirements, e.g. keeping the samples cool during transportation
- Make a booking with the freight/courier for the planned day(s) of water quality sampling
- Ensure correct consignment details and transport labels are received for printing, to attach to the samples.

Table 2—2 general indication of sample volume, preservation & holding times for laboratory analysis

Parameters	General parameters					Major ions	Radionuclides			
	pH, EC, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Hardness and Total Acidity and Alkalinity.	Dissolved Metals (Al, As, B, Ba, Cd, Co, Cu, Fe, Li, Pb, P, Mn, Hg, Mo, Ni, Rb, Se, Sr, Ag, U, Th and Zn).	Total Metals (Al, As, B, Ba, Cd, Co, Cu, Fe, Li, Pb, Mn, Hg, Mo, Ni, Rb, Se, Sr, Ag, U, Th and Zn).	Total Phosphorous (P)	Nutrients (NO2, NO3) & Reactive Phosphorous	Major ions (CaCO3, CO3, HCO3, Ca, Mg, K, Na, Cl, SO4).	Pb-210 & Po-210	U-238, U-234, Th-230, Th-232, Th-228 & U-235	Ra-226 & Ra-228	Rn-222
Typical volume bottle	1L (unfiltered)	60mL (filtered)	60mL (unfiltered)	60mL (unfiltered)	60mL (filtered)	1L (unfiltered) *Volume from the same bottle with green label)*	1L (unfiltered)	1L (unfiltered)	0.5L (unfiltered)	0.2L (unfiltered)
Container	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Glass or Teflon
Preservation	Refrigeration (to 1–10°C)				Frozen	Refrigeration (to 1–10°C)	Refrigeration (to 1–4°C)			No preservation or pre-treatment required
Holding Time	pH: 6 hours others: 7 days +	Metals: 180 days	Metals: 180 days Hg: 28 days	28 days	4 days	7 days +	180 days	180 days	180 days	3 days

3.0 MOBILISATION TO FIELD

Follow all site entry and safety requirements including (but not limited to):

- Follow site access procedures
- Complete vehicle inspections before mobilising to site
- Ensure the first aid kit, tracking and communication devices are functional, charged, and packed in the vehicle
- Notify relevant site personnel of the monitoring plan for each day, confirming emergency contacts, meeting points, and any active project work areas
- Ensure any incidents that occur during field work are reported
- At each sample location, take a moment to assess the area for dangers, including potential slips / trip hazards, flooding, signs of snakes, etc.
- Do not proceed with monitoring activities if unsafe to do so.

4.0 SAMPLE AND DATA COLLECTION

Groundwater monitoring activities will be undertaken as described in the Nolans Borefield Monitoring Program (GHD 2024a). Activities include taking water quality samples, standing water level readings, and water extraction readings. Water quality samples can be taken using one of three methods:

1. Tap sampling method
2. HydraSleeve sampling method
3. Pumping sampling method

Standing water level readings can be taken using one of two methods:

1. Automatic water level loggers
2. Manual readings

Water extraction readings are currently taken only by manual reading of flow meters when in the field.

Details of these methods are provided in the sections below, together with information on when each method is appropriate to use. As well as details related to Quality Assurance and Quality Control (QA/QC) and field data to be collected.

4.1 Tap Sampling Method

Sample taps have been installed at some groundwater monitoring bores to allow for water quality samples to be easily taken. This is the preferred method where available.

For sampling collection from a pre-installed sample tap the following steps are to be taken:

- Arrive at the sample location and check that the monitoring tap is working.
  Note: Taps not used frequently can become seized or blocked. If the tap is blocked, use a piece of wire to remove the blockage. If the tap is still not working, detail this on the field sheet and move to the next site – or use an alternative means of sampling if available.
- Open the tap and allow water to flow until field measurements have stabilised
- Collect water in a 20 L bucket (or as appropriate) and measure field data with a water quality meter to determine when field measurements have stabilized
- Parameters need 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
  - ± 10 mV Redox.
- Once the field measurements have stabilised, collect a fresh bucket of water and turn off the tap.
- Measure and record the stabilised readings for field data
- Transfer water to the sample bottles.

4.2 HydraSleeve Sampling Method

HydraSleeve groundwater samplers can be used to collect a representative sample for most physical and chemical parameters without purging the well. It collects a whole water sample from a user-defined interval (typically within the well screen), without mixing fluid from other intervals.

One or more sleeves are placed within the screened interval of the monitoring well, and a period of time is allocated for the well to re-equilibrate. When activated by rapid upward motion, the check value opens and the HydraSleeve collects a sample. Hydrostatic pressure keeps the devise closed except during sample collection. Once the sampler is full, the one-way reed valve collapses, preventing mixing of extraneous, non-representative fluid during recovery. HydraSleeve go in flat and closed and come out full and closed.

HydraSleeves are useful in cases where groundwater monitoring bores are narrow, constricted, or damaged. They also allow sampling of one or multiple specific screen intervals or target horizons; and allow sampling in bores with low water levels and/or low rates of recharge, as they cause minimal drawdown and minimal agitation of the water column.

For sampling collection using HydraSleeves, the follow steps are to be taken:

1. Assemble the HydraSleeve
2. Deploy the HydraSleeve
3. Retrieve the HydraSleeve

These steps are detailed in the sections below.

4.2.1 Assemble the HydraSleeve

Standard HydraSleeves have white reinforced strips at the top for connecting to a Spring Clip fastened to the tether and are available in Low Density Polyethylene (LDPE). To assemble a Standard HydraSleeve the steps shown in Figure 4—1 below are to be taken.

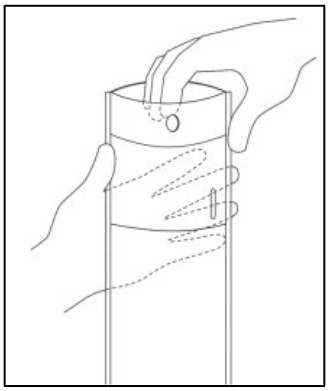
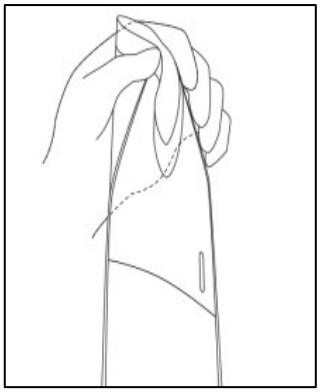
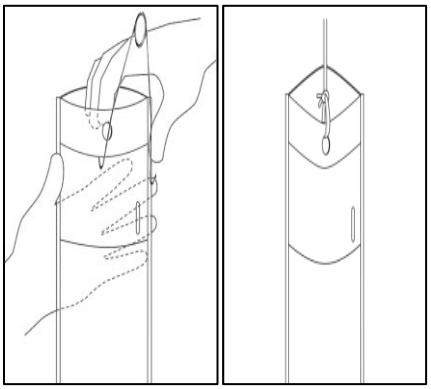
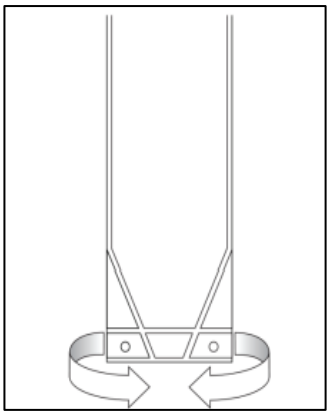
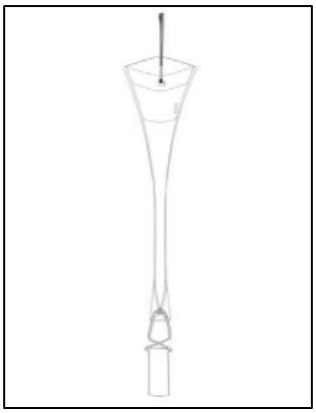
<table>
<tr>
<td> 
1. Remove Hydra Sleeve from package and grasp top to “pop” open. Remember to save the straw for later.</td>
<td> 
2. Squeeze side fins together at top to bend reinforcing strips outward. Crimp the corners to remain open.</td>
<td> 
3. Option 1 (on the left). Attach the tethered spring clip; or
Option 2 (on the right)). Alternatively attach the cord to one side of the HydraSleeve if spring clips are not secure enough. Be sure the top is sharply crimped open.</td>
</tr>
<tr>
<td> 
4. Align the two holes at bottom of HydraSleeve together and attach weight with the weight clip.</td>
<td> 
5. Sampler is ready to be placed in the well.</td>
<td></td>
</tr>
</table>

Figure 4—1 Assembly a HydraSleeve

4.2.2 Deploy the HydraSleeve

To deploy the HydraSleeves, follow the steps below:

- Open the bore cap and allow some time for stabilisation before measurements are made
- Gauge the water level to the Top of Casing (ToC) using the water level meter (see Section 4.5)
- Confirm the water column is at least double the length of the HydraSleeve to allow use
- Knowing the standing water level, calculate the length of tether needed to suspend the sleeve at the desired sampling depth/ saturated screened interval. Account for the HydraSleeve length in the calculation.

- Assemble the HydraSleeve (see Section 4.2.1 above) attach the tether to the top of the sleeve and the weight to the bottom, then slowly lower the weighted sleeve into the well to the desired sample depth. Use a plastic tarp or plastic tub when installing and retrieving the HydraSleeve to avoid any contamination (e.g. to prevent the rope or equipment entering the well from being contaminated by dirt)

  Note. Wear nitrile gloves at all the times while assembling and handling the HydraSleeve

- Secure the upper end of the tether to the well cap prior to beginning deployment to ensure it will not be lost downhole. Then smoothly lower the HydraSleeve, in a continuous downward motion to avoid premature opening. Do not pull the tether upwards in the water column until water samples are being collected. If required, pull up extremely slowly and smoothly for a short distance only. Any rough upwards motion can open the check valve requiring the HydraSleeve to be replaced due to non-representative fluid being collected.
- Once lowered to the final position (at least 2 m above bottom of well), leave in-place for at least 24 hours for the well to equilibrate. This "equilibration time" ensures that flow dynamics and contaminant distribution restabilize to natural flow conditions to represent the aquifer conditions after vertical mixing occurs which may be caused by installation of a sampling device in the well.
- For future monitoring events, reinstall a new sleeve after sampling a well to be retrieved during the next monitoring event.
- Label the string after deployment with a piece of tape and a marker for easy identification from other equipment already deployed in the well.

In cases where multiple screen intervals or target horizons are to be sampled, or larger sample sizes are required, HydraSleeves can be installed in tandem.

The process for installation of tandem HydraSleeves is shown in Figure 4—2 below. The first HydraSleeve is attached to the tether as described above; and a second HydraSleeve is attached to the bottom of the first using your desired length of tether between the two; with a weight attached to the bottom of the second HydraSleeve. To install more than two, follow the same process of attaching each consecutive HydraSleeve as for two, with the weight attached to the bottom of the last HydraSleeve.

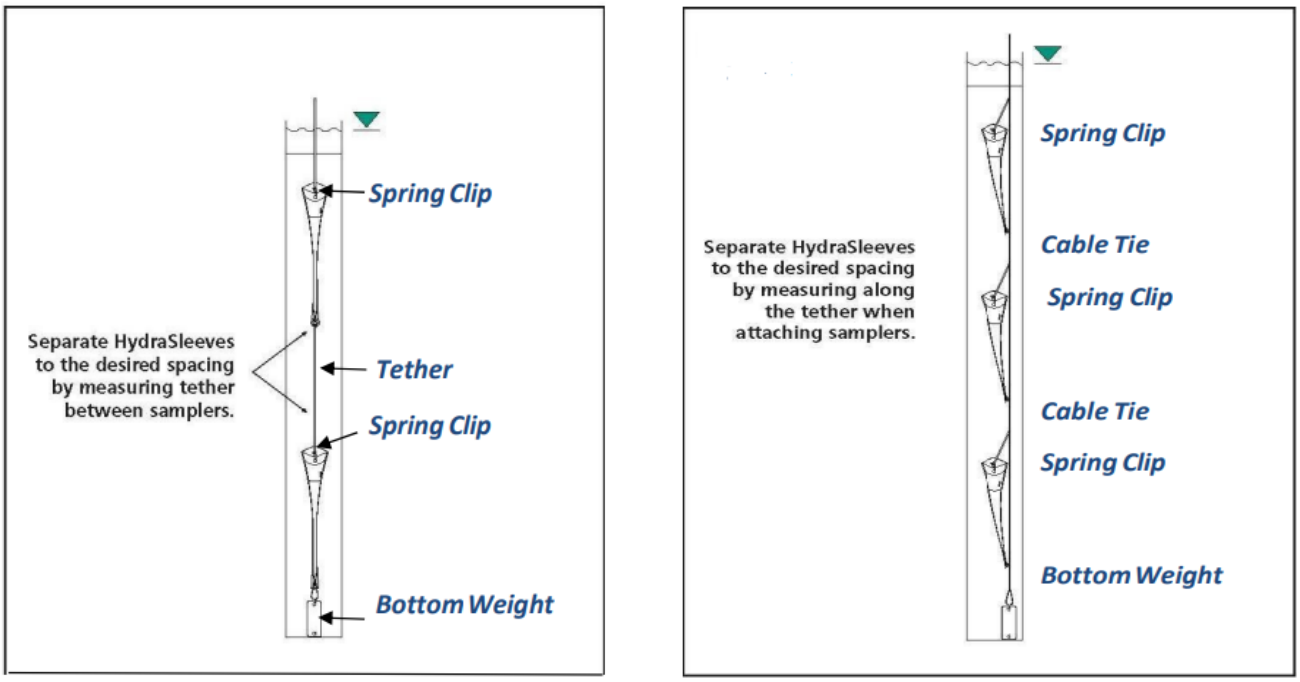


Figure 4—2 Deployment of HydraSleeves in tandem. A: two HydraSleeves; and B: more than two

4.2.3 Retrieve the HydraSleeve

- Prepare a clean area next to the monitoring bore with sample bottles ready. Use a plastic tarp when retrieving the HydraSleeve to avoid any contamination (e.g. to prevent the rope or equipment entering the well from being contaminated by dirt)
- Open the bore cap and allow some time for stabilisation before measurements are made
- Gauge the water level to the Top of Casing (ToC) using the water level meter (see Section 4.5) before retrieval
- Locate the previously installed HydraSleeve tether
- Pull the tether rapidly upwards (approximately 0.5 m per second) in the water column to fill the HydraSleeve
- Slowly draw the tether up until the HydraSleeve is at the surface
- Squeeze the full sampler just below the top to expel water resting above the check valve
- Pierce the sleeve at least 3-4 inches below the top collar with the straw provided, then discharge the water either into a sample cup, or directly into sample bottles
- To control the flow of the sample, raise and lower the bottom of the sleeve or pierce the sleeve just below the discharge tube -sleeve can be squeezed, forcing fluid up through the discharge tube
- Filter any samples required prior to filling sample bottles. For example, when sampling for metals, 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.

- Fill the sample bottles to top with no air space allowed and with the least amount of agitation as possible, and immediately tighten the lid
- Note. Sample collection should be done immediately after the sleeve has been brought to the surface to preserve sample integrity
- 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.
- To measure field data, discharge a small amount of water into the sample cup (enough to submerse the water quality probe). Then place the probe of the water quality meter into the sample cup, wait until readings are stabilized and then record the data. Then discharge the water
- Store the old HydraSleeve and remove from site for disposal, to be disposed at the site office. HydraSleeves cannot be reused.
- Deploy a new HydraSleeve for the next monitoring round. Gauge the water level to the Top of Casing (ToC) before deployment. The weight and weight clip can be reused after decontaminating. The tether may be dedicated to the well and reused or discarded as appropriate.

4.3 Pumping Sampling Method

4.3.1 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 to minimise the volume of stagnant groundwater required to be purged and intercept the inflowing groundwater from the target formation.

4.3.2 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.

Parameters need 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
- ± 10 mV Redox.

4.3.3 Contingency

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.

If a well is low yielding it may be purged dry. In such cases it 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.

4.3.4 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.

Filter any samples required prior to placing in sample bottles. For example, when sampling for metals, 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.

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.

4.3.5 Waste Disposal

Purged groundwater is to be pumped onto the ground and all used disposable sampling equipment should be stored and removed for the field for disposal at the site office.

4.3.6 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.

4.4 Quality Assurance / Quality Control

Both duplicate samples and rinsate blanks are to be collected in the field as QA/QC measures. Duplicate and rinsate samples should be sent as blind samples to the laboratory, labelled and recorded accordingly.

Duplicate samples are taken as a duplicate set of samples at the same time and place and using the same methodology as a routine water quality sample, bottled and labelled separately. Duplicate samples provide an estimate of the error associated with the subsampling/splitting process and laboratory analysis and are a measure of precision. If an acceptably low level of error is occurring, the difference between the duplicate and the routine sample will not be statistically significant.

Rinsate blanks (or equipment blanks) are to be taken from the final rinse of equipment after decontamination, or prior to the use of disposable sampling equipment. Rinsate samples are taken by collecting the deionised water used to rinse equipment following a routine water quality sample being taken. These samples provide information relating to cross-contamination of samples from the sampling equipment. If no contamination is occurring, sample results will be null.

A guideline for the frequency of duplicate and rinsate samples to be taken during routine water quality monitoring for the project is provided in Table 4—2 below.

Table 4—1 Guidance of sample collection for quality control

Sample type	Frequency
Duplicate	One for every ten water quality samples taken
Rinsate blank	One per day of monitoring

4.4.1 Reducing Sample Contamination

It is important to ensure that samples are not contaminated during sampling. Sources of potential sample contamination include from manual handling (e.g. sunscreen, insect repellent, cigarette smoke, etc.), from contaminated water quality probes or other non-disposable field equipment used, and from sample bottle preservatives from other bottles during storage and transport.

The following steps are to be taken to reduce the risk of sample contamination from manual handling:

- Apply sunscreen and insect repellent prior to leaving for sampling and avoid applying directly on hands and wrists. Ensure that hands and wrists are washed with soap and water prior to conducting sampling to remove any excess product
- Do not smoke or eat when sampling
- Use clean disposable gloves at each sampling site immediately before opening sample bottles. Do not wipe gloved hands on your skin or clothing. Change gloves if contamination is suspected
- Keep sample bottles closed until sampling. If grime is present on the outside of the bottle, rinse with sample water prior to opening.
- Sample with hands away from the bottle opening

4.4.2 Decontamination of Equipment

All items and equipment used in between locations for water sampling and testing need to be decontaminated. Both deionised water and a 2-5% Decon 90 detergent solution are used for decontamination.

In the case of smaller equipment like the water quality meter use the decontamination spray bottles. First spray the equipment with the Decon 90 solution, then apply the deionized water. In the case of larger items like the pump and cables, use the decontamination bucket containing Decon 90 solution, and submerge the pump and cables in the bucket.

Decontamination must be completed prior to leaving each site. Ensure the storage areas are clean during transport to the next site – if in doubt, repeat the decontamination procedure prior to sampling at the next site.

4.5 Manual Readings of Water Level

Manual readings of standing water levels within groundwater bores are taken with the following steps:

1. Open the bore cap and allow some time for stabilisation before measurements are made
2. Hang the dipper on the side of the casing then run the tape over the tape guide
3. Loose the brake to start lowering the probe into the water. The buzzer will sound, and the Light-emitting diode (LED) will turn on when the probe touches the water. If there is any cascading water in the well, sensitivity needs to be adjusted to get a clear signal
4. Once the probe touches water, tighten the brake and take the depth reading
5. Repeat 1-3 times to refine and ensure the reading is accurate. Where possible, depth measurements should be recorded to the nearest 1 mm.

4.6 Retrieving Data from Loggers

Automatic water level loggers are used to record standing water level in some of the groundwater monitoring bores. Loggers are installed as per manufacturer's instructions. To retrieve the data from these loggers, a field tablet is used, and data is downloaded while in the field. The logger remains installed to continue data downloads until no longer required. Batteries are to be replaced as per manufacturer's recommendations.

4.7 Retrieving Data from Flow Meters

Flow meters are installed at Arafura's extraction bores and at some of the surrounding groundwater user's bores to monitor water extraction rates. Manual readings of flow meters are taken while in the field, reading the flow meter dial from right to left. Guidance on reading various types of flow meters is provided in the Reading Your Water Meter Factsheet (DEPWS 2024) and general guidance. Extraction volumes are recorded in the field sheet, as well as any observed conditions.

4.8 Field Sheet Records

At each sampling location, field records will be taken using prepared field sheets. Field sheets will include the following minimum information:

- Location (monitoring point and GPS coordinates)
- Date and Time
- Name of personnel
- Type of monitoring activities, including equipment and methods used
- Weather conditions
- In-situ water quality parameter readings (pH, EC, DO, TDS, temperature, etc.) when required
- When taking water samples, the physical characteristics of each sample (e.g., odour, sheen, colour)
- Sample equipment decontamination procedures used, in cases when non-disposable

sampling equipment is used

- Photograph of sample and location
- Relevant field observations including any unusual observations such as visible grease/scum or colour of water, visible disturbance of the monitoring site, etc.

5.0 SAMPLE DISPATCH AND TRANSPORT

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 Esky's 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.

For packaging and dispatching ensure to arrive to Arafura office with plenty time, at least three hours before dispatching time. For that follow the steps below,

- Water samples are to be kept chilled in the field during monitoring activities.
- Once returning to the site office samples must be refrigerated or frozen (e.g., samples for nitrates) before packaging to comply with the preservation requirements.
- Allow a minimum of three hours for sample preparation and packaging prior to the arranged dispatch time.
- Prior to packaging, ensure all sample bottles are correctly labelled.
- Take samples from the fridge and place them in the transport cooler boxes/eskies. The frozen samples are to be kept in a separate cooler box/esky. Cover all samples with ice.
- Place the Chain of Custody in a Ziplock bag and place it inside each cooler box/esky
- Secure each cooler box/esky with tape
- Affix the transport label and a 'Fragile' label to each cooler box/esky (see Figure 5—1 for example).
- Transfer the packaged samples to the arranged transport pick-up point.
- Once dispatched, email the relevant lab to confirm the expected delivery time of the samples, attaching the CoC form, and Transport consignment number for tracking.
- Check with the laboratory following the expected delivery time to ensure the samples were received as expected.



Figure 5—1 Example of packaging of water samples

6.0 DATA MANAGEMENT

- Following completion of monitoring activities, all field sheet records will be entered into Arafura's environmental monitoring system for safe record keeping.
- When laboratory results are received, these will be uploaded into Arafura's environmental monitoring system for safe record keeping.
- Data will be analysed on a monthly to quarterly basis (as appropriate to the parameters) in accordance with the Nolans Borefield Adaptive Management Plan (GHD 2024b).

7.0 ROLES AND RESPONSIBILITIES

Table 7—1 below outlines the responsibilities of personnel in relation to this Groundwater Sampling Operational Procedure.

Table 7—1 Roles and Responsibilities

Job Title	Responsibilities
Environment Manager	▪ Groundwater Sampling Procedure review and approval
Environmental Scientist(s)	▪ Monitoring, data analysis and reporting

7.1 Training and Competency

All personnel conducting water sampling shall be familiar with this operating procedure and have received field training from experienced personnel. This includes training in sample collection, dispatch, using and calibrating field meters.

8.0 REFERENCES

DEPWS 2024 Reading your water meter, Department of Environment, Parks and Water Security, Water Resources Northern Territory, Available at: https://nt.gov.au/__data/assets/pdf_file/0008/193886/how-to-read-your-water-meter-for-water-extraction.pdf (nt.gov.au 2024).

GHD 2024a *Nolans Borefield Monitoring Program*, July 2024, GHD Consulting. Prepared for Arafura Nolans Project.

GHD 2024b *Nolans Borefield Adaptive Management Plan*, July 2024, GHD Consulting. Prepared for Arafura Nolans Project.

GROUNDWATER SAMPLING AND DATA COLLECTION PROCEDURE

Document No: NRE-0000-H-PRO-N-0003 Rev 1

Project Name: Nolans Rare Earths

REVISION HISTORY

Date	Revision	Description	Prepared	Reviewed	Approved
05/08/2024	Rev 1	Submit to DEPWS with groundwater monitoring program	Yemaya Smythe McGuinness S. Environmental Scientist	Gloria Calderon Environmental Scientist	Daniel Jordan Manger Environment
16/11/2023	Rev B	Prepared for internal use	Gloria Calderon Environmental Scientist	Yemaya Smythe McGuinness S. Environmental Scientist	In development
30/08/2023	Rev A	Prepared for internal use	Gloria Calderon Environmental Scientist	GHD	In development

RECORD OF CHANGES

Revision	Reason for Change	Page Number(s)
Rev B	Updated with feedback from review – including advice from GHD regarding methodology for the use of HydraSleeves, and QA/QC requirements.	Whole Document
Rev 1	Updated to include pumping methodology from the Mine Site Groundwater Sampling Procedure. Level of detail and content adjusted for support of the groundwater Monitoring Program rather than for internal use.	Whole Document

DOCUMENT HOLDS

Number	Reason for Hold	Section(s)

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ABBREVIATIONS AND DEFINITIONS

Abbreviation	Meaning
Arafura	Arafura Rare Earths Limited
CoC	Chain of Custody
DO	Dissolved Oxygen
EC	Electrical Conductivity
GPS	Global Positioning System
LDPE	Low Density Polyethylene
LED	Light-emitting diode
L10013	Groundwater Extraction Licence L10013 granted to Arafura Nolas Project Pty Ltd 20 March 2023, and amended 8 August 2023.
Nolans	Nolans Rare Earths Project
ORP	Oxidation-Reduction Potential
pH	Potential of Hydrogen
Project	Nolans Rare Earths Project
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
Shall / Must	A requirement is mandatory
TDS	Total Dissolved Solids
ToC	Top of Casing
TSS	Total Suspended Solids

1.0 INTRODUCTION

1.1 Background

Arafura Rare Earths Limited (Arafura) is developing the Nolans Rare Earths Project (Nolans, or the Project) which is a rare earths mine targeting NdPr located approximately 135 km north-northwest of Alice Springs in the Northern Territory.

Arafura has been granted two licences to extract groundwater for the Project, one (L10010) for the purpose of dewatering the mine pit; and one (L10013) for the purpose of providing project water supply. These licences require a robust groundwater monitoring program to be undertaken by Arafura to monitor for any potential impacts of Arafura's water extraction on the environment, and on the water supply of surrounding groundwater users.

The groundwater monitoring program is detailed in the Nolans Borefield Monitoring Program (GHD 2024a); and the associated management actions in the Nolans Borefield Adaptive Management Plan (GHD 2024b). Key requirements of the monitoring program include monitoring of groundwater levels, water extraction rates, and groundwater quality. Monitoring results need to be accurate and reliable to inform meaningful management of the borefield area.

1.2 Purpose

The purpose of this document is to define the procedures to be followed while undertaking groundwater monitoring activities for the Nolans Project. To ensure the sampling methods deployed are accurate, reliable, consistent, undertaken in a safe manner, and follow best-practice procedures in accordance with relevant Australian standards. This document provides a guideline for the intended methodology and steps to achieve quality monitoring results – details may change over time as relevant to improved knowledge, any relevant changes to the sampling requirements, guidelines and standards – as intended through the process of adaptive management and continual improvement.

The scope of this document includes procedures relating to monitoring of groundwater levels, water extraction rates, and groundwater quality. With steps outlined for these monitoring activities from planning and preparation; mobilisation to field; sample and data collection; sample dispatch and transport; to data management (see Figure 1—1 below). This document has been prepared to align with and expand upon the previously prepared Mine Site Groundwater Sampling Procedure.



Figure 1—1 Aspects of the groundwater sampling procedure

2.0 PLANNING AND PREPARATION

Regular groundwater monitoring will be undertaken by Arafura in accordance with the Nolans Borefield Monitoring Program (GHD 2024a). Planning and preparation for monitoring activities includes the steps below.

1. **Confirm monitoring requirements**
   - Review the monitoring requirements in the Nolans Borefield Monitoring Program (GHD 2024a) to understand what type(s) of monitoring needs to be undertaken and the required cadence
   - Plan at least 3 months in advance for the upcoming required monitoring activities
   - Plan travel, site and safety logistics one to three months in advance as appropriate.
2. **Prepare a monitoring plan for each trip**
   - Determine all monitoring activities required for the planned dates
   - Determine all equipment and field supplies required
   - Determine all monitoring locations
   - Prepare a field plan considering the mobilisation times and distances from one monitoring site to another; the time required to undertake monitoring activities at each location; and required sample holding times prior to dispatch
   - Ensure all required field sheets and forms are prepared
   - Ensure all monitoring methods are well understood
   - Ensure any required training is undertaken in advance.
3. **Confirm adequate stock of monitoring supplies**
   - Review the groundwater monitoring equipment check lists in Table 2—1 below to understand what is required for the monitoring to be undertaken
   - Confirm sufficient supplies are in stock (refer to Table 2—1 below)
   - It is recommended this is undertaken at least one month in advance of the planned monitoring to allow time to source additional supplies if required
   - Order additional supplies if required.
4. **Check monitoring equipment**
   - Check all equipment is available for use on the planned monitoring dates
   - Check and confirm all equipment are in good working condition
   - Check the calibration log and ensure all equipment are up to date with any calibration requirements
   - Conduct calibrations if required.
5. **Confirm laboratory arrangements**

- In all cases where water quality samples are being taken, ensure an up-to-date laboratory arrangement is in place for the receival, processing and analysis of samples. Including current costing and payment arrangements.
- Ensure all aspects of sample handling, preservation, preparation, transportation, and holding times are well understood for the types of samples/analytes being taken. Enquire with the laboratory to clarify any unknown aspects
- Ensure the relevant sample submission and chain of custody (CoC) forms are prepared.

6. Notify any relevant stakeholders

- Notify any relevant stakeholders of the planned monitoring activities including landholders.
- This is relevant where activities may interact with other land user's activities; where monitoring locations are located outside of Arafura's mining tenure; when monitoring bores are owned by other parties (e.g. pastoralists or Power and Water Corporation); or activities may interact or affect tradition owner use of the land.
- In any such cases notification and/or consultation may be appropriate in advance to advise of and determine:
  - Planned monitoring locations
  - Planned monitoring activity type(s)
  - Accessibility of roads/tracks
  - Any third-party induction requirements
  - Any supervision, approval or permission requirements.

7. Prepare ready for mobilisation

- Prior to sampling, prepare the field equipment and sample bottles ready for mobilisation
- Details of the indicative steps are provided in Section 2.1 below, this may be adjusted as appropriate to the monitoring activities being undertaken at the time.

The below equipment check lists can be used to aid with the planning and preparation for monitoring activities (Table 2—1).

Table 2—1 Groundwater monitoring equipment check lists

HydraSleeve water quality sampling equipment check list	
Water quality meter (calibrated and fully charged)	
Water quality meter calibration solutions (depending on the meter usually pH, EC and ORP)	
Labelled sample bottles (ensure there is enough for blanks, duplicates and triplicates) with spare bottle sets in case replacements are required	
Sample cup and bucket (20 L)	
Hydra sleeves, collars, weights and clips (require cable for deployment)	
Syringes threaded 5mL (with luer-lok nozzle) and filters 0.45 µm	
Syringes catheter 5mL, GoPro filters and endline filter	
Sampling gloves – disposable, nitrile, powder-free	
Clamps	
Scissors/multi-tool	
Clipboard, pens/pencil and permanent marker (and spares)	
Ziplock bags for each set of bottles (if the lab does not provide them)	
Camera/phone to take photos	
Esky (with ice or ice bricks to keep the samples chilled)	
Bailers (if applicable)	
Decontamination spray bottles (1 filled with DI water and 1 filled with 2-5% Decon detergent)	
Tape and security seal for eskies	
Spare batteries and/or charger for water quality meter, camera, GPS, field test meters and water level meters	
Bore padlock keys and tools to remove well caps	
Field folder, pencils and pens with relevant printed forms including: • Field sheets/ field records • Laboratory CoC forms • Relevant procedures • Site safety information including emergency contact details, site maps, Job Hazard Analysis, etc.	
Pumping water quality sampling equipment check list	
Water level gauge or interface probe	
Water quality meter (calibrated and fully charged)	
Low-flow sampling pump/equipment	
Disposable low-flow sampling tubes	
0.45 µm water filters and suction pump	
Eskies and cool bricks	
Laboratory sample bottles	
Sampling gloves	
Decontamination plastic or stainless-steel bucket and container of 2-5% Decon detergent mixture to fill	
Decontamination spray bottles (1 filled with DI water and 1 filled with 2-5% Decon detergent)	
Bore padlock keys and tools to remove well caps	

Permanent marker for writing on bottle labels	
Field folder, pencils and pens with relevant printed forms including: • Groundwater Gauging sheet • Groundwater Purging sheet • Field record sheets • Laboratory CoC forms • Relevant procedures • Site safety information including emergency contact details, site maps, Job Hazard Analysis, etc.	
Standing water level equipment check list	
Water level meter (dipper) calibrated	
Spare batteries for water level meter	
Tablet with Win-Situ Software full charged (login details required)	
Docking station for Rugged TROLL and BaroTROLL	
USB cable for Level TROLL	
Spare automatic water level loggers	

2.1 Prepare ready for mobilisation

Once arriving to site, and before mobilisation to the field, prepare all required monitoring equipment and sample bottles. This is recommended at least one day prior to sampling. Indicative guidance is provided below based on current monitoring requirements; this may change over time.

2.1.1 Sample bottle preparation

- When undertaking water quality monitoring, prepare and label the set of sample bottles required
- Prepare the sample bottles with any preservatives required (if not already prepared by the laboratory)
- As per current laboratory requirements for general water quality parameters at monitoring bores, a set of five (5) sample bottles are required for each monitoring bore to be sampled (see Figure 2—1 below)
- As per current laboratory requirements for radionuclides analysis, a set of four (4) sample bottles are required for each monitoring bore to be sampled (see Figure 2—1 below)
- Extra bottles should be prepared for duplicate and rinsate/blank samples, as required to meet the QA/QC requirements (see Section 4.3 below for details)
- Each sample bottle should have a waterproof label attached appropriate for the required labelling details (see Figure 2—2 below for an example). Information on the labels can be handwritten in the field, or labels can be pre-printed with some of the required information to reduce error.
- An indication of sample volume, preservation and holding times to meet laboratory requirements relevant to the current groundwater quality parameters being sampled is shown in Table 2—2 below.



Figure 2—1 Example of bottle set prepared for: general parameters (left); and radionuclides analysis (right).

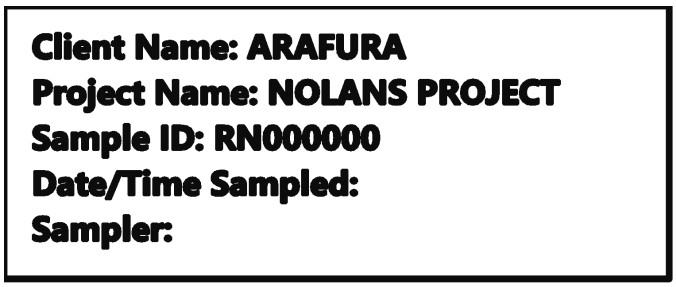


Figure 2—2 Example of sample container label

2.1.2 Equipment preparation

- Ensure all equipment to be used is in good working order, and fully charged.
- Pack all essential items and equipment required to take to the field. Place all essential items for the water sampling into one field box for easy access and time management, and all spare items in a second one. Use the appropriate checklists for reference (Table 2—1 above).
- If ice bricks are to be used for water quality sample preservation in the field, ensure they are placed in the freezer. Alternatively, ensure the ice machine is switched on and working.
- Ensure freight has been booked for the day of sampling, with all required instructions given to the freight company relating to sample handling and transport. Print out the consignment note and transport labels to be attached to each parcel.

2.1.3 Transport Booking

In all cases where water quality samples are being taken:

- Check freight/courier arrangements available to ensure samples will meet required holding times
- Ensure the freight/courier is aware of and able to meet the handling requirements, e.g. keeping the samples cool during transportation
- Make a booking with the freight/courier for the planned day(s) of water quality sampling
- Ensure correct consignment details and transport labels are received for printing, to attach to the samples.

Table 2—2 general indication of sample volume, preservation & holding times for laboratory analysis

Parameters	General parameters					Major ions	Radionuclides			
	pH, EC, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Hardness and Total Acidity and Alkalinity.	Dissolved Metals (Al, As, B, Ba, Cd, Co, Cu, Fe, Li, Pb, P, Mn, Hg, Mo, Ni, Rb, Se, Sr, Ag, U, Th and Zn).	Total Metals (Al, As, B, Ba, Cd, Co, Cu, Fe, Li, Pb, Mn, Hg, Mo, Ni, Rb, Se, Sr, Ag, U, Th and Zn).	Total Phosphorous (P)	Nutrients (NO2, NO3) & Reactive Phosphorous	Major ions (CaCO3, CO3, HCO3, Ca, Mg, K, Na, Cl, SO4).	Pb-210 & Po-210	U-238, U-234, Th-230, Th-232, Th-228 & U-235	Ra-226 & Ra-228	Rn-222
Typical volume bottle	1L (unfiltered)	60mL (filtered)	60mL (unfiltered)	60mL (unfiltered)	60mL (filtered)	1L (unfiltered) *Volume from the same bottle with green label)*	1L (unfiltered)	1L (unfiltered)	0.5L (unfiltered)	0.2L (unfiltered)
Container	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Plastic	Glass or Teflon
Preservation	Refrigeration (to 1–10°C)				Frozen	Refrigeration (to 1–10°C)	Refrigeration (to 1–4°C)			No preservation or pre-treatment required
Holding Time	pH: 6 hours others: 7 days +	Metals: 180 days	Metals: 180 days Hg: 28 days	28 days	4 days	7 days +	180 days	180 days	180 days	3 days

3.0 MOBILISATION TO FIELD

Follow all site entry and safety requirements including (but not limited to):

- Follow site access procedures
- Complete vehicle inspections before mobilising to site
- Ensure the first aid kit, tracking and communication devices are functional, charged, and packed in the vehicle
- Notify relevant site personnel of the monitoring plan for each day, confirming emergency contacts, meeting points, and any active project work areas
- Ensure any incidents that occur during field work are reported
- At each sample location, take a moment to assess the area for dangers, including potential slips / trip hazards, flooding, signs of snakes, etc.
- Do not proceed with monitoring activities if unsafe to do so.

4.0 SAMPLE AND DATA COLLECTION

Groundwater monitoring activities will be undertaken as described in the Nolans Borefield Monitoring Program (GHD 2024a). Activities include taking water quality samples, standing water level readings, and water extraction readings. Water quality samples can be taken using one of three methods:

1. Tap sampling method
2. HydraSleeve sampling method
3. Pumping sampling method

Standing water level readings can be taken using one of two methods:

1. Automatic water level loggers
2. Manual readings

Water extraction readings are currently taken only by manual reading of flow meters when in the field.

Details of these methods are provided in the sections below, together with information on when each method is appropriate to use. As well as details related to Quality Assurance and Quality Control (QA/QC) and field data to be collected.

4.1 Tap Sampling Method

Sample taps have been installed at some groundwater monitoring bores to allow for water quality samples to be easily taken. This is the preferred method where available.

For sampling collection from a pre-installed sample tap the following steps are to be taken:

- Arrive at the sample location and check that the monitoring tap is working.
  Note: Taps not used frequently can become seized or blocked. If the tap is blocked, use a piece of wire to remove the blockage. If the tap is still not working, detail this on the field sheet and move to the next site – or use an alternative means of sampling if available.
- Open the tap and allow water to flow until field measurements have stabilised
- Collect water in a 20 L bucket (or as appropriate) and measure field data with a water quality meter to determine when field measurements have stabilized
- Parameters need 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
  - ± 10 mV Redox.
- Once the field measurements have stabilised, collect a fresh bucket of water and turn off the tap.
- Measure and record the stabilised readings for field data
- Transfer water to the sample bottles.

4.2 HydraSleeve Sampling Method

HydraSleeve groundwater samplers can be used to collect a representative sample for most physical and chemical parameters without purging the well. It collects a whole water sample from a user-defined interval (typically within the well screen), without mixing fluid from other intervals.

One or more sleeves are placed within the screened interval of the monitoring well, and a period of time is allocated for the well to re-equilibrate. When activated by rapid upward motion, the check value opens and the HydraSleeve collects a sample. Hydrostatic pressure keeps the devise closed except during sample collection. Once the sampler is full, the one-way reed valve collapses, preventing mixing of extraneous, non-representative fluid during recovery. HydraSleeve go in flat and closed and come out full and closed.

HydraSleeves are useful in cases where groundwater monitoring bores are narrow, constricted, or damaged. They also allow sampling of one or multiple specific screen intervals or target horizons; and allow sampling in bores with low water levels and/or low rates of recharge, as they cause minimal drawdown and minimal agitation of the water column.

For sampling collection using HydraSleeves, the follow steps are to be taken:

1. Assemble the HydraSleeve
2. Deploy the HydraSleeve
3. Retrieve the HydraSleeve

These steps are detailed in the sections below.

4.2.1 Assemble the HydraSleeve

Standard HydraSleeves have white reinforced strips at the top for connecting to a Spring Clip fastened to the tether and are available in Low Density Polyethylene (LDPE). To assemble a Standard HydraSleeve the steps shown in Figure 4—1 below are to be taken.

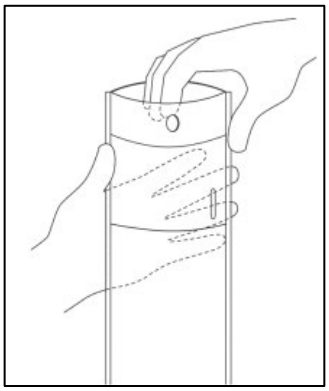
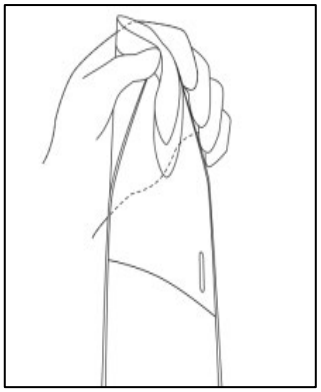
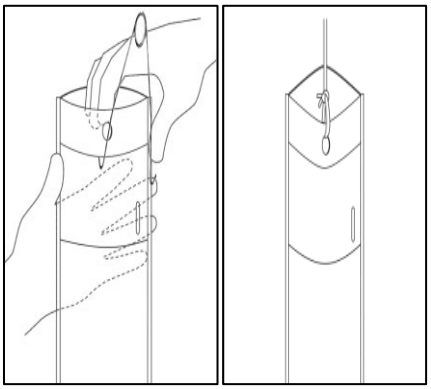
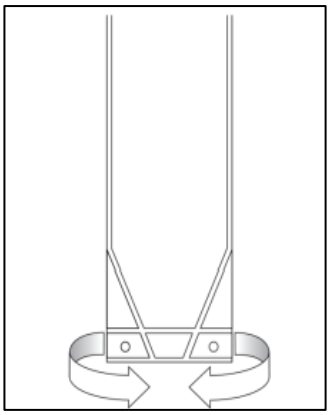
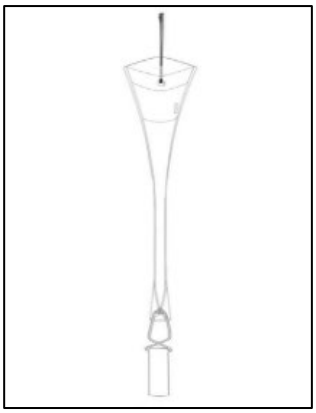
<table>
<tr>
<td> 
1. Remove Hydra Sleeve from package and grasp top to “pop” open. Remember to save the straw for later.</td>
<td> 
2. Squeeze side fins together at top to bend reinforcing strips outward. Crimp the corners to remain open.</td>
<td> 
3. Option 1 (on the left). Attach the tethered spring clip; or
Option 2 (on the right)). Alternatively attach the cord to one side of the HydraSleeve if spring clips are not secure enough. Be sure the top is sharply crimped open.</td>
</tr>
<tr>
<td> 
4. Align the two holes at bottom of HydraSleeve together and attach weight with the weight clip.</td>
<td> 
5. Sampler is ready to be placed in the well.</td>
<td></td>
</tr>
</table>

Figure 4—1 Assembly a HydraSleeve

4.2.2 Deploy the HydraSleeve

To deploy the HydraSleeves, follow the steps below:

- Open the bore cap and allow some time for stabilisation before measurements are made
- Gauge the water level to the Top of Casing (ToC) using the water level meter (see Section 4.5)
- Confirm the water column is at least double the length of the HydraSleeve to allow use
- Knowing the standing water level, calculate the length of tether needed to suspend the sleeve at the desired sampling depth/ saturated screened interval. Account for the HydraSleeve length in the calculation.

- Assemble the HydraSleeve (see Section 4.2.1 above) attach the tether to the top of the sleeve and the weight to the bottom, then slowly lower the weighted sleeve into the well to the desired sample depth. Use a plastic tarp or plastic tub when installing and retrieving the HydraSleeve to avoid any contamination (e.g. to prevent the rope or equipment entering the well from being contaminated by dirt)

  Note. Wear nitrile gloves at all the times while assembling and handling the HydraSleeve

- Secure the upper end of the tether to the well cap prior to beginning deployment to ensure it will not be lost downhole. Then smoothly lower the HydraSleeve, in a continuous downward motion to avoid premature opening. Do not pull the tether upwards in the water column until water samples are being collected. If required, pull up extremely slowly and smoothly for a short distance only. Any rough upwards motion can open the check valve requiring the HydraSleeve to be replaced due to non-representative fluid being collected.
- Once lowered to the final position (at least 2 m above bottom of well), leave in-place for at least 24 hours for the well to equilibrate. This "equilibration time" ensures that flow dynamics and contaminant distribution restabilize to natural flow conditions to represent the aquifer conditions after vertical mixing occurs which may be caused by installation of a sampling device in the well.
- For future monitoring events, reinstall a new sleeve after sampling a well to be retrieved during the next monitoring event.
- Label the string after deployment with a piece of tape and a marker for easy identification from other equipment already deployed in the well.

In cases where multiple screen intervals or target horizons are to be sampled, or larger sample sizes are required, HydraSleeves can be installed in tandem.

The process for installation of tandem HydraSleeves is shown in Figure 4—2 below. The first HydraSleeve is attached to the tether as described above; and a second HydraSleeve is attached to the bottom of the first using your desired length of tether between the two; with a weight attached to the bottom of the second HydraSleeve. To install more than two, follow the same process of attaching each consecutive HydraSleeve as for two, with the weight attached to the bottom of the last HydraSleeve.

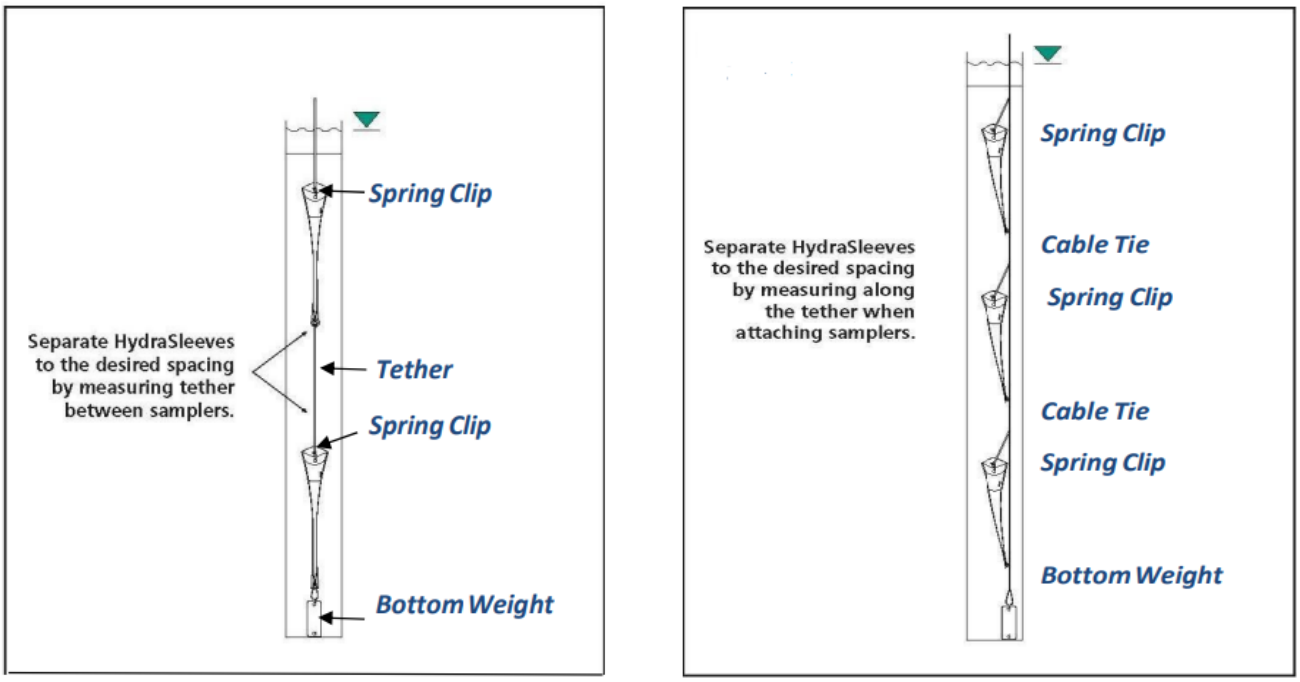


Figure 4—2 Deployment of HydraSleeves in tandem. A: two HydraSleeves; and B: more than two

4.2.3 Retrieve the HydraSleeve

- Prepare a clean area next to the monitoring bore with sample bottles ready. Use a plastic tarp when retrieving the HydraSleeve to avoid any contamination (e.g. to prevent the rope or equipment entering the well from being contaminated by dirt)
- Open the bore cap and allow some time for stabilisation before measurements are made
- Gauge the water level to the Top of Casing (ToC) using the water level meter (see Section 4.5) before retrieval
- Locate the previously installed HydraSleeve tether
- Pull the tether rapidly upwards (approximately 0.5 m per second) in the water column to fill the HydraSleeve
- Slowly draw the tether up until the HydraSleeve is at the surface
- Squeeze the full sampler just below the top to expel water resting above the check valve
- Pierce the sleeve at least 3-4 inches below the top collar with the straw provided, then discharge the water either into a sample cup, or directly into sample bottles
- To control the flow of the sample, raise and lower the bottom of the sleeve or pierce the sleeve just below the discharge tube -sleeve can be squeezed, forcing fluid up through the discharge tube
- Filter any samples required prior to filling sample bottles. For example, when sampling for metals, 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.

- Fill the sample bottles to top with no air space allowed and with the least amount of agitation as possible, and immediately tighten the lid
- Note. Sample collection should be done immediately after the sleeve has been brought to the surface to preserve sample integrity
- 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.
- To measure field data, discharge a small amount of water into the sample cup (enough to submerse the water quality probe). Then place the probe of the water quality meter into the sample cup, wait until readings are stabilized and then record the data. Then discharge the water
- Store the old HydraSleeve and remove from site for disposal, to be disposed at the site office. HydraSleeves cannot be reused.
- Deploy a new HydraSleeve for the next monitoring round. Gauge the water level to the Top of Casing (ToC) before deployment. The weight and weight clip can be reused after decontaminating. The tether may be dedicated to the well and reused or discarded as appropriate.

4.3 Pumping Sampling Method

4.3.1 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 to minimise the volume of stagnant groundwater required to be purged and intercept the inflowing groundwater from the target formation.

4.3.2 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.

Parameters need 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
- ± 10 mV Redox.

4.3.3 Contingency

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.

If a well is low yielding it may be purged dry. In such cases it 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.

4.3.4 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.

Filter any samples required prior to placing in sample bottles. For example, when sampling for metals, 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.

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.

4.3.5 Waste Disposal

Purged groundwater is to be pumped onto the ground and all used disposable sampling equipment should be stored and removed for the field for disposal at the site office.

4.3.6 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.

4.4 Quality Assurance / Quality Control

Both duplicate samples and rinsate blanks are to be collected in the field as QA/QC measures. Duplicate and rinsate samples should be sent as blind samples to the laboratory, labelled and recorded accordingly.

Duplicate samples are taken as a duplicate set of samples at the same time and place and using the same methodology as a routine water quality sample, bottled and labelled separately. Duplicate samples provide an estimate of the error associated with the subsampling/splitting process and laboratory analysis and are a measure of precision. If an acceptably low level of error is occurring, the difference between the duplicate and the routine sample will not be statistically significant.

Rinsate blanks (or equipment blanks) are to be taken from the final rinse of equipment after decontamination, or prior to the use of disposable sampling equipment. Rinsate samples are taken by collecting the deionised water used to rinse equipment following a routine water quality sample being taken. These samples provide information relating to cross-contamination of samples from the sampling equipment. If no contamination is occurring, sample results will be null.

A guideline for the frequency of duplicate and rinsate samples to be taken during routine water quality monitoring for the project is provided in Table 4—2 below.

Table 4—1 Guidance of sample collection for quality control

Sample type	Frequency
Duplicate	One for every ten water quality samples taken
Rinsate blank	One per day of monitoring

4.4.1 Reducing Sample Contamination

It is important to ensure that samples are not contaminated during sampling. Sources of potential sample contamination include from manual handling (e.g. sunscreen, insect repellent, cigarette smoke, etc.), from contaminated water quality probes or other non-disposable field equipment used, and from sample bottle preservatives from other bottles during storage and transport.

The following steps are to be taken to reduce the risk of sample contamination from manual handling:

- Apply sunscreen and insect repellent prior to leaving for sampling and avoid applying directly on hands and wrists. Ensure that hands and wrists are washed with soap and water prior to conducting sampling to remove any excess product
- Do not smoke or eat when sampling
- Use clean disposable gloves at each sampling site immediately before opening sample bottles. Do not wipe gloved hands on your skin or clothing. Change gloves if contamination is suspected
- Keep sample bottles closed until sampling. If grime is present on the outside of the bottle, rinse with sample water prior to opening.
- Sample with hands away from the bottle opening

4.4.2 Decontamination of Equipment

All items and equipment used in between locations for water sampling and testing need to be decontaminated. Both deionised water and a 2-5% Decon 90 detergent solution are used for decontamination.

In the case of smaller equipment like the water quality meter use the decontamination spray bottles. First spray the equipment with the Decon 90 solution, then apply the deionized water. In the case of larger items like the pump and cables, use the decontamination bucket containing Decon 90 solution, and submerge the pump and cables in the bucket.

Decontamination must be completed prior to leaving each site. Ensure the storage areas are clean during transport to the next site – if in doubt, repeat the decontamination procedure prior to sampling at the next site.

4.5 Manual Readings of Water Level

Manual readings of standing water levels within groundwater bores are taken with the following steps:

1. Open the bore cap and allow some time for stabilisation before measurements are made
2. Hang the dipper on the side of the casing then run the tape over the tape guide
3. Loose the brake to start lowering the probe into the water. The buzzer will sound, and the Light-emitting diode (LED) will turn on when the probe touches the water. If there is any cascading water in the well, sensitivity needs to be adjusted to get a clear signal
4. Once the probe touches water, tighten the brake and take the depth reading
5. Repeat 1-3 times to refine and ensure the reading is accurate. Where possible, depth measurements should be recorded to the nearest 1 mm.

4.6 Retrieving Data from Loggers

Automatic water level loggers are used to record standing water level in some of the groundwater monitoring bores. Loggers are installed as per manufacturer's instructions. To retrieve the data from these loggers, a field tablet is used, and data is downloaded while in the field. The logger remains installed to continue data downloads until no longer required. Batteries are to be replaced as per manufacturer's recommendations.

4.7 Retrieving Data from Flow Meters

Flow meters are installed at Arafura's extraction bores and at some of the surrounding groundwater user's bores to monitor water extraction rates. Manual readings of flow meters are taken while in the field, reading the flow meter dial from right to left. Guidance on reading various types of flow meters is provided in the Reading Your Water Meter Factsheet (DEPWS 2024) and general guidance. Extraction volumes are recorded in the field sheet, as well as any observed conditions.

4.8 Field Sheet Records

At each sampling location, field records will be taken using prepared field sheets. Field sheets will include the following minimum information:

- Location (monitoring point and GPS coordinates)
- Date and Time
- Name of personnel
- Type of monitoring activities, including equipment and methods used
- Weather conditions
- In-situ water quality parameter readings (pH, EC, DO, TDS, temperature, etc.) when required
- When taking water samples, the physical characteristics of each sample (e.g., odour, sheen, colour)
- Sample equipment decontamination procedures used, in cases when non-disposable

sampling equipment is used

- Photograph of sample and location
- Relevant field observations including any unusual observations such as visible grease/scum or colour of water, visible disturbance of the monitoring site, etc.

5.0 SAMPLE DISPATCH AND TRANSPORT

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 Esky's 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.

For packaging and dispatching ensure to arrive to Arafura office with plenty time, at least three hours before dispatching time. For that follow the steps below,

- Water samples are to be kept chilled in the field during monitoring activities.
- Once returning to the site office samples must be refrigerated or frozen (e.g., samples for nitrates) before packaging to comply with the preservation requirements.
- Allow a minimum of three hours for sample preparation and packaging prior to the arranged dispatch time.
- Prior to packaging, ensure all sample bottles are correctly labelled.
- Take samples from the fridge and place them in the transport cooler boxes/eskies. The frozen samples are to be kept in a separate cooler box/esky. Cover all samples with ice.
- Place the Chain of Custody in a Ziplock bag and place it inside each cooler box/esky
- Secure each cooler box/esky with tape
- Affix the transport label and a 'Fragile' label to each cooler box/esky (see Figure 5—1 for example).
- Transfer the packaged samples to the arranged transport pick-up point.
- Once dispatched, email the relevant lab to confirm the expected delivery time of the samples, attaching the CoC form, and Transport consignment number for tracking.
- Check with the laboratory following the expected delivery time to ensure the samples were received as expected.



Figure 5—1 Example of packaging of water samples

6.0 DATA MANAGEMENT

- Following completion of monitoring activities, all field sheet records will be entered into Arafura's environmental monitoring system for safe record keeping.
- When laboratory results are received, these will be uploaded into Arafura's environmental monitoring system for safe record keeping.
- Data will be analysed on a monthly to quarterly basis (as appropriate to the parameters) in accordance with the Nolans Borefield Adaptive Management Plan (GHD 2024b).

7.0 ROLES AND RESPONSIBILITIES

Table 7—1 below outlines the responsibilities of personnel in relation to this Groundwater Sampling Operational Procedure.

Table 7—1 Roles and Responsibilities

Job Title	Responsibilities
Environment Manager	▪ Groundwater Sampling Procedure review and approval
Environmental Scientist(s)	▪ Monitoring, data analysis and reporting

7.1 Training and Competency

All personnel conducting water sampling shall be familiar with this operating procedure and have received field training from experienced personnel. This includes training in sample collection, dispatch, using and calibrating field meters.

8.0 REFERENCES

DEPWS 2024 Reading your water meter, Department of Environment, Parks and Water Security, Water Resources Northern Territory, Available at: https://nt.gov.au/__data/assets/pdf_file/0008/193886/how-to-read-your-water-meter-for-water-extraction.pdf (nt.gov.au 2024).

GHD 2024a *Nolans Borefield Monitoring Program*, July 2024, GHD Consulting. Prepared for Arafura Nolans Project.

GHD 2024b *Nolans Borefield Adaptive Management Plan*, July 2024, GHD Consulting. Prepared for Arafura Nolans Project.

Threatened species assessment of Gravel, Magazine and Access tenure, 23-25 February 2024, Nolans Project

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1 INTRODUCTION

EcOz Environmental Consultants (EcOz) has been engaged by Arafura Rare Earths Limited (Arafura) to undertake a threatened species assessment of tenure associated with proposed gravel pits, magazine and access for the Nolans Project – specifically ML33107, EMP33078, EMP33079, EMP33080, EMP33081, EMP33082, EMP33084, EMP33085, AA33279 and AA33280 (collectively referred to as the current development area) (Map 1 in Appendix A). The intent of the assessment is to determine which threatened species occur, or are likely to occur, within the current development area, and (if applicable) recommend mitigation measures to minimise potential impacts to those species. This information will then be used to determine whether the project has the potential to have a significant impact on any of those species.

The outcome of this assessment will be used to inform an *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) Self-Assessment, and further approval documentation (if applicable).

To address these requirements, this report presents:

- A desktop threatened species 'likelihood of occurrence' assessment to determine which species have a reasonable chance of occurring within the current development area (to inform which species will require targeted field surveys/assessment).
- Targeted threatened species surveys, outlining survey techniques, survey effort and results.
- Recommended mitigation measures to minimise potential impacts to threatened species considered to be at risk from the proposed activities.
- If applicable, undertake a significant impact assessment for species known or likely to occur within the current development area (using criteria and process defined in the *EPBC Significant Impact Guidelines 1.1*, DoE 2013)

2 DESKTOP REVIEW

To determine which threatened species may occur within the current development area and therefore require targeted field assessment, a desktop threatened species likelihood of occurrence assessment was undertaken (refer to Appendix B). A total of 13 threatened fauna species were assessed (no threatened flora species were identified to potentially occur within search area or surrounds).

The desktop assessment indicated that two threatened species have a reasonable chance of occurring within the current development area, and therefore were subject to targeted field survey and assessment:

- Central Australian Rock-wallaby (*Petrogale lateralis centralis*)
- Southern Whiteface (*Aphelocephala leucopsis*)

The remaining species were either given likelihood ratings of 'Low' or 'None' for the current development area and therefore do not require targeted survey because inherent risk of impact to those species is low / negligible.

The EPBC Protected Matters Search Tool report also identified numerous listed migratory species that are known, or have potential, to occur in the region (Appendix C). However, very few migratory species have been recorded near the current development area because it does not support habitat typically utilised by migratory species that can occur in the region. As such, migratory species have not been targeted in field studies because inherent risk of impact to these species is low / negligible.

3 CENTRAL AUSTRALIAN ROCK-WALLABY

The Central Australian Rock-wallaby (*Petrogale lateralis centralis*) is listed a Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act; Commonwealth) and Near Threatened under the *Territory Parks and Wildlife Conservation Act* (TPWC Act; Northern Territory).

Targeted surveys in 2010, 2011 and 2015, and NT Atlas records, confirm that Central Australian Rock-wallaby inhabits rocky ranges and hills located within and surrounding the Nolans project area (GHD 2016). Subsequently, because potentially suitable habitat occurs within and adjacent to the current development area, a targeted field survey was undertaken to confirm if habitat is currently utilised by Central Australian Rock-wallaby and if critical habitat is present. This section describes species background, survey methodology, sampling effort and results for surveys conducted within February 2024.

3.1 Species background

The Central Australian Rock-wallaby is a small to moderately sized macropod, which occurs in rocky habitats throughout central Australia. They emerge in the later afternoon / early evening to feed, and often bask in the sun during the early morning following a cold night (NRETAS 2006).

Critical habitat is rocky habitat with extensive development of caves, crevices and overhangs that allow the animals to escape extremes of weather and to hide from predators (Pearson 2013; Geelen 1999). Suitable vegetation communities (with palatable grasses, herbs and forbs present) need to be near shelter/refugia sites (Pearson 2013). Particularly important food plants are Desert Fig (*Ficus platypoda*) and Spearwood (*Pandorea doratoxylon*) (Blackbourn 1991; Capararo 1994) – however rock-wallaby can be present without these plants being present. Their close association with rocky habitats makes it relatively easy to delineate the habitat that is potentially suitable for rock wallabies to use for shelter. They have a limited foraging zone (usually within 100m of outcrops) which means that their effective shelter and foraging areas can be estimated (Pearson 2013) (foraging distance is often reduced due to predation pressure).

Major threats include predation by introduced species (fox and cat) and to a lesser extent native species (Dingo) (NRETAS 2006; Read and Ward 2011). Habitat degradation caused by changed fire regimes and grazing by introduced herbivores are also a key threat to this species (NRETAS 2006; Read and Ward 2011). With their specific habitat requirements, the species can be limited in their ability to disperse.

3.2 Methodology

Areas of potentially suitable habitat were identified by reviewing vegetation and landform mapping undertaken as part of baseline studies (GHD 2016; LES 2023), aerial imagery and contours. For this survey, all rocky habitat types and steep terrain were considered as potential habitat, and as such, representative survey transects were undertaken within these areas to check for rock-wallaby presence/absence and presence of critical habitat. Survey techniques are described below and follow those recommended in DSEWPC (2011):

- Day-time searches in areas of potential habitat for critical features such as shelter / den sites (caves, rock boulders, rock ledges) and presence of important food plants (Desert Fig and Spearwood).
- Day-time searches for signs of activity, mainly including scats and rock shelters worn smooth from resting, to determine species presence / absence (rock-wallaby have a distinctive scat that can reliably be used to determine species presence).
- Observations / sightings of rock-wallabies basking during the early morning using binoculars from a location on the ground beneath suitable habitat.

Survey transects started at the base of rocky hills and traversed up and along rocky ridge habitat, with surveyors prioritising areas of potential shelter / den habitat and areas of prominent outcrop. The following data was collected for each transect:

- Landform description and photograph
- Vegetation community description, fire history and weed presence
- Presence of suitable refuges / shelter / dens
- Presence / absence of evidence of rock-wallaby (sighting, scat, track)
- Presence / absence of key food plants (herbage, spearwood and desert fig)
- Presence / absence and type of predator scats (cat, fox, dingo)
- Presence / absence and type of other macropod/mammal scats or grazing or sighting

When rock-wallaby scats were identified, the following data was collected:

- Number of scats (within 50m intervals) (data can be used to estimate activity in an area)
- Scat size (i.e. adult or juvenile)
- Scat age (recorded to estimate current inhabitation and previous/recent occurrence):
    - Fresh - black, glossy, 95% intact;
    - Recent – black, some gloss, 70% intact
    - Old – grey or whitish; or black/dark brown with no glossy sheen, <70% intact
- Number and location of recently occupied refuges
- Number and location of unused refuges

3.3 Survey effort

Six survey areas were identified as described in Table 3-1 and shown in Maps 2 to 5 (Appendix A). A total transect length of 18,074 m was surveyed. All transects were undertaken on-foot except for transect 4-3 which was inspected via drone due to heat conditions making ground-access unsafe (also, rocky habitat in this area will not be directly impacted by proposed works as it falls outside the lease area). Survey transects were not required within survey area 6 (AA33279 main access road) because no suitable rocky habitat is present (confirmed during previous pre-clearing surveys in 2022 and 2023 (LES 2022; EcOz 2023).

Table 3-1. Survey effort details

Survey area	Type	Lease(s)	Transect ID	Transect length	Central coordinate	
					Easting	Northing
1	Gravel pit	EMP33078 EMP33079 EMP33080 EMP33083 EMP33084	1-1	1,488m	323164	7491753
			1-2	553m	323288	7491299
			1-3	1,920m	322939	7491008
			1-4	676m	323333	7490675
			1-5	4,101m	322200	7490998
2	Gravel pit	EMP33081 EMP33082	2-1	1,791m	320774	7492571
			2-2	1,216m	320838	7492702
3	Haul road	AA33280	3-1	2,980m	319266	7496934
			3-2	1,046m	319677	7496774
			3-3	839m	319635	7497005
			3-4 (drone only)	1,103m	319918	7498574
4	Magazine	ML33107	4-1	634m	318874	7497522
			4-2	4,255m	319382	7497621
5	Gravel pit	EMP33085	5-1	302m	328304	7490444
6	Main access road	AA33279	NA	NA	NA	NA

3.4 Results

The field survey was undertaken between the 23 – 25 February 2024 by Tom Ewers-Reilly (Lead Ecologist, EcOz), who is an experienced arid zone ecologist working in the region since 2003.

Survey results for each survey area are summarised in Table 3-2. Full details are provided in Appendix D and representative site photographs are provided in Appendix E.

The survey confirmed that Central Australian Rock-wallaby do not currently inhabit rocky habitat found within or adjacent to the current development area (no scats, tracks or sightings). The lack of scat evidence (and data from previous surveys) indicates that habitat has not been used by the species for several years.

Possible den / shelter habitat was identified within survey areas 1, 2, 3 and 4 (see photographs in Appendix E); however, these features may not be of adequate depth to meet temperature requirements of the rock-wallaby and are unlikely to provide protection from predator species (a cat was also flushed from one of these sites). Additionally, important food plants were rarely observed at these locations, and no rock-wallaby scats were found. Euro scats were abundant at all of these locations.

Key predator species (cat, fox and dingo) have been confirmed to occur in the broader area by recent biodiversity monitoring (EcOz 2024, report currently in prep.), as well as cat and dingo observations within rock features during the current survey. The presence of predation pressure reduces the likelihood that habitat within the current development area is suitable for Central Australian Rock-wallaby – because there is no adequate escape terrain / safety refuge in the small isolated hills and ridges (LES 2022).

Central Australian Rock-wallaby are more likely to occur in the larger hills and ridges in the surrounding range system (Reynolds Range) which support higher quality and abundance of shelter sites and key food plants, and presumably less predation pressure (compared to the small isolated hills in the current development area).

Table 3-2. Summary results for each survey area

Survey area	Type	Leases	Survey results summary
1	Gravel pit	EMP33078 EMP33079 EMP33080 EMP33083 EMP33084	No evidence that Central Australian Rock-wallaby occur in this survey area. This area was previously surveyed as part of baseline surveys in 2015 (GHD 2016) and during a fauna survey in 2022 (LES 2022) and evidence of Central Australian Rock-wallaby was also not detected. The isolated rocky hills and central ridgeline within (and surrounding) this area support extensive rocky outcrop with occasional minor overhangs; however no deep caves, crevices or boulder piles were observed. As such, suitable den / shelter habitat for Central Australian Rock-wallaby is not present. Cat and dingo scats were observed in area (predator species). Low abundance of important food plants (One Desert Fig was observed within transect 1-5, Spearwood was not observed in area).
2	Gravel pit	EMP33081 EMP33082	No evidence that Central Australian Rock-wallaby occur in this survey area. This area was previously surveyed during a fauna survey in 2022 (LES 2022) and evidence of Central Australian Rock-wallaby was also not detected. The rocky ridgeline in the centre of this area supports extensive rocky outcrop, minor overhangs and small caves on the south facing slopes. The small cave features may be suitable den habitat (photographs provided in Appendix E); however scat searches at these sites recorded and abundance of Euro scat only, and Euros were sighted at a few of these locations. Dingo scats were observed in area (predator species). No important food plants were observed.

Survey area	Type	Leases	Survey results summary
3	Haul road	AA33280	No evidence that Central Australian Rock-wallaby occur in this area. This area has not been subject to previous survey. The rocky ridges within this area support extensive rocky outcrop with occasional minor overhangs; however no deep caves, crevices or boulder piles were observed. As such, suitable den / shelter habitat for Central Australian Rock-wallaby is not present. Dingo scats were observed in area (predator species). No important food plants were observed.
4	Magazine	ML33107	No evidence that Central Australian Rock-wallaby occur in this area. This area has not been subject to previous survey. This area supports numerous low rocky hills with some minor boulder piles with crevices. None were considered as suitable for den / shelter sites for Central Australian Rock-wallaby. Cat sighting and dingo scats were observed in area (predator species). There is a low abundance of important food plants (two Desert Fig were observed – transects 4-1 and 4-2, and Spearwood had a scattered occurrence in transect 4-2 and was either dead or senesced at the time of survey).
5	Gravel pit	EMP33085	No evidence that Central Australian Rock-wallaby occur in this area. This area was previously surveyed during a fauna survey in 2022 (LES 2022) and evidence of Central Australian Rock-wallaby was also not detected. There is no rocky habitat within this area; however, a low isolated rock hill is present adjacent to the eastern boundary. This low rocky hill does not support suitable den / shelter habitat. No predator species evidence at site. No important food plants were observed.
6	Main access road	AA33279	Targeted surveys were not undertaken due to absence of suitable habitat and this area has been suitably covered in previous pre-clearing reports which indicated no suitable habitat (LES 2022; EcOz 2023). Rocky habitat adjacent to existing track was not suitable for dens / shelter sites. No evidence that Central Australian Rock-wallaby occur in this area. No important food plants were observed.

4 SOUTHERN WHITEFACE

Southern Whiteface (*Aphelocephala leucopsis*) is listed a Vulnerable under the EPBC Act (Commonwealth) and Least Concern under the TPWC Act (Northern Territory). *Note:* Southern Whiteface was not listed as a threatened species under the EPBC Act at the time of EIS approvals (became Vulnerable on 31 March 2023). Previous surveys have recorded Southern Whiteface in the area (GHD 2016). Subsequently, a targeted field survey was undertaken to identify critical habitat and general occurrence within the current development area. This section describes species background, survey methodology, sampling effort and results for surveys conducted within February 2024.

4.1 Species background

The Southern Whiteface is a small stocky finch-like bird, which occurs across most of mainland Australia south of the tropics. They are found in a wide range of open woodlands and shrublands typically dominated by acacias or eucalypts on ranges, foothills and lowlands and plains where there is an understorey of grasses or shrubs, or both (Higgins & Peter 2002; DCCEEW 2023). They feed almost exclusively on the ground for insects, spiders and seeds (Higgins & Peter 2002), and can occur in mixed species feeding flocks (often with Thornbill species) (DCCEEW 2023). They normally breed from July to October (however this is rainfall dependent). They build large bulky domed nest of grass, bark and roots usually in a tree hollow or crack (Higgins & Peter 2002). Critical habitat is as follows (as per DCCEEW 2023):

- Living and dead trees with hollows and crevices which are essential for roosting and nesting.
- Undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both.
- Habitat with low tree densities and an herbaceous understory litter cover (essential foraging habitat)

4.2 Methodology

There is currently no EPBC survey guidelines for Southern Whiteface due to recent listing as a threatened species, as such, the survey was designed based on surveyor experience and focused on identification of critical habitat features as noted in DCCEEW 2023.

Survey techniques were as follows:

- Checked for species presence (opportunistic birdwatching with binoculars).
- Check for the presence of hollows in living and dead trees that could be used for roosting / nesting.
- Check for suitable foraging habitat (herbaceous and grassy understorey litter cover)

Survey effort for this species occurred in conjunction with survey transects as undertaken for Central Australian Rock-wallaby targeted surveys (refer to Section 3.3).

4.3 Results

The field survey was undertaken between the 23 – 25 February 2024 by Tom Ewers-Reilly (Lead Ecologist, EcOz), who is an experienced arid zone ecologist working in the region since 2003.

Southern Whiteface was not recorded during the current survey.

The current development area supports suitable foraging habitat for Southern Whiteface; however, this habitat is widespread throughout the region and is not restricted to the current development area. Cattle grazing occur in the area which has likely significantly reduced foraging habitat quality and condition of critical habitat for this species (i.e. high level of herbaceous and grassy understorey litter cover).

No suspected nest or roost sites were identified; and no tree hollows or tree crevices/cracks suitable for nesting were found. It is unlikely that the area will be used for breeding.

5 CONCLUSION

A desktop review indicated that two threatened species have potential to occur within the gravel, magazine and access tenure for the Nolans Project (ML33107, EMP33078, EMP33079, EMP33080, EMP33081, EMP33082, EMP33084, EMP33085, AA33279 and AA33280) (collectively referred to as the current development area) – Central Australian Rock-wallaby and Southern Whiteface.

Targeted surveys indicate these species do not currently occupy the current development area, and that critical habitat for these species is not present (species summaries provided below). As such, a species-specific significant impact assessment (using the EPBC Significant impact guidelines, DoE 2013) was not undertaken due to inherently low impacts on these species and their populations.

- **Central Australian Rock-wallaby** (Vulnerable EPBC Act). Targeted field survey confirmed that the species does not inhabit the current development area, and that critical habitat is not present (due to absence of good quality den / shelter sites, absence or low abundance of important food plants, and generally high predator occurrence in the area). Proposed works within the current development area will not have a significant impact on the species. As such, the requirement for specific protection buffers and management mitigations for Central Australian Rock-wallaby are not required.
- **Southern Whiteface** (Vulnerable EPBC Act). Targeted field survey did not record species presence however it has been recorded in the general area. Potential habitat for roosting / nesting was not observed within the current development area and is considered unlikely to occur within the proposed disturbance footprints due to absence of tree species that typically support tree hollows and crevices. The current development area could be used for foraging purposes; however habitat is of marginal quality due to cattle grazing and fire impacts, and there is ample areas outside of the current development area that also provide suitable foraging grounds. Minor disturbance to low quality foraging habitat will not impact the species population or reduce species distribution (the current development area is not located on the edge of the species distribution). Proposed works within the current development area will not have a significant impact on the species. As such, the requirement for specific protection buffers and management mitigations for Southern Whiteface are not required.

As part of standard biodiversity management practices for the Nolans project, Arafura have committed to undertaking Pre-Clearing surveys prior to ground disturbance where there is significant biodiversity risk to threatened species and/or threatened species habitat (as per “Ground Disturbance Permit” process in the Nolans Biodiversity Management Plan 2023). Although no specific management measures have been recommended for Central Australian Rock-wallaby, as a precautionary measure (because this species is mobile and known to occur in the surrounding region), it is recommended that the following areas are included in Pre-Clearing surveys to check for species presence:

- **EMP33079** (Survey Area 1): Rocky habitat within proposed disturbance areas, especially habitat in close proximity to the Desert Fig.
- **EMP33081** (Survey Area 2): Rocky habitat on south facing slopes within proposed disturbance areas, especially areas in close proximity to cave sites
- **AA33280** (southern part of Survey Area 3): Rocky habitat within proposed disturbance areas

If Pre-Clearing surveys confirm presence, or likely presence, of Central Australian Rock-wallaby (or any other threatened species), it is recommended the regulator is informed and a suitably qualified person is engaged to confirm identification and propose management measures to ensure that significant impact to the species is avoided.

6 REFERENCES

Blackbourne LJ (1991) The *diet and ranging of the Black-footed Rock-wallaby at Simpsons Gap, Alice Springs*. Honours Thesis, University of New England, Armidale, NSW.

Capararo SM (1994) *Potential dietary overlap between Black-footed Rock-wallaby (Petrogale lateralis) and two common sympatric herbivores in central Australia*. Honours Thesis, University of New England, Armidale, NSW.

DCCEEW (2023) *Conservation Advice for Aphelocephala leucopsis (southern whiteface).* Document prepared by the Australian Government Department of Climate Change, Energy, the Environment and Water.

Department of the Environment (DoE) (2013). *Matters of National Environmental Significance (significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999)* https://www.dcceew.gov.au/environment/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance

DSEWPC (2011), Survey *guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act 1999*, prepared by Commonwealth of Australia.

EcOz (2023) *Pre-clearing surveys 29-30 March 2023 – Nolans Rare Earths project*. Report prepared by EcOz Environmental Consultants (Author Tom Ewers-Reilly) for Arafura Rare Earths Limited, April 2023.

Geelen LJ (1999). *A preliminary study of the black-footed rock-wallaby (Petrogale lateralis MacDonnell Ranges raxe) in the Anangu Pitantjatjara lands, South Australia*. B.Sc (Honours) Thesis, University of Adelaide.

GHD (2016). *Appendix N – Fauna and Threatened Species Report for the Nolans Project*. Report prepared by GHD for the Nolans Environmental Impact Statement.

Higgins PJ & Peter JM (eds) (2002) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 6: Pardalotes to Shrike-thrushes*. Oxford University Press, Melbourne.

LES (2022), *Fauna Pre-clearance Survey October 2022– Nolans Bore Project*, report prepared by Low Ecological Services (Bill Low and Roberta Ferrari) for Arafura Resources Limited.

LES (2023) *Vegetation spatial data and related clearance matters at Nolans Rare Earth project current footprint* (memo). Memo prepared by Low Ecological Services (Bill Low and Roberta Ferrari) for Arafura Resources Limited.

NRETAS (2006). *Threatened species of the Northern Territory, Black-footed Rock-wallaby, Petrogale lateralis*. Compiled by Chris Pavey May 2006. Northern Territory Natural Resources, Environment, The Arts and Sport (NRETAS).

Pearson D (2013) *Recovery plan for five species of rock wallabies: Black-footed rock wallaby (Petrogale lateralis), Short-eared rock wallaby (Petrogale brachyotis), Monjon (Petrogale burbidgei), Nabarlek (Petrogale concinna), Rothschild rock wallaby (Petrogale rothschildi)*. Prepared by the Western Australian Government Department of Parks and Wildlife July 2013. Western Australian Wildlife Management Program No. 55

Read JL and Ward MJ (2011). *Bringing back the warru: initiation and implementation of the South Australian Warru Recovery Plan*. Australian Mammalogy 33, 214-220.

APPENDIX A MAPS

MAP 1. Current development area and Survey Areas, 23 - 25 February 2024

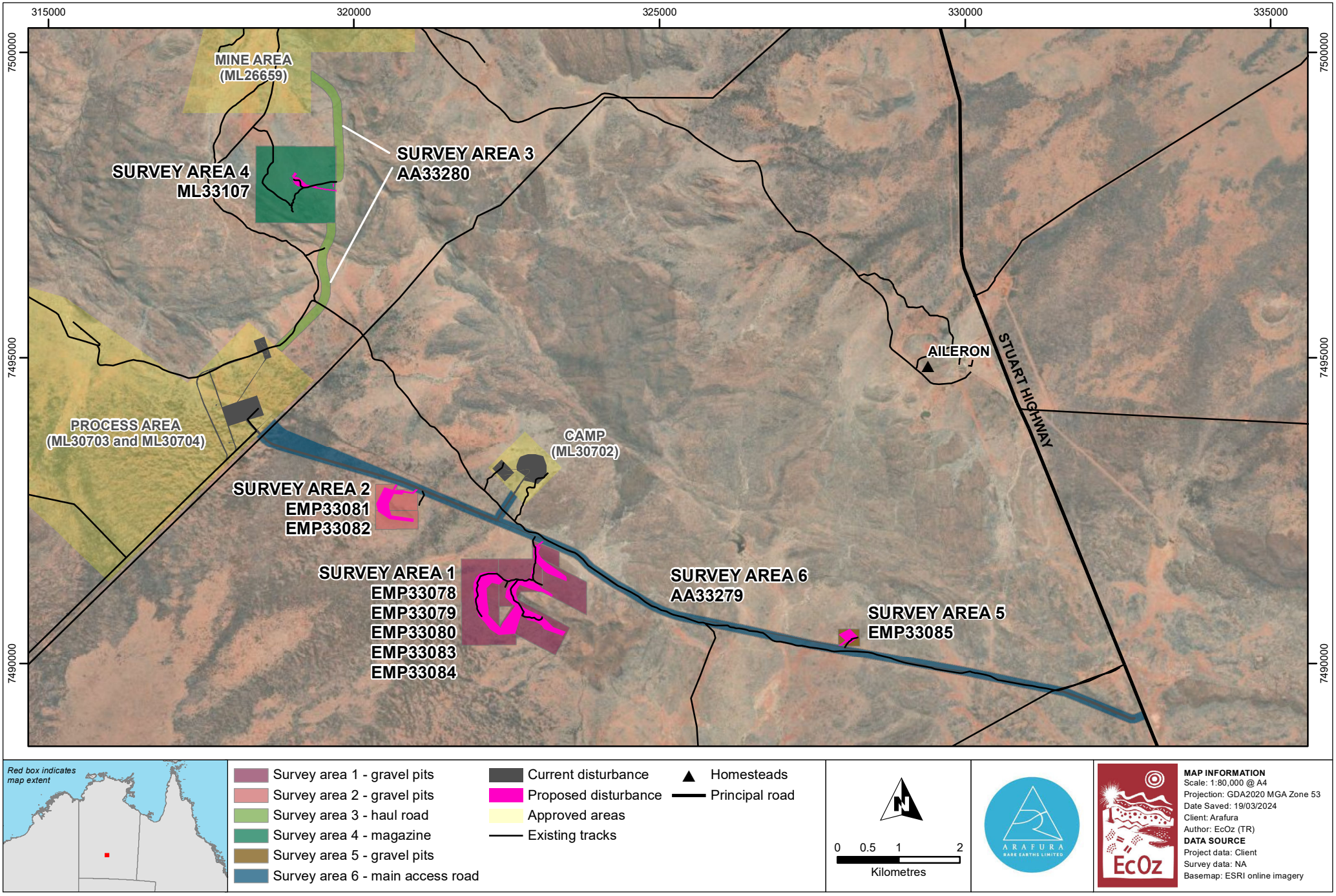
MAP 2. Survey areas and survey effort, 23 - 25 February 2024

MAP 3. Survey effort: Survey Area 1

MAP 4. Survey effort: Survey Area 2

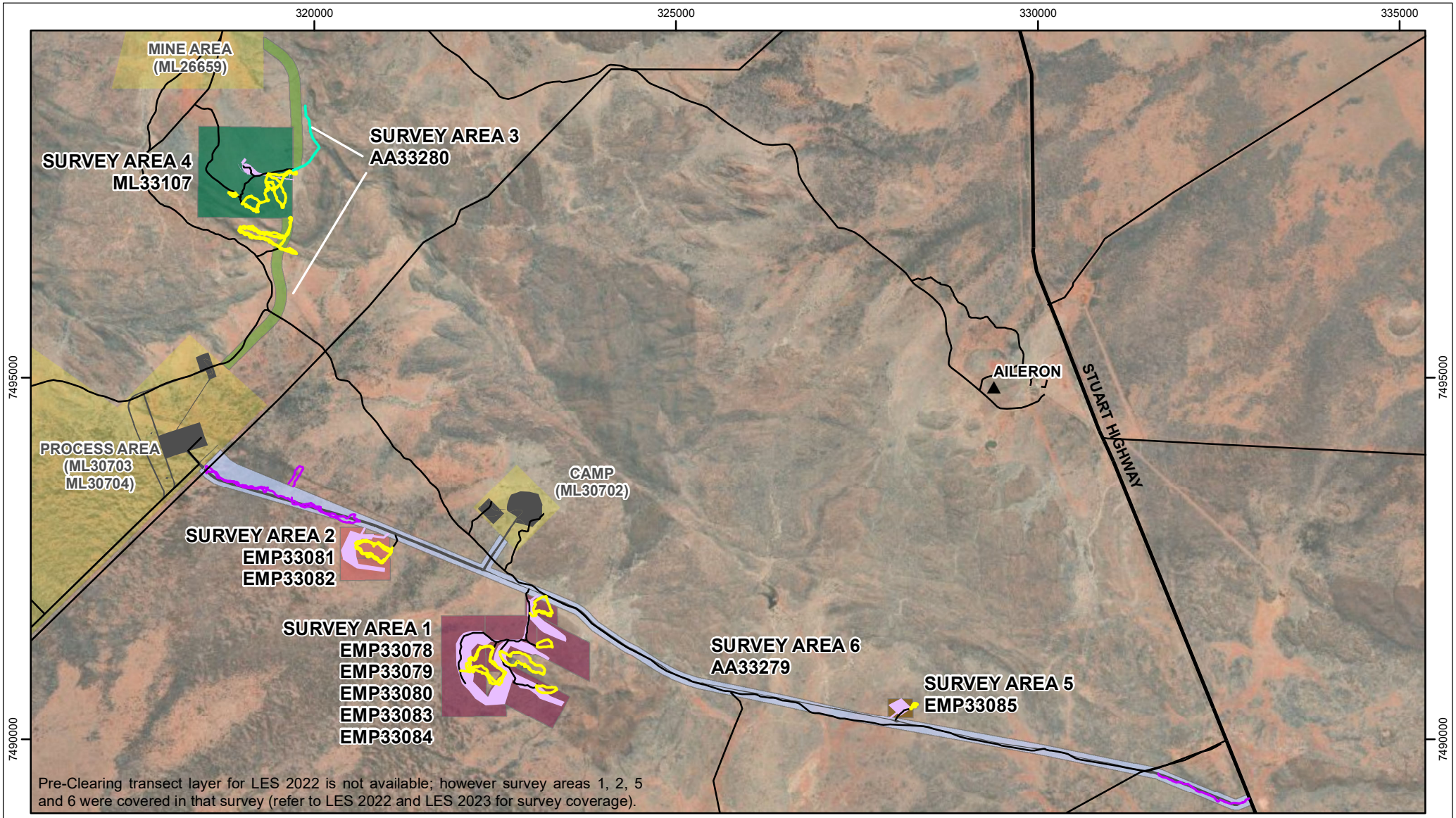
MAP 5. Survey effort: Survey Area 3 and 4

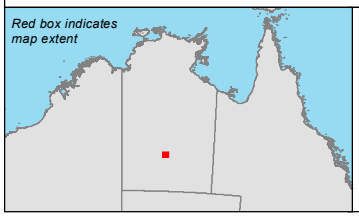
MAP 6. Survey effort: Survey Area 5



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MAP 1. Current development area and Survey Areas, 23 - 25 February 2024





- Survey area 1 - gravel pits
- Survey area 2 - gravel pits
- Survey area 3 - haul road
- Survey area 4 - magazine
- Survey area 5 - gravel pits
- Survey area 6 - main access road
- Current disturbance
- Proposed disturbance
- Survey transect - on-foot
- Survey transect - drone
- Approved areas
- Existing tracks
- Homesteads
- Principal road
- Pre-Clearing tracnsects (EcOz 2023)

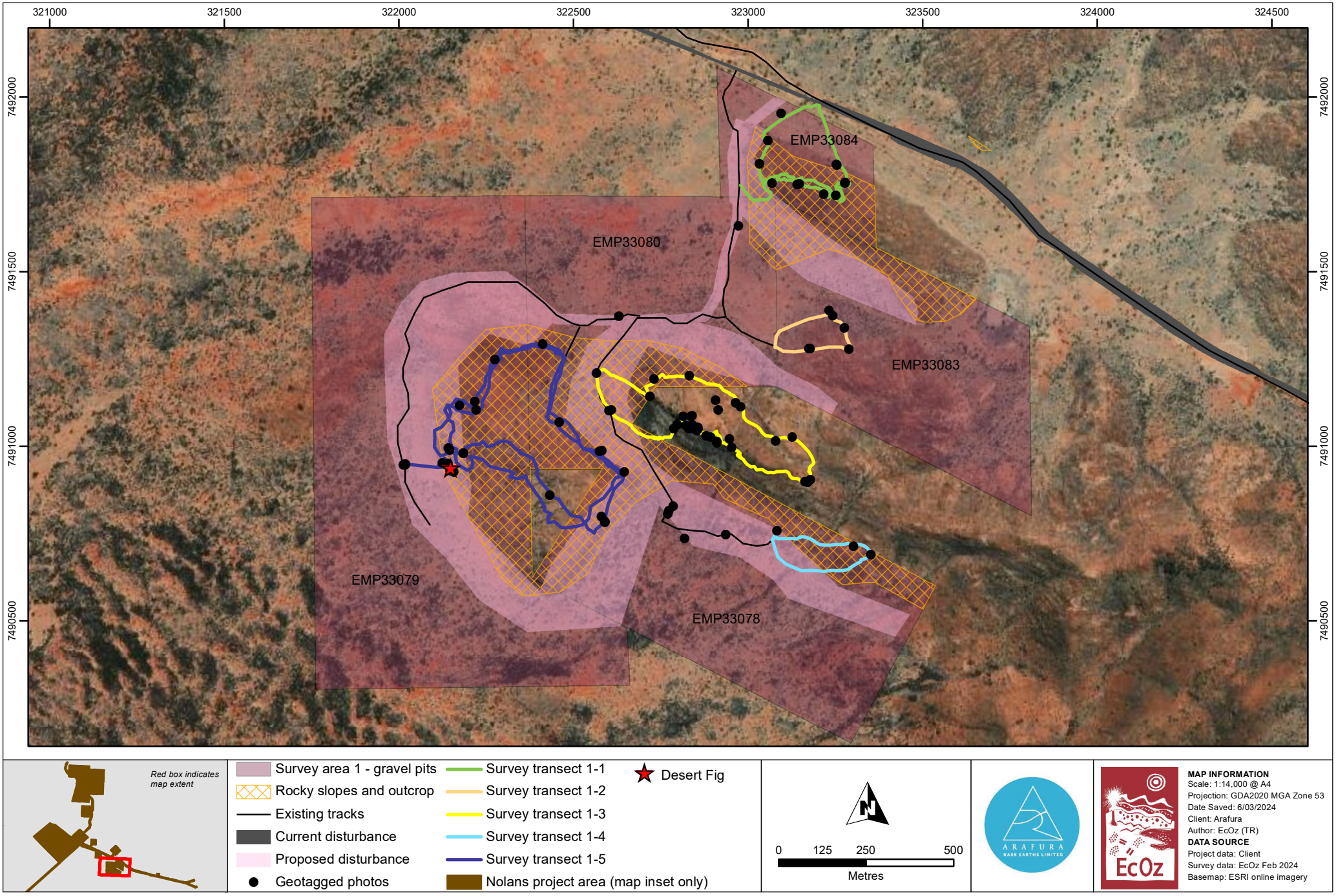
N

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Kilometres

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Client: Arafura
Author: EcOz (TR)
DATA SOURCE
Project data: Client
Survey data: EcOz Feb 2024
Basemap: ESRI online imagery

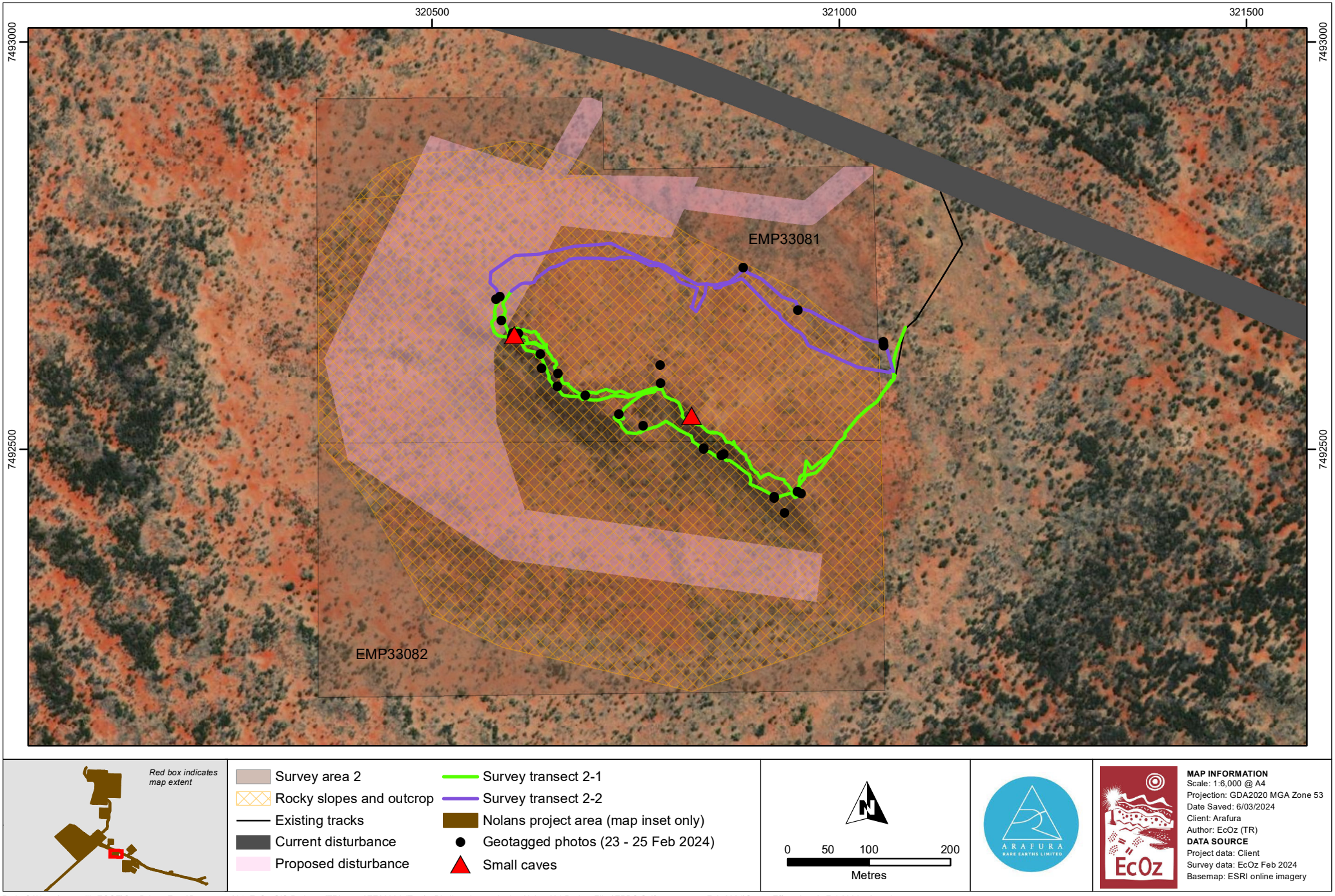
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MAP 2. Survey areas and survey effort, 23 - 25 February 2024



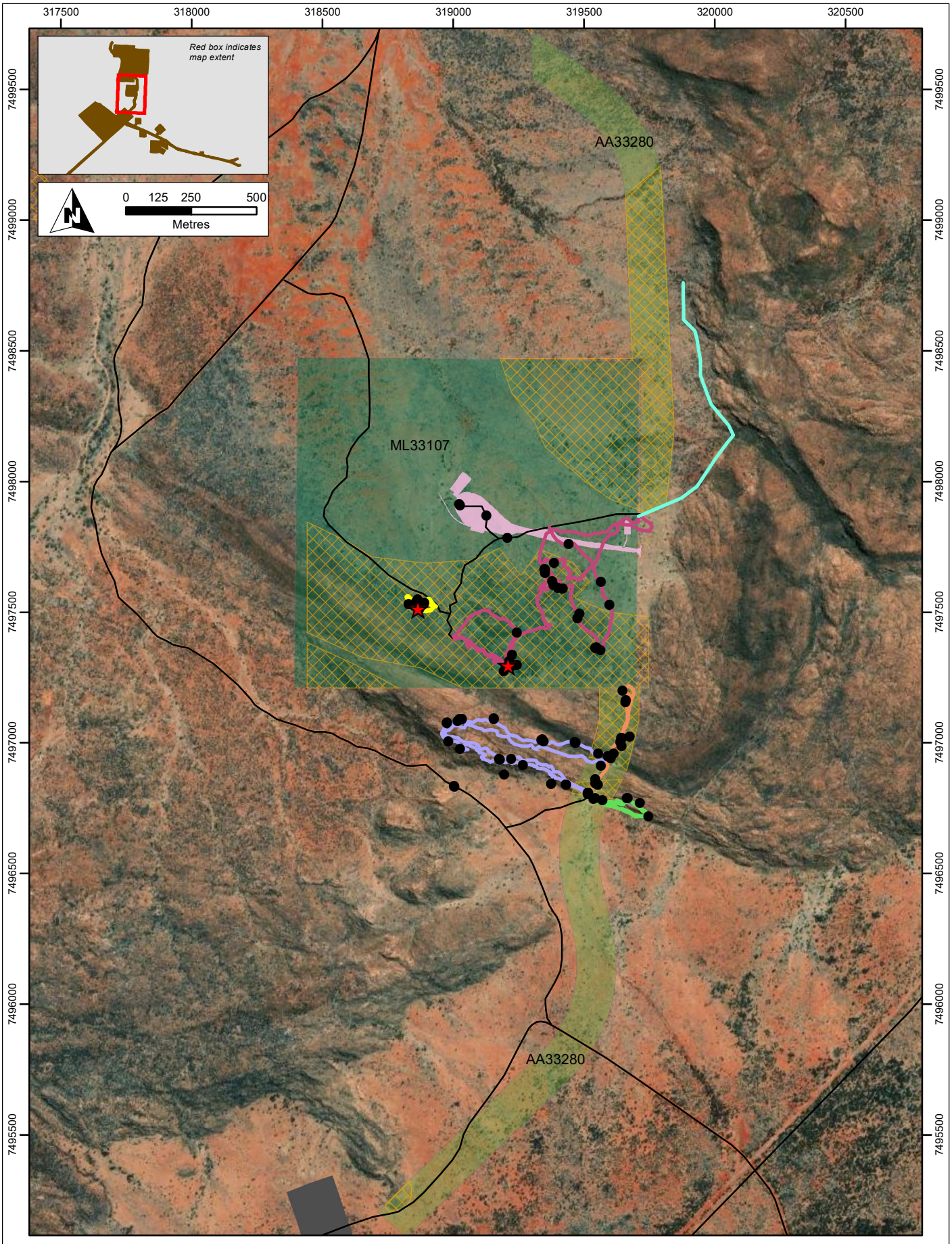
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MAP 3. Survey effort: Survey Area 1



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MAP 4. Survey effort: Survey Area 2



Survey area 3 - haul road
Survey area 4 - magazine
Rocky slopes and outcrop
Existing tracks
Current disturbance
Proposed disturbance
Survey transect 3-1
Survey transect 3-2
Survey transect 3-3
Survey transect 3-4
Survey transect 4-1
Survey transect 4-2
Nolans project area (map inset only)
Geotagged photos
Desert Fig

MAP INFORMATION
Scale: 1:20,000 @ A4
Projection: GDA2020 MGA Zone 53
Date Saved: 6/03/2024
Client: Arafura
Author: EcOz (TR)

DATA SOURCE
Project data: Client
Survey data: EcOz Feb 2024
Rocky areas: GHD 2015; LES 2022
Basemap: ESRI online imagery

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MAP 5. Survey effort: Survey Area 3 and 4



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MAP 6. Survey effort: Survey Area 5

APPENDIX B DESKTOP THREATENED SPECIES LIKELIHOOD OF OCCURRENCE ASSESSMENT

The desktop threatened species 'likelihood of occurrence' assessment was undertaken to identify which threatened species have potential to occur within the current development area. This process is based on desktop research and recent onsite studies, and focusses on species that are listed as Vulnerable, Endangered or Critically Endangered under the *Territory Parks and Wildlife Conservation Act* (TPWC Act) and/or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The outcome of this assessment will identify which threatened species require targeted survey effort to enable robust assessment of potential impacts. The procedure is described below and assessment results are summarised in Table A.

Procedure

The following procedure was used to undertake the likelihood of occurrence assessment for each relevant threatened species:

1) Collate a list of threatened flora and fauna records within 50 km of the current development area using the latest NT Flora and Fauna Atlas (dataset download 4 December 2023).
2) Use the Protected Matters Search Tool (PMST) to determine species listed as threatened under the *EPBC Act* (November 2023 – see Attachment 3). A 50 km buffer was applied from the current development area. The PMST is an online enquiry tool managed by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) which interrogates a range of existing flora and fauna data, as well as using predictive modelling, to speculate on the presence of species within a search area.
3) Combine results from steps 2 and 3 to generate a list of species that may occur within the broader area. Species that are extinct are omitted from the assessment (but are in the summary table below).
4) Review details for each of those species – conservation status (Northern Territory and Commonwealth), habitat requirements, distribution, number of records (from the Northern Territory Fauna and Flora Atlas dataset), and presence inferences from the PMST report.
5) Analyse the likelihood that each species will occur within the current development area by applying likelihood ratings defined below. This assessment uses the available records, survey data, and habitat information to infer habitat suitability of the subject area surveyed – available studies are below:
    - Vegetation and landform mapping generated during EIS baseline studies (GHD 2016)
    - Vegetation and landform mapping updates / revisions (LES 2023)
    - Fauna survey data from EIS baseline studies (GHD 2016)
    - Preclearance fauna survey (LES 2022)
    - Preclearance fauna survey (EcOz 2023)

Likelihood	Likelihood of occurrence definition
HIGH	It is expected that this species occurs within the current development area because there is critical habitat and recent (post-2000) records or knowledge that the species occurs in the local area.
MEDIUM	Species may occur within the current development area because there is suitable habitat; however, there is evidence that lowers its likelihood of occurrence (known range contraction of the species in the region, no recent records within or close to the mineral lease, substantial loss of habitat within the mineral lease since previous records, species is naturally-rare or occurs at a low density etc.).
LOW	Species may occur, as a vagrant, within the current development area; only marginally-suitable habitat is expected. No recent records / known occurrences within the region.
NONE	There is strong evidence that this species will not occur within the current development area (i.e. there is no suitable habitat and/or the species is considered to be regionally-extinct).

TABLE A. DESKTOP THREATENED SPECIES LIKELIHOOD OF OCCURRENCE ASSESSMENT – VARIOUS MLs, EMPs and AAs – NOLANS PROJECT – FEB 2024						
Scientific name	**Scientific name**	**TPWC Act**	**EPBC Act**	**Recorded within 50km**	**EPBC PMST**	**Likelihood of occurrence assessment (specific to the current development area using available desktop resources)**
Birds						
Australian Painted Snipe	*Rostratula australis*	EN	EN	No	Species or species habitat may occur in the area	**NONE** • Species requires wetland habitat which is not present within or adjacent to current development area. • No proximate records
Sharp-tailed Sandpiper	*Calidris acuminata*	LC	VU	No	Species or species habitat may occur in the area	**NONE** • Species requires wetland habitat which is not present within or adjacent to current development area. • No proximate records
Curlew Sandpiper	*Calidris ferruginea*	CR	CR	No	Species or species habitat may occur in the area	**NONE** • Species requires wetland habitat which is not present within or adjacent to current development area. • No proximate records
Red Goshawk	*Erythrotriorchis radiatus*	VU	EN	No	Species or species habitat may occur in the area	**LOW** • The current development area outside of known distribution in the NT. • The current development area does not support preferred habitat for the species (prefers tall Eucalyptus forest & riparian areas [Woinarski 2006]). • No proximate records • If present, species would only occur a vagrant.
Night Parrot	*Pezoporus occidentalis*	CR	EN	No	Species or species habitat may occur in the area	**LOW** • No proximate records • No confirmed sightings in the wider region for several decades. • Spinifex habitat on rocky hills could provide suitable roost habitat; however, fire history in the area has likely reduced habitat suitability (Night Parrot requires long unburnt areas of Spinifex for roosting [Pavey 2006] in particular Bull Spinifex *Triodia longiceps* [DOE 2017; Murphy 2017] which is not known to occur in the area).
Grey Falcon	*Falco hypoleucos*	VU	VU	Yes	Species or species habitat likely occur in the area	**LOW** • Only one record within 50km of the current development area. • Species usually nests in the tallest trees along watercourses, particularly River Red Gum and Coolabah, and telecom towers [Falkenberg 2011] – which are not present within the current development area. • Foraging habitat is present within the current development area (however foraging habitat is widespread and not specific to an area – hunting areas typically occur in response to small bird flocks)

TABLE A. DESKTOP THREATENED SPECIES LIKELIHOOD OF OCCURRENCE ASSESSMENT – VARIOUS MLs, EMPs and AAs – NOLANS PROJECT – FEB 2024						
Scientific name	**Scientific name**	**TPWC Act**	**EPBC Act**	**Recorded within 50km**	**EPBC PMST**	**Likelihood of occurrence assessment (specific to the current development area using available desktop resources)**
Southern Whiteface	*Aphelocephala leucopsis*	LC	VU	Yes	Species or species habitat known to occur in the area	**HIGH** • There are proximate records, including those from baseline studies. • The species is relatively common in the southern Northern Territory (hence its listing as Least Concern under TPWC Act). • Suitable habitat is present within the current development area. • Species can forage in a wide range of open woodlands and shrublands. • Roost / nesting habitat occurs in living and dead trees with hollows which are not expected to be present within the current development area.
Princess Parrot	*Polytelis alexandrae*	VU	VU	Yes	Species or species habitat likely occur in the area	**LOW** • Species not known to occur within the current development area. • Species is highly nomadic and could occasionally pass through the area as a vagrant. • There is no suitable breeding / nesting habitat within the current development area (i.e. Marble Gum, River Red Gum and Desert Oak).
Mammals						
Central Australian Rock-wallaby	*Petrogale lateralis centralis*	NT	VU	Yes	Species or species habitat known to occur in the area	**HIGH** • Numerous records in the general area. • Previous targeted surveys in 2015 and 2022 did not detect the species within the current development area (noting that not all areas were checked during those previous surveys). • There is potential for suitable habitat within the current development area (i.e. rocky hills) (requires site assessment to confirm habitat suitability). • The isolated nature of the rocky hills within the current development area may reduce habitat suitability due to increase predation pressure from surrounding plains (cat and fox are known to occur in the area).
Ghost Bat	*Macroderma gigas*	NT	VU	No	Species or species habitat may occur in the area	**NONE** • No records within 50km of current development area. • All records in the greater region are historic. • The species has undergone major distributional changes and, in the NT, is now only known to occur in the Top End. • The species has not been recorded in the southern NT since the early 1960s and is presumed to be regionally extinct/extirpated. • Rocky habitat within the area may support suitable caves for roost sites; however, population contraction to the north deems specie unlikely to occur (as described in above points).

TABLE A. DESKTOP THREATENED SPECIES LIKELIHOOD OF OCCURRENCE ASSESSMENT – VARIOUS MLs, EMPs and AAs – NOLANS PROJECT – FEB 2024						
Scientific name	**Scientific name**	**TPWC Act**	**EPBC Act**	**Recorded within 50km**	**EPBC PMST**	**Likelihood of occurrence assessment (specific to the current development area using available desktop resources)**
Greater Bilby	*Macrotis lagotis*	VU	VU	No	Species or species habitat may occur in the area	**NONE** • No proximate records • Species occurs in spinifex hummock grasslands on sandy soils (Southgate 1990), which are not present within current development area.
Central Rock-rat (Antina)	*Zyzomys pedunculatus*	CR	CR	No	Species or species habitat may occur in the area	**NONE** • No proximate records • Species occurs in high altitude rugged quartzite peaks (now only known to occur in the MacDonnell Ranges) (McDonald 2012) which do not occur within the current development area or surrounds.
Reptiles						
Great Desert Skink	*Liopholis kintorei*	VU	VU	Yes	Species or species habitat known to occur in the area	**NONE** • Species is known to occur 30km to the southwest on spinifex sandplains. • However suitable/critical habitat for the species does not occur within or surrounding the current development area (species generally occurs in tall open shrubland, hummock grasslands on red sandplains and sand ridges, Cogger et al. 1993).

Status key: CR = Critically Endangered, **EN** = Endangered, **NT** = Near Threatened, **LC** = Least Concern

REFERENCES

Cogger, H., Cameron, E., Sadlier, R. and Eggler, P. (1993). *The Action Plan for Australian Reptiles*. Australian Nature Conservancy Agency, Canberra.

Department of Environment (2017) *Pezoporus occidentalis. Species profile and Threats Database.* Department of the Environment, Canberra

Falkenberg IS (2011) *Aspects of the ecology of the Grey Falcon Falco hypoleucos in the South Australian arid zone*. Corella 35. 23-28

McDonald 2012 P (2012). *Threatened species of the Northern Territory – Central Rock-rat Zyzomys pedunculatus.* Northern territory Government Department of Environment and Natural Resources (DENR)

Murphy SA, Paltridge R, Silcock J, Murphy R, Kutt AS and Read J (2017). *Understanding and managing the threats to Night Parrots in south-western Queensland*. The Emu – Austral Ornithology 117, 135-145.

Pavey C (2006), *Threatened species of the Northern Territory – Night Parrot Pezoporus occidentalis.* Northern territory Government Department of Environment and Natural Resources (DENR)

Southgate R (1990) Habitat and diet of the Greater Bilby Macrotis lagotis Reid (Marsupalia: Peramelidae). In: Seebeck et al (eds) Bandicoots and Bilbies. Surrey Beatty & Sons, Sydney, NSW.

Woinarksi J (2006), *Threatened species of the Northern Territory – Red Goshawk Erythrotriorchris radiatus*. Northern territory Government Department of Environment and Natural Resources (DENR)

APPENDIX C EPBC PMST REPORT

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 20-Feb-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	13
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	2
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	3
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species			[Resource Information]
Status of Conservation Dependent and Extinct are not MNES under the EPBC Act. Number is the current name ID.			
Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area	In feature area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macroderma gigas			
Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In feature area
Macrotis lagotis			
Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Petrogale lateralis centralis			
Warru, Central Australian Rock-wallaby [90831]	Vulnerable	Species or species habitat known to occur within area	In feature area
Zyzomys pedunculatus			
Central Rock-rat, Antina [68]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
REPTILE			
Liopholis kintorei			
Great Desert Skink, Tjakura, Warrarna, Mulyamiji, Tjalapa, Nampu [83160]	Vulnerable	Species or species habitat known to occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Motacilla cinerea			
Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius veredus			
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
Glareola maldivarum			
Oriental Pratincole [840]		Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Anna's Reservoir	Conservation Reserve	NT	In buffer area only
Woodgreen	Conservation Reserve	NT	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Nolans Rare Earth Project, NT	2015/7436		Post-Approval	In feature area
Controlled action				
Development of Rare Earth Oxide and Phosphate Mine at Nolans Mine Site	2008/4371	Controlled Action	Completed	In feature area
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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APPENDIX D FIELD DATA

FIELD DATA – CENTRAL AUSTRALIAN ROCK-WALLABY SURVEY TRANSECTS – NOLANS PROJECT – 23-25 FEBRUARY 2024										
Transect ID	Transect length	Central coordinate		Landform description	Vegetation description	Fire history	Weed presence	Key food plants present?	Rock-wallaby refugia / dens present?	Rock-wallaby evidence	Other mammals observed
		Easting	Northing								
1-1	1,488m	323164	7491753	Low rocky hill with extensive minor outcrop.	Low open shrubland (Acacia, Senna spp.) over tussock grass. Isolated Bloodwood trees. Some patches of spinifex.	Last burnt in 2023	None observed	None observed	None present	None	• Euro (scats) • Red Kangaroo (scats) • Dingo (scats)
1-2	553m	323288	7491299	Low rocky hill with minor outcrop.	Low open shrubland over tussock grass. Isolated Bloodwood trees. Some patches of spinifex.	Last burnt in 2023	Small amounts of Buffel Grass	None observed	None present	None	• Euro (scats) • Red Kangaroo (scats) • Dingo (scats)
1-3	1,920m	322939	7491008	Rocky ridge line with extensive rock outcrop; minor overhangs on southern slopes. Shallow caves or crevices present.	Low open Acacia shrubland over tussock grass and occasional spinifex (low amount of spinifex likely a result of 2023 fire). Scattered small trees.	Last burnt in 2023	Small amounts of Buffel Grass	None observed	Some small caves were found; however all were shallow and not considered deep enough to be suitable for den.	None	• Euro (scats and sighting) • Echidna (scat and sighting) • Rodent (scats)
1-4	676m	323333	7490675	Low rocky hill with minor outcrop.	Low open Acacia shrubland over tussock grass. Scattered small trees. Blue Mallee in area.	Last burnt in 2023	Small amounts of Buffel Grass	None observed	None present	None	• Euro (scats) • Cat (scats) • Dingo (scats)
1-5	4,101m	322200	7490998	Large area of low rocky and gravelly hills with extensive areas of rocky outcrop. Some boulders and minor overhangs. No caves or deep crevices found.	Low open Acacia shrubland over tussock grass and spinifex grass. Scattered Bloodwood, Blue Mallee, Whitewood.	Some patches recently burnt (2024). Many areas haven't burnt for several years.	Small amounts of Buffel Grass	One Desert Fig observed growing out of boulder pile.	None present	None	• Euro (scats) • Red Kangaroo (scats) • Echidna (scat) • Dingo (scats) • Cat (sighting, scat) • Rodent (scats)

FIELD DATA – CENTRAL AUSTRALIAN ROCK-WALLABY SURVEY TRANSECTS – NOLANS PROJECT – 23-25 FEBRUARY 2024											
Transect ID	Transect length	Central coordinate		Landform description	Vegetation description	Fire history	Weed presence	Key food plants present?	Rock-wallaby refugia / dens present?	Rock-wallaby evidence	Other mammals observed
		Easting	Northing								
2-1	1,791m	320774	7492571	Isolated rocky hill with south facing rock faces and extensive outcrop and minor overhangs. Northern slopes shallow outcrop only. Gravelly scree slopes. Some caves and crevices present on the upper south facing slopes.	Low open Acacia shrubland over tussock grass and spinifex grass. Scattered Bloodwood, Blue Mallee, Whitewood, Mulga, Supplejack, Native Current, Ghost Gum.	Not recently burnt	Small amounts of Buffel Grass	None observed	Caves and crevices could be potentially suitable. Although uncommon at site.	None	• Euro (scats and sighting) • Echidna (scats) • Rodent (scats) • Dingo (scats)
2-2	1,046m	320838	7492702	Isolated rocky hill. Northern slopes shallow outcrop only. Gravelly scree slopes.	Low open Acacia shrubland over tussock grass and spinifex grass. Scattered Bloodwood, Blue Mallee, Whitewood, Mulga.	Not recently burnt	Small amounts of Buffel Grass	None observed	None present	None	• Euro (scats)
3-1	2,980m	319266	7496934	Ridgeline with extensive rock outcrop and minor overhangs on the south facing slopes. Northern slopes shallow outcrop only. No caves or deep crevices found.	Scattered shrubs and trees over spinifex.	Not recently burnt	Small amounts of Buffel Grass	None observed	None present	None	• Euro (scats and sighting) • Rodent (scats) • Dingo (scats)
3-2	1,046m	319677	7496774	Ridgeline with extensive outcrop and minor overhangs on southern slopes. Northern slopes shallow outcrop only. Small shallow caves present.	Scattered shrubs and trees over spinifex.	Not recently burnt	Small amounts of Buffel Grass	None observed	None present. Some small caves were found; however all were shallow and not considered deep enough to be suitable for den.	None	• Euro (scats) • Rodent (scats)

FIELD DATA – CENTRAL AUSTRALIAN ROCK-WALLABY SURVEY TRANSECTS – NOLANS PROJECT – 23-25 FEBRUARY 2024										
Transect ID	Transect length	Central coordinate		Landform description	Vegetation description	Fire history	Weed presence	Key food plants present?	Rock-wallaby refugia / dens present?	Rock-wallaby evidence	Other mammals observed
		Easting	Northing								
3-3	839m	319635	7497005	Drainage gully / gap in ridge. Rocky areas but relatively low relief.	Drainage gully supports Melaleuca glomerata (inland paperbark). Rocky areas have a low shrubland of Acacia and Senna spp.	Not recently burnt	Small amounts of Buffel Grass	None observed	None present	None	• Euro (scats) • Cattle (scats, tracks) • Red Kangaroo (scats) • Dingo (scats)
3-4	1,103m (Drone)	319918	7498574	Ridgeline with extensive rock outcrop and overhangs on the west facing slopes.	Scattered shrubs and low trees over spinifex and tussock grasses.	Not recently burnt	Could not determine from imagery	None observed	Potential. Would need to confirm via on-ground survey	NA (didn't check on-ground)	• NA (didn't check on-ground)
4-1	634m	318874	7497522	Isolated low rocky hill with boulders and some crevices/ cracks.	Scattered shrubs and low trees over spinifex and tussock grasses. Caustic Vine, Wild Orange, Desert Fig, Conkerbush, Native Plum, Rock Fuchsia.	Not recently burnt	Small amounts of Buffel Grass	One Desert Fig observed growing out of boulder pile.	None present. Some crevices / caves under boulder piles however not considered to be suitable depth for den site.	None	• Euro (scats) • Echidna (scats) • Rodent (scats)
4-2	4,255m	319382	7497621	Large area of rocky and gravelly hills with extensive areas of rocky outcrop. Some boulders and minor overhangs. No caves or deep crevices found.	Scattered shrubs and low trees over spinifex and tussock grasses. Common shrubs - Acacia spp., Caustic Vine, Wild Orange, Conkerbush, Native Plum, Rock Fuchsia.	Not recently burnt	Small amounts of Buffel Grass	One Desert Fig observed growing out of boulder pile. Spearwood present in some areas however shrubs look dead /senesced	None present	None	• Euro (scats, sighting, carcass) • Cat (sighting) • Echidna (scats) • Rodent (scats) • Dingo (scats)
5-1	302m	328304	7490444	Isolated small rocky hill. Boulders.	Scattered shrubs over tussock grass.	Recently burnt	Buffel Grass common	None observed	None present	None	• Euro (scats)

APPENDIX E SITE PHOTOGRAPHS

Survey transect 1-1





Survey transect 1-2





Survey transect 1-3





Survey transect 1-3





Survey transect 1-3





Survey transect 1-4





Survey transect 1-5





Survey transect 1-5





Survey transect 2-1





Survey transect 2-1





Survey transect 2-2





Survey transect 3-1





Survey transect 3-2





Survey transect 3-3







Survey transect 3-4 (drone inspection only)







Survey transect 4-1







Survey transect 4-2





Survey transect 4-2







Survey transect 5-1







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Environmental Impact Self-Assessment

Nolans Bore - Explosives Magazine and Gravel Pits

25 March 2024

PREPARED FOR:

Arafura Resources Ltd



CDM Smith
listen. think. deliver.

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Section 1 Assessment Overview

Arafura Rare Earths Limited (Arafura) propose gravel pits, explosives magazine and access for the Nolans Project (hereafter referred to as the 'development areas') – specifically ML33107, EMP33078, EMP33079, EMP33080, EMP33081, EMP33082, EMP33083, EMP33084, EMP33085, AA33279 and AA33280 (collectively referred to as the development area) (Figure 1-1). The proposed activities were included within the Environmental Impact Statement (EIS) assessed under the Northern Territory Environment Protection Act 2019 (EP Act) and the Commonwealth Environment Protection and Biodiversity Act 1999 (EPBC Act).

In the EIS the explosives magazine was proposed to be located near the southwest corner of WRD 1 whilst the location of the borrow pits were not specified, though the EIS stated that a range of raw material requirements for construction and operations, including gravel, would be sourced "either from within or near the Nolans site." These EIS references are presented in Appendix 1 of this document. Subsequent to approvals under both Acts, the locations of the gravel pits and explosives magazine (ie the development area) have been confirmed and assessing the environmental impacts associated with disturbance at these locations are the subject this self-assessment.

The intent of the self-assessment is to determine whether impacts on environment values specific to the development area (in addition to those assessed for the Nolans Project by the EIS) are considered significant or not, and whether they require referral for assessment to the Northern Territory Environment Protection Authority (NT EPA) and/or Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The assessment has taken into account the Environmental Impact Statement, Mine Management Plan, DCCEEW licence conditions and site-specific survey validating habitat assessments and protected species likelihood of occurrence assessment. An ecological survey of the explosives magazine and gravel pits was undertaken by EcOz Environmental Services in February 2024, it is noted that no significant values of concern or MNES were identified during the survey.

The project area has been extensively surveyed for cultural heritage artifacts (regulated under the Heritage Act 2011) and sacred sites (regulated under the Sacred Sites Act 1989). The project area has previously been subject to heritage surveys in conjunction with the Traditional Owners in 2006, 2010, 2012, and 2015.

Additionally, in 2022 and 2023, Extent Heritage conducted two heritage due diligence surveys to augment the historical surveys. These recent surveys covered these areas:

- Camp
- Pipeline
- Turkey's nest at the processing plan
- Gravel borrow pits (EMP 33078-33085)
- Site Access Road realignment (SAR)
- Borefield pipeline alignment
- Solar farm
- Mine Access Road (MAR)

The Traditional Owners (Anmatjere People) were invited to participate in these due diligence surveys, however, they declined because they stated that the area had been extensively surveyed by Traditional Owners in the past and conducting another survey in their company was not necessary.

Cultural heritage artifact scatters are common across the Project area, and all known scatters have either been avoided by the project designs, or where avoidance was not possible, have been authorised to be removed by Works Approvals issued by the NT Heritage Council in 2022 and 2023.

The Extent heritage surveys could only assess the archaeological (scientific) significance of these areas. Any assessment of the cultural significance would require the input of the Traditional Owners through the application of an Aboriginal

Areas Protection Authority (AAPA) Certificate issued by AAPA and a Sacred Sites Clearance Certificate (SSCC) issued by the Central Land Council (CLC).

The locations of Sacred Sites (as regulated under the Sacred Sites Act 1989) around and adjacent to the Project area are well known from the previous and current SSCC and AAPA certificates:

- AAPA Authority Certificate C2008-205 – issued for exploration of the mine ML.
- AAPA Authority Certificate C2013-205 - issued for exploration over the entire mining area and borefield.
- AAPA Authority Certificate C2024-012 – issued for the current operations and borefield (excluding the gravel pits, magazine and solar farm).
- CLC SSCC C2019-105 - issued for the current operations and borefield (excluding the gravel pits, magazine and solar farm).
- SSCC C2022-080v1 – issued for the current site access road and mine access road alignments.
- C2023-032v1 – issued for the production and monitoring bores in the borefield.

A CLC SSCC for the magazine, solar farm and gravel pit areas has been applied to from CLC and will be issued once a current update to the Project Native Title Agreement (NTA) is finalised. An AAPA certificate for these areas will be applied for once the NTA is finalised.

The magazine area will be surveyed for artifacts prior to any ground disturbance, and if located, the project design will be adjusted or a Works Approval application to the NT Heritage Council will be made to salvage any discovered objects.

Due to the number of SSCC and AAPA certificates both historical and current for the project, it is unlikely that a Sacred Site will be found in the magazine or gravel pit areas. Therefore, the potential to encounter previously unidentified sacred sites is very low.

All development activities will be conducted in accordance with the Arafura Cultural Heritage Management Plan approved under Mining Authority 1127-1. This includes conformance with the following procedures:

- Unexpected Finds Procedure – Historical and Cultural Heritage Items
- Unexpected Finds Procedure – Suspected Human Remains

The conclusion of the assessment is that the disturbance is not significant (noting the cumulative disturbance of threatened species habitat does not exceed that already approved for the development) and does not require further referral under the EP Act or EPBC Act for assessment. The mitigation of environmental impacts can be managed through amendments of the Mine Management Plan, the Nolans Construction Materials Mining Management Plan (NRE-0000-O-PLN-O-0002 Rev 1.3) and the DCCEEW approval.

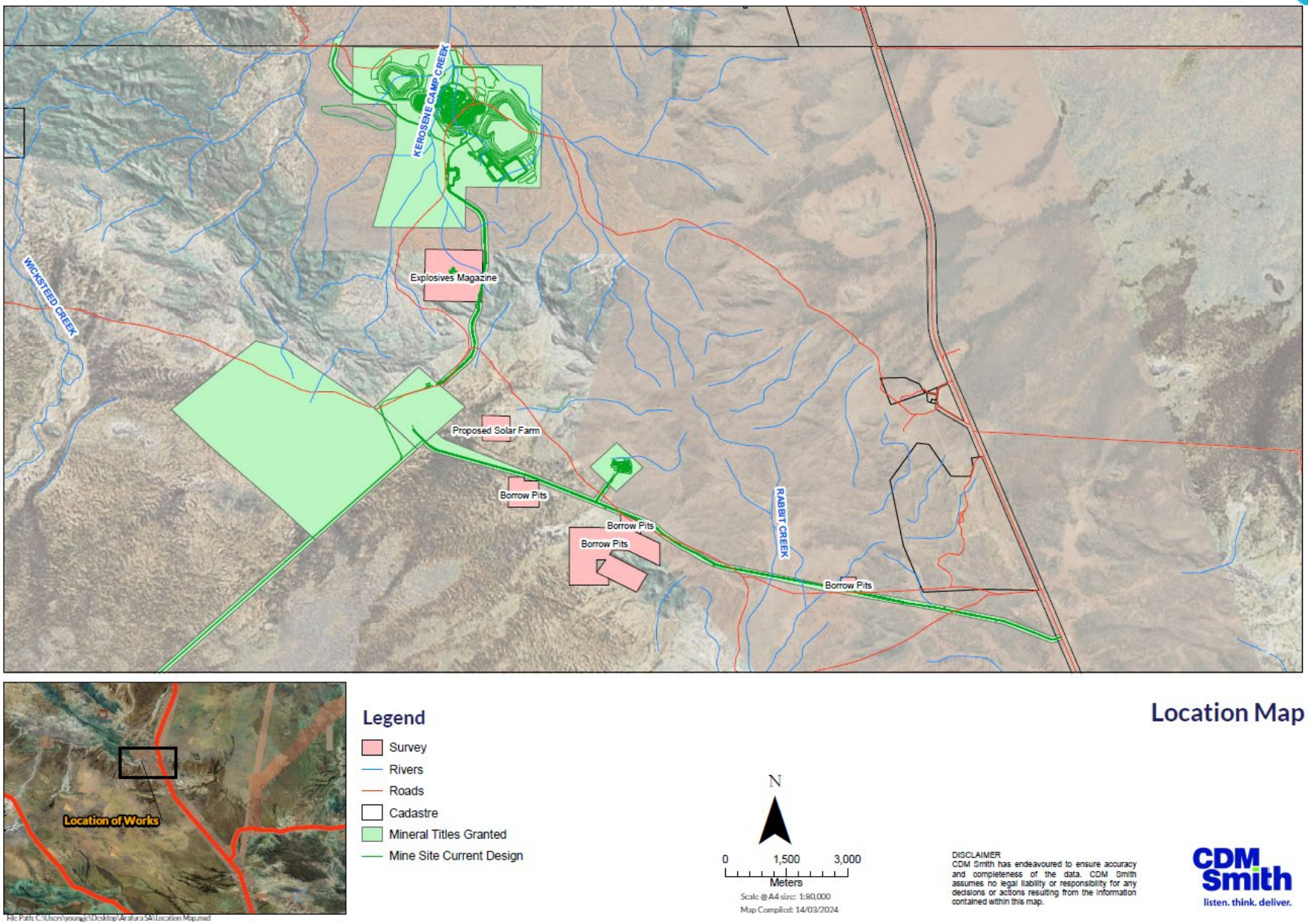


Figure 1-1 Location Map

Section 2 Referral Screening Tool

The Northern Territory Environmental Protection Authority (NTEPA) has developed a screening tool to assist proponents in determining whether a proposed action requires formal referral under the EP Act (NTEPA, 2021a). Likewise DCCEEW present guidance as it relates to the EPBC Act; https://www.dcceew.gov.au/environment/epbc/advice/self-assessments. A hybrid approach has been adopted for the self-assessment of the gravel pits and explosives magazine following both DCCEEW and NT EPA guidance.

The NT EPA screening tool is comprised of two parts namely, Part 1 (Screening questions) and Part 2 (Checklist). As the actions are related to a larger action, Part 1 has been presented here to inform the reader on the assessment considerations. However, note that due to the context of the activities being assessed (i.e. that the activities have been assessed under the EIA process and the areas are the subject of assessment) the applicability has been interpreted.

2.1 Part 1 – General Screening Questions

1	Is the industry type or activity proposed inherently hazardous with the potential to give rise to multiple or major impact sources and environmental stressors with the potential to impact on the environment? If so, does the nature of the industry preclude impact sources and stressors being substantively reduced?	YES	Refer action
	NO		
2	**Site selection**: Are any environmental values present, or likely to be present within the site/area that has the potential to be impacted by the proposal (either directly, indirectly, or cumulatively)? If so, is it considered impractical to change the locations or design of the action to avoid the environmental value/s?	YES	Refer action
	NO		
3	**Construction and operation**: Are any environmental values or sensitivities within the area of influence and the region in which the proposal is located likely to be impacted by methods of construction and operation, timing, or inputs (water, raw materials, machinery, chemicals, staff) and outputs (product, emissions, discharges, wastes) of the proposal?	YES	Refer action
	NO		
4	**End of life**: Are any environmental values or sensitivities likely to be impacted when the proposal finishes its functional life and closes? If so does the action have the potential to cause ongoing environmental impacts, or residual impacts?	YES	Refer action
	NO		
5	**Cumulative impacts**: At any stage of the life of the proposal, on its own or cumulatively with other proposals and actions, does the proposal have the potential to impact an environmental value? If so, referral is likely to be required.	NO	Referral may not be required

2.2 Part 2 – Checklist

Table 2-1 has been reviewed within the context and framework of the NTEPA's environmental factors and objectives (NTEPA, 2021b) and EPBC Matters of National Environmental Significance (MNES)[1].

The scope of the development in the context of the self-assessment includes:

- Disturbance associated with the construction and operation of gravel pits, explosives magazine and access roads.

The assessment provides a preliminary evaluation of whether the proposed activities in relation to the confirmed locations have the potential to result in a significant impact on the environment and if further referral to the NTEPA or DCCEEW is necessary. The assessment of impact takes into consideration the proposed mitigation measures and available site-specific information, as well as the existing licence conditions for the development that, for example, allow limited clearing of critical habitat.

To undertake a preliminary evaluation of impacts on the NT EPA and DCCEEW factors it is important to understand the definition of 'significant impact'. Refer to Section 2.3 for the definition of a 'significant impact' in relation to the Northern Territory Environment Protection Act 2019 (EP Act) and the NT EPA's contemporary guidance and the EPBC Act; https://www.dcceew.gov.au/environment/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance.

***Explanation**: Use questions 1-5 from part 1 of the screening tool. Indicate answer to questions 1-5 in corresponding checkbox. The table below gives an indication of the possible environmental values for each environmental factor that should be considered when considering each question. If the answer to a question is 'yes', it is possible that the proposal may have the potential to have a significant impact on the environment and the proposal should be referred to the NT EPA (NTEPA, 2021a).*

[1] https://www.agriculture.gov.au/sites/default/files/documents/nes-guidelines_1.pdf

Table 2-1 Pre-Referral screen tool Part 2

Theme	Environmental factor and objective	Indicative environmental values and sensitivities relevant to each environmental factor	Summary of key environmental values and sensitivities of relevance to the development areas	Proponent's answer to screening questions 1-5. If answer is 'yes' consider, justify or assess the significance (Yes/ No/ Uncertain or Not Applicable (N/A))					Preliminary evaluation of significance (Nature, scale, context and sensitivity; refer definition provided below table)
				Q1	Q2	Q3	Q4	Q5	
LAND	1) Landforms Objective: Conserve the variety and integrity of distinctive physical landforms.	▪ distinctive features in the landscape, either geological or anthropogenic ▪ subterranean karstic terrain and faults ▪ craters, gorges, ranges, caves, massifs, escarpments, plateaus ▪ monuments ▪ tourism related to landforms	▪ The development area is in the Burt Plain Bioregion and is broadly characterised by plains of acacia shrubland, tussock grassland and hummock grassland, acacia and eucalypt woodlands, and mountain ranges in the east, north and west of the bioregion ▪ The site is not in close proximity to National Parks nor high tourism areas.	N/A	N/A	N/A	N/A	N/A	**Potential impacts are not considered significant.** ▪ No key distinctive physical landforms relevant to the development area for the NT EPA 'Landforms' factor.
	2) Terrestrial environmental quality (TEQ) Objective: Protect the quality and integrity of land and soils so that environmental values are supportedand maintained.	▪ good quality soils, including chemical, physical, biological and aesthetic qualities thatsupport life ▪ the biological processes that depend on soil quality	▪ The site is located within the Southeastern Reynolds Range, which lies over the Arunta Province. The Arunta region is a basement inlier with a complex history of sedimentation, magmatism and tectonism. ▪ The surface geology, particularly within the northern parts of the resource area, comprise in-situ derived Quaternary sediments and minor alluvial and Aeolian sand sediments, with minor carbonate deposits. ▪ The dominant soil types within the development area are Rudosols, defined as minimally developed soils, with a generally thin A1 horizon and the occasional minor B horizon in fissures within the underlying parent rock or saprolite. ▪ There are no known areas of contaminated soils within the development area as it has not been previously developed. ▪ There has been limited previous disturbance to the area involving access tracks.	N/A	No	No	No	No	**Potential impacts are not considered significant.** ▪ Environmental values associated with TEQ at the site are highly limited. ▪ There is no known presence of contamination that could be mobilised to air or water during land clearing and construction.
	3) Terrestrial ecosystems Objective: Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	▪ 'sensitive or significant' vegetation or buffers (as defined in the NT Land Clearing Guidelines) ▪ vegetation that provides an important ecological function ▪ listed threatened species and their habitat (NT and Commonwealth) ▪ listed migratory species and their habitat (Commonwealth) ▪ listed threatened ecological communities (Commonwealth) ▪ locally endemic species or species with restricted habitat ▪ species of social, cultural, livelihood and/or economic significance ▪ species that are data deficient and their status is unknown ▪ protected area or reserve, including Indigenous Protected Area	▪ The development area is outside mapped mangroves and rainforests as per ecological surveys. ▪ The development area is outside mapped 'significant vegetation' as per DEPWS Natural Resource Maps (NR Maps) and ecological surveys. ▪ Several threatened fauna species listed under the Territory Parks and Wildlife Conservation Act 2001 (NT) (TPWC Act) with potential to occur within the area and surrounds (GHD 2016). ▪ Targeted surveys in 2010, 2011 and 2015, and NT Atlas records, confirm that Central Australian Rock-wallaby inhabits rocky ranges and hills located within and surrounding the Nolans development area. ▪ Southern Whiteface (*Aphelocephala leucopsis*) is listed a Vulnerable. Previous surveys have recorded Southern Whiteface in the area (GHD 2016). ▪ No protected areas or reserves occur within the vicinity of the development area. ▪ No nominated, provisional or declared heritage places located within, or directly adjacent to, the development area although there is a Traditional Owner Restricted Work Area to the west.	N/A	No	No	No	No	**Potential impacts are not considered significant.** ▪ A desktop threatened species likelihood of occurrence assessment was undertaken (EcOz 2024). No threatened flora species were identified within search area. ▪ Two threatened species (Central Australian Rock-wallaby and the Southern Whiteface) have a reasonable chance of occurring within the development area. Targeted field survey for the Rock wallaby confirmed that the species does not currently inhabit the lease areas, and that critical habitat is not present. Targeted field survey for the Whiteface did not record species presence however it has been recorded in the area. The low quality of habitat and vast areas of surrounding suitable habitat conclude any impacts are not significant. ▪ Pre-disturbance surveys will be conducted. ▪ Clearing of habitat for listed threatened species will be within the cumulative allowance by DCCEEW for the development area, as listed in EPBC 2015/7436 conditions of approval. ▪ Management Plans will be developed. and include controls for introduced species (weeds), biodiversity, waste, as part of the Mining Management Plan supporting documentation.

Theme	Environmental factor and objective	Indicative environmental values and sensitivities relevant to each environmental factor	Summary of key environmental values and sensitivities of relevance to the development areas	Proponent's answer to screening questions 1-5. If answer is 'yes' consider, justify or assess the significance (Yes/ No/ Uncertain or Not Applicable (N/A))					Preliminary evaluation of significance (Nature, scale, context and sensitivity; refer definition provided below table)
				Q1	Q2	Q3	Q4	Q5	
		▪ existing conservation and management activities ▪ introduced species and/or invasive species ▪ integrity of terrestrial ecosystems and the ecological services they provide ▪ biological and functional diversity ▪ provision of refuge ▪ food supply							
WATER	1) Hydrological processes <u>Objective</u>: Protect the hydrological regimes of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	▪ the supply and quantity of water in surface water features including rivers, lakes, wetlands, swamps, creeks, billabongs, intermittent streams, floodplains, mangroves and drainage lines ▪ the supply and quantity of water in groundwater features including aquifers, aquitards and water tables ▪ declared beneficial uses ▪ present and future uses, and users of water ▪ current or potential water supplies, including regional scale aquifers ▪ culturally important water features or other features affected by water level	▪ There are no groundwater bores in the development area. ▪ The development area would only be subject to sheet flow during precipitation events. ▪ The development area is not within a Water Control District.	N/A	No	No	No	No	**Potential impacts are not considered significant.** ▪ No groundwater will be taken during construction activities. ▪ No permanent surface water features within the development area and surrounds. ▪ No mapped groundwater dependent ecosystems or springs and ground-truthed ecological surveys support the mapping. ▪ The development area is outside all use and management control areas. ▪ All activities will be undertaken in a limited disturbance footprint with limited scale and extent. There will be no significant changes to the surfaces and therefore no risk of significantly altering the existing hydrological regime.
	2) Inland water environmental quality <u>Objective</u>: Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	▪ the quality of water in surface water features including rivers, lakes, wetlands, swamps,creeks, billabongs, intermittent streams, floodplains, mangroves and drainage lines ▪ the quality of water in groundwater features including aquifers and water tables ▪ declared beneficial uses ▪ present and future uses and users of water ▪ current or potential water supplies, including regional scale aquifers ▪ potability / drinkability ▪ culturally important water features	▪ No permanent freshwater habitats in or surrounding the development area.	N/A	No	No	No	No	**Potential impacts are not considered significant.** ▪ No groundwater will be taken during construction activities. ▪ No permanent surface water features within the development area and surrounds. ▪ The development area is outside all use and management control areas. ▪ All activities will be undertaken in a limited disturbance footprint with limited scale and extent. There will be no significant changes to the surfaces and therefore no risk of significantly altering the existing hydrological regime. ▪ General construction environmental management controls will be developed and implemented (including erosion and sediment controls).
	3) Aquatic ecosystems	▪ threatened species	▪ Kerosene Camp Creek runs through the proposed mine site and directly across the proposed pit area. This creek is fed via a	N/A	No	No	No	No	**Potential impacts are not considered significant.**

Theme	Environmental factor and objective	Indicative environmental values and sensitivities relevant to each environmental factor	Summary of key environmental values and sensitivities of relevance to the development areas	Proponent's answer to screening questions 1-5. If answer is 'yes' consider, justify or assess the significance (Yes/ No/ Uncertain or Not Applicable (N/A))					Preliminary evaluation of significance (Nature, scale, context and sensitivity; refer definition provided below table)
				Q1	Q2	Q3	Q4	Q5	
	Objective: Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	▪ the health of the biota in inland waterways ▪ the habitats that support the lifecycle of aquatic biota ▪ groundwater dependent ecosystems ▪ Ramsar wetlands ▪ species of social, cultural, livelihood and/or economic significance ▪ integrity of aquatic ecosystems and the ecological services they provide ▪ biological and functional diversity ▪ provision of refuge	number of tributaries. No aquatic fauna have been recorded from the development area. ▪ Kerosene Camp Creek is ephemeral with sporadic flow events. ▪ No inland aquatic habitats (i.e. lakes, wetlands, creeks) present within the development area and surrounds. ▪ No groundwater dependent ecosystems present. ▪ No Ramsar wetlands occur within the vicinity of the development area.						▪ There are no inland aquatic environments within the boundaries of the development area or in close proximity. ▪ With the implementation of standard construction and operational management controls there is little to no identifiable risk to downstream aquatic ecosystems values, should there be any that occur.
SEA	1) Coastal processes Objective: Protect the geophysicaland hydrological processes that shape coastal morphology so thatthe environmental values of the coast are maintained.	▪ processes that support marine ecosystems (see Marine Ecosystems Factor below) such as coral reefs, mangroves, salt marshes, seagrass meadows and sponge gardens ▪ primary productivity ▪ nutrient cycling ▪ carbon storage ▪ climate regulation ▪ conservation significant low lying areas including tidal creeks, deltas and river mouths ▪ storm surge protection ▪ unique coastal landforms ▪ cultural and aesthetic values ▪ active or passive recreation	• NA	N/A	No	No	No	No	**NA**
	2) Marine Environmental Quality Objective: Protect the quality and productivity of water, sediment and biota so that environmental valuesare maintained.	▪ quality of the water, sediment and biota ▪ ecosystem health condition ▪ physical parameters that support fishing and aquaculture ▪ physical parameters that support recreation and aesthetics ▪ industrial water supply ▪ cultural and spiritual values	• NA	N/A	No	No	No	No	**NA**
	3) Marine ecosystems Objective: Protect marine habitats to maintain environmental	▪ conservation significant marine and coastal fauna and critical habitat such as nesting, breeding or foraging habitat ▪ conservation significant marine and coastal benthos, flora and vegetation (seagrass meadows,	• NA	N/A	No	No	No	No	**NA**

Theme	Environmental factor and objective	Indicative environmental values and sensitivities relevant to each environmental factor	Summary of key environmental values and sensitivities of relevance to the development areas	Proponent's answer to screening questions 1-5. If answer is 'yes' consider, justify or assess the significance (Yes/ No/ Uncertain or Not Applicable (N/A))					Preliminary evaluation of significance (Nature, scale, context and sensitivity; refer definition provided below table)
				Q1	Q2	Q3	Q4	Q5	
	values including biodiversity, ecological integrity and ecological functioning.	sponge gardens, coral reefs, mangrove communities and salt marshes) ▪ groups of species (species richness and assemblages of species) ▪ ecological functions and processes ▪ species of social, cultural, livelihood and/or economic significance. ▪ integrity of marine ecosystems and the ecological services they supply ▪ biological diversity ▪ functional diversity ▪ provision of refuge ▪ food supply							
AIR	1) Air quality Objective: Protect air quality and minimise emissions and their impactso that environmental values are maintained.	▪ the chemical, physical and biological characteristics of quality air ▪ the biological processes that depend on the air quality	▪ There are no permanent sources of air pollution in the existing environment.	N/A	No	No	No	No	**Potential impacts are not considered significant.** ▪ Air emissions from vehicles will be localised and temporary (during construction) with no impact on the ambient air quality. ▪ Given the relatively remote location of the site air quality is expected to be good most of the year and the development area would not alter the local or regional quality. ▪ Appropriate dust control measures are considered to be effective in mitigating potential impacts.
	2) Atmospheric processes Objective: Minimise greenhouse gas emissions so as to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050.	• a contribution to the NT's greenhouse gas emissions • adaptation to a changing climate • capacity of communities and country to respond or adapt to climate change	▪ Emissions from the development area will be minimal in a local scale greenhouse emissions context.	N/A	No	No	No	No	**Potential impacts are not considered significant.** ▪ Increase in greenhouse gas emissions associated with development related vehicle movements and construction will be minimal and certainly not significant. ▪ The development area would not exceed trigger values in the large emitter policy.
PEOPLE	1) Community and economy Objective: Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.	▪ dwellings, homelands, communities, towns and suburbs where people live ▪ liveable environment ○ good amenity – air quality, noise, aesthetics ○ access to natural resources including bush food ○ recreational use of the natural or built environment (e.g.	▪ Enhancement to communities and businesses as discussed in the EIS Economic Impact Report and Social Impact Assessment, and MMP Territory Benefits Plan	N/A	No	No	No	No	**Potential impacts are not considered significant.** ▪ The are no existing commercial operations in the ▪ development area or that will be negatively impacted by the development. ▪ Community and amenity benefits from the mines development as referenced in the EIS and MMP

Theme	Environmental factor and objective	Indicative environmental values and sensitivities relevant to each environmental factor	Summary of key environmental values and sensitivities of relevance to the development areas	Proponent's answer to screening questions 1-5. If answer is 'yes' consider, justify or assess the significance (Yes/ No/ Uncertain or Not Applicable (N/A))					Preliminary evaluation of significance (Nature, scale, context and sensitivity; refer definition provided below table)
				Q1	Q2	Q3	Q4	Q5	
		fishing, cycling, sports, picnics) ○ access to social infrastructure and services including transport and logistics ▪ Healthy lifestyles ○ sense of wellbeing ○ good mental health ○ community aspirations ▪ Financial security ○ affordable access to food, water, electricity, transport and communication networks ○ livelihoods ▪ participation in jobs, businesses and education ▪ existing industries such as agriculture, pastoralism, tourism, fisheries ▪ vulnerable sectors of the community ▪ connections to culture and community (that are not explicitly protected under culture and heritage legislation addressed in the Culture and heritage factor) ○ Aboriginal rights and interests, including right of access ○ cultural practices ○ sense of belonging, inclusion, connectedness and cohesion ○ healthy social relationships						
	2) Culture and heritage <u>Objective</u>: Protect sacred sites, culture and heritage.	▪ sacred sites ▪ historic heritage and places ▪ world heritage	▪ Anthropology surveys of the area have been completed and there are no sites of significance in the development area. Therefore, the potential to encounter previously unidentified heritage sites is very low. ▪ There are no significant European heritage sites within or in the vicinity of the site. ▪ There are no world heritage areas in or near the site.	N/A	No	No	No	No	**Potential impacts are not considered significant.** ▪ There are no Aboriginal sites of significance within the development area.

Theme	Environmental factor and objective	Indicative environmental values and sensitivities relevant to each environmental factor	Summary of key environmental values and sensitivities of relevance to the development areas	Proponent's answer to screening questions 1-5. If answer is 'yes' consider, justify or assess the significance (Yes/ No/ Uncertain or Not Applicable (N/A))					Preliminary evaluation of significance (Nature, scale, context and sensitivity; refer definition provided below table)
				Q1	Q2	Q3	Q4	Q5	
	3) Human health Objective: Protect the health of the Northern Territory population.	▪ drinking water ▪ recreational water ▪ air quality ▪ bush tucker ▪ radiological limits ▪ biting insects	▪ The site is not within a Public Drinking Water Area. ▪ Air quality in the area is anticipated to be relatively unimpacted from anthropogenic activities (i.e., no point source emissions as part of the development in the development area) ▪ Biting insects are prevalent on a seasonal and diurnal basis.	N/A	No	No	No	No	**Potential impacts are not considered significant.** ▪ The development area works are not expected to cause a significant long-term change to the existing activities/uses of the area and are therefore unlikely to impact on human health.

2.3 Definition of 'Significant Impact'

The Northern Territory Environment Protection Act 2019 (EP Act) defines a significant impact as:

> *"A significant impact of an action is an impact of major consequence having regard to:*
>
> *(a) the context and intensity of the impact; and*
>
> *(b) the sensitivity, value and quality of the environment impacted on and the duration, magnitude and geographic extent of the impact".*

The NT EPA guidance on referral of a proposal (NTEPA, 2021a) outlines how the NT EPA determines that environmental impact assessment of a proposal is not required. The NT EPA will consider the proposal in terms of its potential for significant environmental impacts. In its consideration, the NT EPA will examine:

- Context and intensity of the impact
- Duration, magnitude and geographic extent of the impact and
- Sensitivity, value and quality of the environment impacted on.

Environmental impact assessment is unlikely to be required where:

- The type of proposal is not considered hazardous in nature.
- Environmental impacts from activities associated with a proposal are readily understood.
- The potential impacts are limited in extent and duration.
- Environmental values and sensitivities are not present or are unlikely to be significantly impacted by proposed activities.
- Impact mitigation is readily available and proven to be effective in limiting significant impacts to the environment.
- Relevant stakeholders have been identified and engaged.

The proposed Arafura Explosives Magazine, gravel pits, and the activities undertaken to support the proposal are considered to align with the above Significant Impact criteria.

Section 3 Commonwealth Government - Matters of National Environmental Significance Screening

Under the EPBC Act an action will require approval from the Commonwealth Minister if the action has, will have, or is likely to have, a significant impact on a Matter of National Environmental Significance (MNES). The Project currently has a licence under the EPBC Act however a variation is required to reflect the development areas listed (i.e., explosives magazine, gravel pits and site access) and the associated revised development boundaries. A search of the Commonwealth Protected Matters Search Tool (PMST) was undertaken for the development areas (DCCEEW 2023). A summary of the results of the PMST are provided in Table 3-1 and Table 3-2. The full PMST results are provided in Appendix C. The MNES relevant to the development areas included listed threatened species and listed migratory species. An assessment of the likelihood of these threatened and migratory species to occur on site and an assessment of the action against Significant Impact Guidelines 1.1 criteria was undertaken.

Table 3-1 Matters of National Environmental Significance (5km buffer)

Matters of National Environmental Significance	Relevant	Description
World Heritage Properties	No	There are no world heritage properties in close proximity to the development area.
National Heritage Properties	No	There are no national heritage places in close proximity to the development area.
Wetlands of international importance/Ramsar wetlands	No	There are no wetlands of international importance / Ramsar wetlands in close proximity to the development area.
Great Barrier Reef Marine Park	No	The development area is not within the Great Barrier Reef Marine Park.
Commonwealth Marine Area	No	The development is not located within a Commonwealth marine area.
Nationally Threatened Ecological Communities	No	No threatened ecological communities have been identified in the development area and none are considered likely to occur.
Nationally Threatened Species	Yes	The PMST identified 12 threatened species as potentially occurring within the development area (refer to **Error! Reference source not found.**). No threatened flora or threatened ecological communities were identified on the development area.
Migratory Species	Yes	The development area is not listed on the Ramsar Convention, in which Australia has entered into international agreements to protect the breeding and summer grounds of migratory birds. A PMST showed there were nine (9) migratory species with the potential to occur within the development area (refer to **Error! Reference source not found.**A).
Nuclear Actions (including Uranium Mining)	No	Not applicable
A water resource, in relation to coal seam gas development and large coal mining development	No	Not applicable

Table 3-2 Likelihood of Occurrence of Threatened Species in the PMST

Common Name	Scientific Name	EPBC Status	Potential Occurrence	Species Summary
Birds				
Southern Whiteface	*Aphelocephala leucopsis*	V	Known	There are proximate records, including those from baseline studies. Suitable habitat is present within the development area, and the broader region. The development area could be used for foraging purposes; however, habitat is of marginal quality due to cattle grazing and fire impacts, and there are ample areas outside of the development area that also provide suitable foraging grounds. Potential habitat for roosting / nesting was not observed and is considered unlikely to occur within the proposed disturbance footprints due to absence of tree species that typically support tree hollows and crevices.
Sharp-tailed Sandpiper	*Calidris acuminata*	V, M	Low	Species requires wetland habitat which is not present within or adjacent to development area. No proximate records.
Curlew Sandpiper	*Calidris ferruginea*	E, M	Low	Species requires wetland habitat which is not present within or adjacent to development area. No proximate records.
Red Goshawk	*Erythrotriorchis radiatus*	V	Low	The development area is outside of known distribution in the Northern Territory. The development area does not support preferred habitat for the species (species prefers tall open Eucalyptus Forest and riparian areas. No proximate records.
Grey Falcon	*Falco hypoleucos*	V	Low	Species usually nests in the tallest trees along watercourses, particularly River Red Gum and Coolabah, and telecom towers. Foraging habitat is present within the development area (however foraging habitat is widespread and not specific to an area – hunting areas typically occur in response to small bird flocks)
Night Parrot	*Pezoporus occidentalis*	E	Low	Spinifex habitat on rocky hills could provide suitable roost habitat; however, fire history in the area has likely reduced habitat suitability (Night Parrot requires long unburnt areas of Spinifex for roosting in particular Bull Spinifex *Triodia longiceps* [DOE 2017; Murphy 2017] which is not known to occur in the area).
Princess Parrot, Alexandra's Parrot	*Polytelis alexandrae*	V	Low	There is no suitable breeding / nesting habitat within the development area (i.e., Marble Gum, River Red Gum and occasionally Desert Oak).
Australian Painted Snipe	*Rostratula australis*	E	Low	Species requires wetland habitat which is not present within or adjacent to development area. No proximate records.

Common Name	Scientific Name	EPBC Status	Potential Occurrence	Species Summary
Mammals				
Ghost Bat	*Macroderma gigas*	V	Low	The species has not been recorded in the southern NT since the early 1960s and is presumed to be regionally extinct/extirpated.
Warru, Central Australian Rock-wallaby	*Petrogale lateralis centralis*	V	Known	Numerous records in the general area. Previous targeted surveys in 2015 and 2022 did not detect the species within the current development area (noting that not all areas were checked). Potential for suitable habitat within the current development area (i.e. rocky hills) (requires site assessment to confirm habitat suitability). The isolated nature of the rocky hills within the current development area may reduce habitat suitability due to increase predation pressure from surrounding plains (cat and fox are known to occur in the area).
Central Rock-rat, Antina	*Zyzomys pedunculatus*	CE	Low	Species occurs in high altitude rugged quartzite peaks (now only known to occur in the MacDonnell Ranges to the south of the development area) (McDonald 2012) which is not supported within the development area or surrounds.
Reptiles				
Great Desert Skink, Tjakura, Warrarna, Mulyamiji, Tjalapa, Nampu	*Liopholis kintorei*	V	Low	Species occurs in high altitude rugged quartzite peaks (now only known to occur in the MacDonnell Ranges to the south of the development area) (McDonald 2012) which is not supported within the development area or surrounds.

3.1.1 Migratory Species

Nine listed migratory birds (two threatened) have been listed under EPBC.

Under the EPBC Act, 'important habitat' is identified in EPBC Act Policy Statement 1.1 Significant Impact Guidelines – Matters of National Environmental Significance (DoE 2015a). Important habitats in Australia for migratory birds under the EPBC Act include those recognised as nationally or internationally important (DoE 2015b). Under the guidelines, habitat should be considered internationally important if it regularly supports:

- 1 percent (%) of the individuals in a population of one species or subspecies of waterbird; OR
- A total abundance of at least 20,000 waterbirds.

Nationally important habitat for migratory shorebirds can be defined using a similar approach to these international criteria, i.e. if it regularly supports:

- 0.1 % of the flyway population of a single species of migratory shorebird; OR
- 2000 migratory shorebirds; OR
- 15 migratory shorebird species.

Based on surveys conducted there is no suitable habitat within the development areas for these birds.

Section 4 Management Measures and Controls

Both desktop and field based studies have informed the self-assessment. The self-assessment assumes the accuracy of the information obtained in the field studies and is predicated on implementing both standard management and control measures, and those recommended in technical studies.

The Nolans Construction Materials Mining Management Plan (NRE-0000-O-PLN-O-0002 Rev 1.3) provides the overarching governance for management measures and controls for the development areas.

The compilation of specific measures that should be implemented are presented below. If the development inclusions or extents change, or the following management measures cannot be implemented, the conclusions in this self-assessment should be reviewed for accuracy:

- A site-specific Erosion and Sediment Control Plan shall be developed prior to undertaking any works in accordance with the MMP commitments and Mining Authorisation 1127-01.
- Follow the approved Biodiversity Management Plan to protect the Rock Wallaby, which includes regular species monitoring, the monitoring of access roads, and reduced driving speeds at night to minimise impacts on the species.

Section 5 References

Department of Environment, Parks and Water Security (2021). NR Maps Natural Resource Maps. Accessed March 2024. http://nrmaps.nt.gov.au/nrmaps.html

Department of Environment, Parks and Water Security (2022). NR Maps Natural Resource Maps. Accessed March 2024. http://nrmaps.nt.gov.au/nrmaps.html

Department of Environment (2017) Pezoporus occidentalis. Species profile and Threats Database. Department of the Environment, Canberra

Department of Environment (DoE) (2015a) Significant Impact Guidelines 1.1 – Matters of National Environmental Significance, Commonwealth of Australia. Available from: https://www.dcceew.gov.au/sites/default/files/documents/nes-guidelines_1.pdf

Department of Environment (DoE) (2015b) Draft referral guideline for 14 birds listed as migratory species under the EPBC Act, Commonwealth of Australia. Available from: https://www.agriculture.gov.au/sites/default/files/documents/migratory-birds-draft-referral-guideline.pdf

Department of Environment (DoE) (2015) Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species, Commonwealth of Australia. Available from: https://www.agriculture.gov.au/sites/default/files/documents/bio4190517-shorebirds-guidelines.pdf

Department of Environment, Parks and Water Security (2022). NR Maps Natural Resource Maps. Accessed March 2024. http://nrmaps.nt.gov.au/nrmaps.html

Falkenberg IS (2011) Aspects of the ecology of the Grey Falcon Falco hypoleucos in the South Australian arid zone. Corella 35. 23-28

Garnett, S., Szabo, J. and Dutson, G. (2011). The Action Plan for Australian Birds 2010. CSIRO Publishing. Available from: http://birdsindanger.net/taxatable.

McDonald 2012 P (2012). Threatened species of the Northern Territory – Cantral Rock-rat Zyzomys pedunculatus. Northern territory Government Department of Environment and Natural Resources (DENR)

Murphy SA, Paltridge R, Silcock J, Murphy R, Kutt AS and Read J (2017). Understanding and managing the threats to Night Parrots in south-western Queensland. The Emu – Austral Ornithology 117, 135-145.

Northern Territory Environment Protection Authority (NTEPA), 2021a. Referring a Proposal to the NT EPA: Environmental impact assessment, Guidance for proponents (version 1.0). Darwin, Northern Territory, Australia.

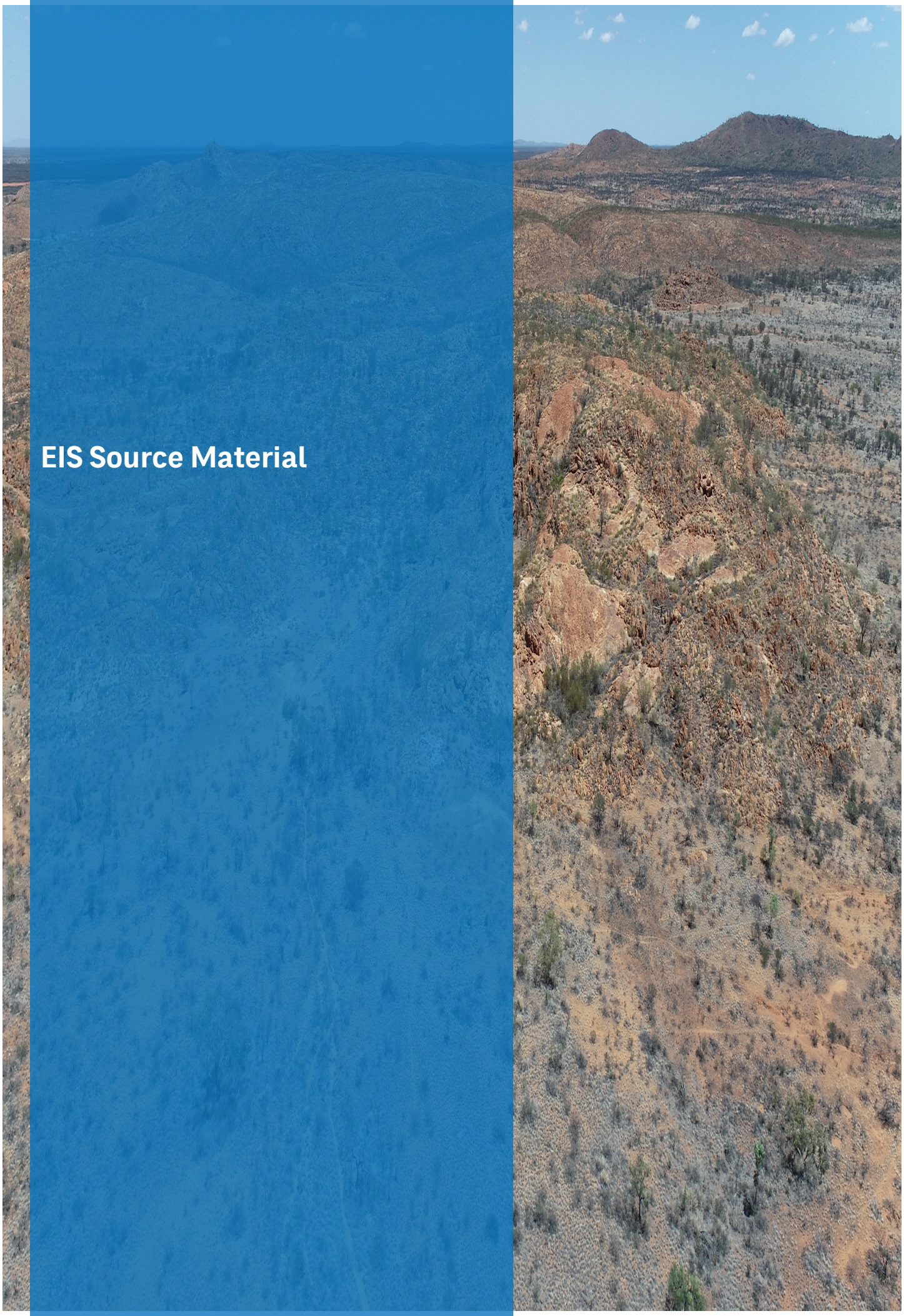
Northern Territory Environment Protection Authority (NTEPA), 2021b. NT EPA Environmental Factors and Objectives: Environmental impact assessment General Technical Guidance (version 2.0). Darwin, Northern Territory, Australia.

Pavey C (2006), Threatened species of the Northern Territory – Night Parrot Pezoporus occidentalis. Northern territory Government Department of Environment and Natural Resources (DENR)

Southgate R (1990) Habitat and diet of the Greater Bilby Macrotis lagotis Reid (Marsupalia: Peramelidae). In: Seebeck et al (eds) Bandicoots and Bilbies. Surrey Beatty & Sons, Sydney, NSW.

Woinarksi J (2006), Threatened species of the Northern Territory – Red Goshawk Erythrotriorchris radiatus. Northern territory Government Department of Environment and Natural Resources (DENR)

EIS Source Material



EIS Source Material

In the EIS the explosives magazine was proposed to be located near the southwest corner of WRD 1 (as shown in EIS Figure 3-1 as a small orange square.) The location of the borrow pits were not specified, though the EIS stated that a range of raw material requirements for construction and operations, including gravel, would be sourced "either from within or near the Nolans site." Subsequent to approvals under both Acts, the locations of the gravel pits and explosives magazine (i.e. the development area) have been confirmed. Inclusion of the explosives magazine and gravel borrow pits are located in the below sections of the EIS.

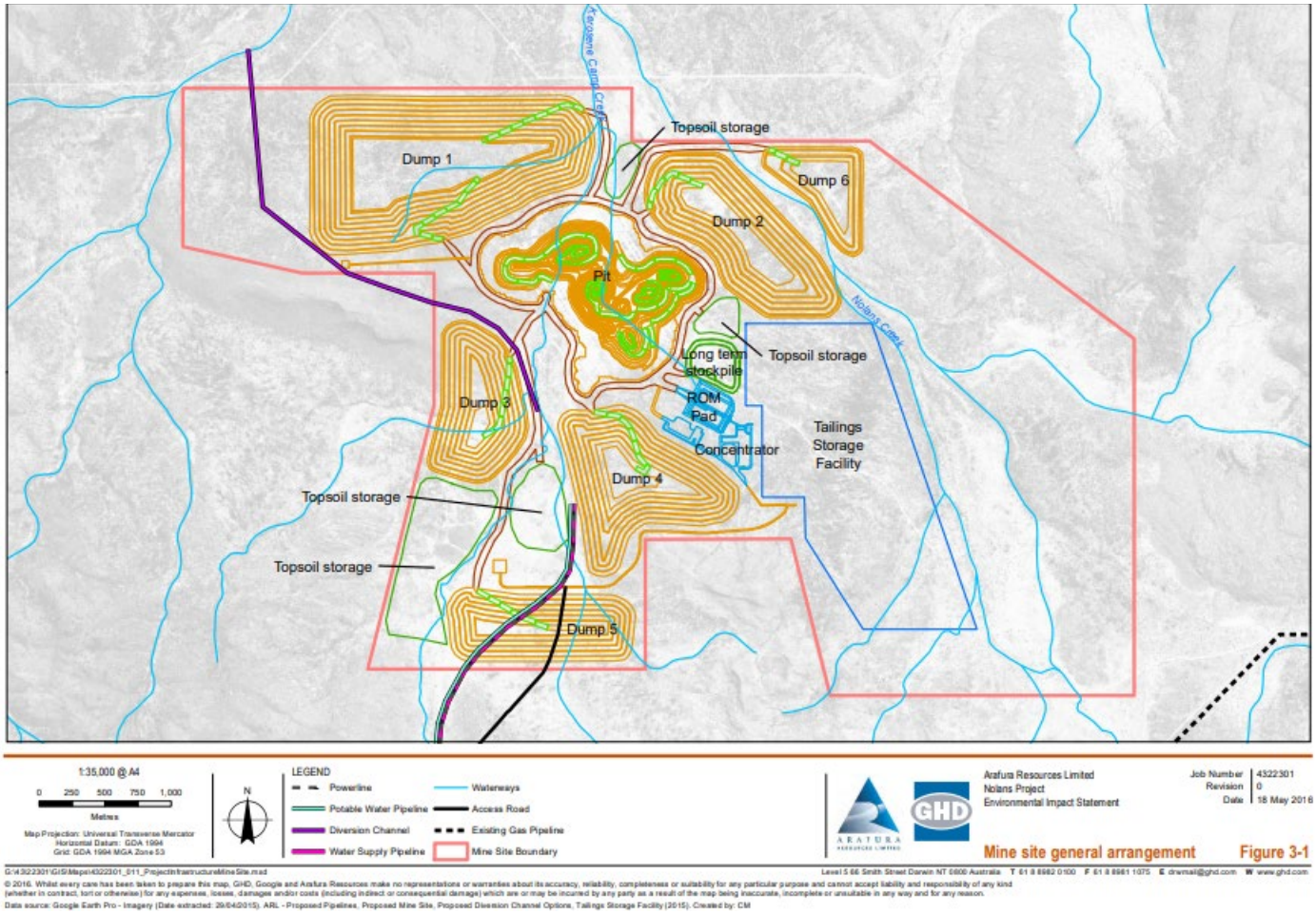
Explosives magazine

3.5.5 Mining methodology

Drill and blast will be required for both ore and waste with design powder factors ranging from around 0.40 kg/BCM for oxide mineralisation and waste to around 0.60 kg/BCM for fresh mineralisation and waste. Blasthole drilling will be carried out by 89mm blasthole drills. All blasting will be undertaken using emulsion explosives selected mainly for its water resistance and resultant reduced drilling cost. The bulk emulsion explosives are delivered by a sub-contractor as a down-the-hole service which is the supply of bulk explosives on the bench.

All final design batters and interim walls will be pre-split drilled and blasted with specialised packaged explosives.

The sub-contractor's explosives plant will be located south of WRD 3 and north of WRD 5 as shown in Figure 3-1. An explosives magazine will be located near the south west corner of WRD 1.



Gravel Borrow Pits

3.4.3 Sources of construction materials

A preliminary geotechnical site investigation was carried out by Knight Piésold Pty Ltd (2014) to evaluate foundation conditions and identify potential material borrow sources for the Nolans site infrastructure. This survey investigated a number of locations with 30 km of the Nolans site to assess construction material. Some of the sites investigated are sites used previously for highway construction or road construction on Aileron Station. Prior to project construction further geotechnical investigation will be undertaken and construction materials investigation completed. Any required regulatory approvals to source these materials for construction purposes (i.e. associated with extractive minerals title processes) will be sought prior to construction. Wherever possible the company intends using material from the pit pre-strip as construction material.

Interpretation of site conditions is based on the sub surface lithology revealed during the investigation program which included visual assessment of the in situ materials, the results of in situ field tests, and the results of laboratory testing carried out on selected representative samples collected during the fieldwork.

The geotechnical site investigation identified borrow material for earthworks construction within 30 km of the mine site, and these are summarised in Table 3-2.

Table 3-2 Summary of borrow materials

Material Type	Description	Location
Zone A	Low permeability material, generally greater than 30% fines and a PI of 8 or more.	Two possible source areas, within the pit area and to the south east of the TSF.
Zone C	Granular material (sandy gravel) with a fines content typically of 15 % to 20 %.	This material will be won from the overburden in the pit or by selective excavation from the WRD.
Zone F	Sand with less than 5% fines.	Two possible source areas, within creeks and imported from a local quarry.
Base Course	Granular material (sandy gravel) with a fines content typically of 15% to 20%	Two possible source areas, Native Gap road quarry and imported from a local quarry.
Road Aggregate	14 mm high strength stone.	One possible source area, imported from a quarry in Alice Springs.
Concrete	Variable properties but generally 40 N/mm^2	Proposed onsite batching plant during construction.

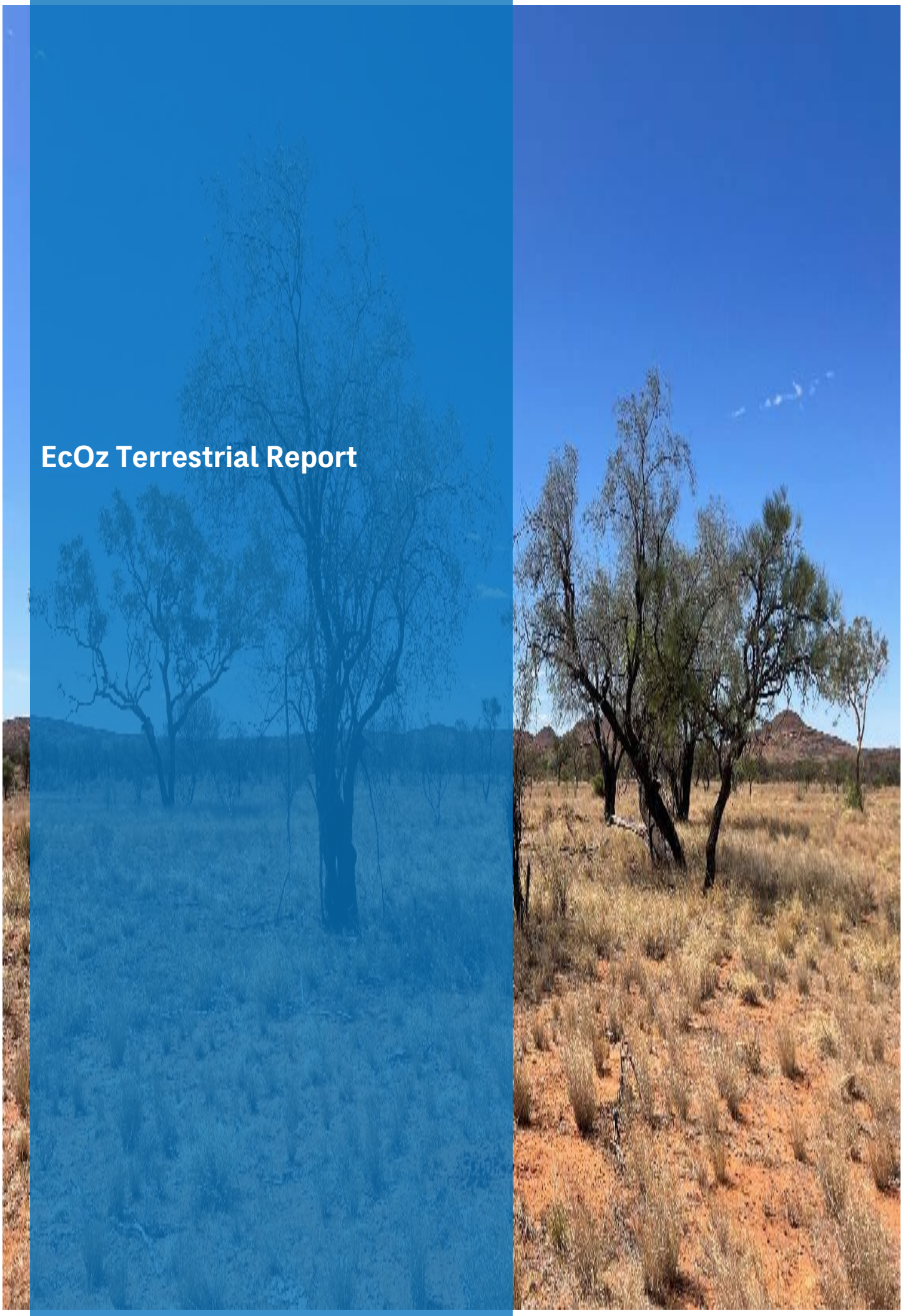
4.3.6 Raw materials supply

The project has a range of raw material requirements for construction and operations. It is intended that the bulk of the raw materials, which includes rock, gravel, sand, topsoil and carbonate material, will be sourced either from within or near the Nolans site.

Rock will be selected during the initial pre-strip of the pit for use in various aspects of construction. Care will be taken to ensure this material is benign in terms of its chemical composition and radionuclide concentrations.

Gravel material will be sourced from an old road construction quarry on the Stuart Highway about 25 kilometres from the processing plant, or from a local source on Aileron Station about 12 kilometres from the plant. Prior to this occurring the necessary regulatory approvals will be sought. Other gravel for cement manufacture will be transported to site from quarries near Alice Springs.

EcOz Terrestrial Report



EPBC Search



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 18-Mar-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	12
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	3
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Status of Conservation Dependent and Extinct are not MNES under the EPBC Act. Number is the current name ID.		
Scientific Name	Threatened Category	Presence Text
BIRD		
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
MAMMAL		

Scientific Name	Threatened Category	Presence Text
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area
Petrogale lateralis centralis		
Warru, Central Australian Rock-wallaby [90831]	Vulnerable	Species or species habitat known to occur within area
Zyzomys pedunculatus		
Central Rock-rat, Antina [68]	Critically Endangered	Species or species habitat may occur within area
REPTILE		
Liopholis kintorei		
Great Desert Skink, Tjakura, Warrarna, Mulyamiji, Tjalapa, Nampu [83160]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis		
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Chalcites osculans as Chrysococcyx osculans		
Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Nolans Rare Earth Project, NT	2015/7436		Post-Approval
Controlled action			
Development of Rare Earth Oxide and Phosphate Mine at Nolans Mine Site	2008/4371	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Not controlled action			
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Kerosene Camp Creek Management Plan

Interference with a waterway - Kerosene Camp Creek

PREPARED FOR:

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Document history & status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
RevA	20/02/24	Stacey Kopf	Stacey Kopf	01/03/2024	RevA
RevB	13/09/24	Paul Davey	Stacey Kopf	16/09/24	RevB

Distribution of copies

Version	Date issued	Quantity	Electronic	Issued to
RevA	01/03/2024	1	Word Doc	Arafura
Rev01	16/09/2024	1	Word Doc	Arafura

Last Saved:	16 September 2024
File Name:	Kerosene Camp Creek Management Plan
Author:	Elizabeth Reynolds
Project Manager:	Stacey Kopf
Client:	Arafura Resources Limited
Document Title:	**Interference with a waterway - Kerosene Camp Creek**
Document Version:	001
Project Number:	1001541

Section 1 Introduction

1.1 Objective

The objective of this Management Plan is to satisfy an application for a Permit to Construct or Alter Works (the Permit) under the *Water Act 1992* for the diversion of Kerosene Camp Creek (KCC). The KCC Diversion Management Plan (GHD, 2017 SEIS Appendix 14) is part of a series of Environmental Management Plans that together form the Environment Management System for the Nolans Project.

1.2 Planning

The diversion of KCC (the Project) is intended to prevent the inundation of the Nolans Mine open-cut mining areas in the event of a major flood event by diverting flows from the upstream reaches of KCC to an adjacent unnamed tributary of KCC, while minimising the downstream impacts on KCC and the surrounding environment.

The Project is located within the Burt Plain Bioregion and is characterised by intermittent rainfall and ephemeral waterways. The environmental baseline of the region has been detailed in the Permit Application and supporting Appendices.

1.3 Approach

This report uses the KCC Diversion Management Plan (GHD, 2017, SEIS Appendix 14) with updated information, design plans and technical reports to support the application for a Permit to Construct or Alter Works under the *Water Act 1992*. This report was informed by the Kerosene Camp Creek Risk Assessment (Appendix B of the Permit Application) and based on public data and existing information provided by Arafura summarised in the Desktop Review (Appendix F of the Permit Application).

1.4 Design

In alignment with the Nolans Mine Environmental Impact Statement (EIS) and supporting documents, Arafura commissioned a preliminary design plan from Pells Sullivan Meynink (PSM) found in Appendix A of the Permit Application. The design addresses Recommendation 7 of the *EIS Assessment Report 84 (NT EPA)* to provide flood mitigation and maintain the environmental values of the catchment.

The design criteria for the Kerosene Camp Creek diversion incorporates:

- A stable channel, which is unlikely to undergo significant geomorphic change over time,
- Sediment transport comparable to its natural flow,
- The need for ongoing maintenance where possible, and
- Sufficient capacity to convey the estimated peak flow from the 0.1 % AEP storm event.

Section 2 Implementation

The Implementation criteria covered in this Section of the KCC Management Plan includes updated management and implementation programs aligned with the 2017 GHD Diversion Management Plan (SEIS, Appendix 14).

2.1 Construction

The management of upstream runoff is an important component of the construction of the diversion works.

If construction commences during the wet season, temporary diversions will be constructed upslope of the diversion to redirect flows around active work areas. Temporary diversions will be constructed and stabilised in a manner to minimise erosion. A temporary dam will be constructed at the downstream end of the diversion to prevent the discharge of sediment laden water from the works area into the downstream environment.

Once construction of the creek diversion has been completed the temporary diversion will be backfilled and the downstream dam removed. Erosion and sediment controls that are to be implemented throughout the construction period include:

- Check dams within the temporary diversions and permanent creek diversion to slow flow velocities and encourage sediment accretion; and
- Clean water diversion drains to divert runoff around the works area.

2.2 Revegetation

The revegetation of the land disturbed will be undertaken progressively to minimise prolonged environmental impacts. Arafura will undertake works necessary to repair and rehabilitate any diversion that does not meet performance standards outlined in the Environmental Management Plan System approved as part of the Nolans Project EIS.

Revegetation of the land disturbed by diversion works will be undertaken in three stages:

- Stage one will include:
  - Spreading of topsoil and the establishment of a cover crop (grasses) to stabilise exposed surfaces and minimise sediment generation during rainfall events,
  - Direct seeding and planting of native vegetation within defined vegetation zones.
- Stage two will include:
  - Ongoing removal of weeds and supplemental seeding and planting where necessary,
  - Identification and undertaking of remedial actions (if any).
- Stage three will include:
  - An evaluation of the revegetation, with stage two repeated as necessary.

As soon as practical diversion works will be revegetated with suitable native species, with a preference for:

- Locally endemic species, and

- Fast-growing species that allow for rapid soil cover and erosion protection.

2.3 Communication

All personnel will be made aware of this Management Plan during site inductions. Workforce communication days and toolbox talks will be incorporated into general meetings to reinforce the commitments outlined in this Plan.

2.4 Review

The Mine Manager is responsible for the reporting of any significant findings regarding the implementation of the Plan.

This Plan will be reviewed:

- Every three years,
- Following an independent environmental audit, with findings relevant to this Plan,
- Following an environmental incident or community complaint relevant to the control measures outlined in this Plan, or
- Following relevant outcomes from a risk assessment or change management process. If any significant modifications to the Plan are required as an outcome of the review, relevant government agencies will be consulted regarding the changes.

Section 3 Management Plan

The Implementation criteria described in Section 2 are summaries in a KCC Management Action Plan (Table 3-1) identifying the primary activity to be managed, potential impact, mitigating factor and management action. The Management Action Plan (Table 3-1) can be used to measure and evaluate performance and compliance with the series of Environmental Management Plants that together form the Environment Management System for the Nolans Project.

Table 3-1 KCC Management Action Plan

Primary Activity	Potential Impact	Mitigating Factors	Management Action
All operational activities	Erosion	The region experiences long periods of minimal rainfall	▪ Implementation of the Erosion and Sediment Control Plan (ESCP) (GHD 2016, Appendix X-L), including: – Staged clearing of vegetation to minimise areas of bare ground and clear land only as required and in accordance with ESCP. ▪ Implement the Mine Closure Management Plan to rehabilitate KCC (GHD 2016, Appendix W). ▪ Implement repair and reinstatement works to address identified erosion. ▪ Separate and stockpile topsoil during excavation for reuse as part of reinstatement. ▪ Reinstate original soil profiles following disturbance. Subsoil material shall not be left exposed, particularly in areas with dispersive clay subsoils. ▪ Where high-risk areas are disturbed, or subject to ongoing erosion issues, seek specialist input into repair and stabilisation methods. Stabilisation may require soil amelioration, seed and fertiliser application, temporary stabilisation and or engineering controls. ▪ Minimise the length and duration of disturbance. Clearly establish work area boundaries to avoid unnecessary disturbance. ▪ Use existing access tracks only.

Primary Activity	Potential Impact	Mitigating Factors	Management Action
All operational activities	Biodiversity – flora and vegetation Diversion of the old channel resulting in loss of overland and subsurface flow, riparian areas and impact on ecological communities and riparian areas.	The disturbance areas are established and regularly maintained. Works are limited to within the access areas and designated disturbance areas. No known threatened flora species are in the area of disturbance.	Implement the Biodiversity Management Plan (GHD 2016, Appendix X-D), including: Plans to minimise vegetation clearing where possible, particularly within sensitive vegetation communities. Where possible apply buffer widths recommended by the Northern Territory Land Clearing Guidelines in riparian areas. Procedures for demarcating the limits of clearing, and no-go areas. Use of already-disturbed areas (rather than undisturbed areas) wherever possible (e.g. lay down areas for construction). Staged clearing of vegetation to minimise areas of bare ground and clear land only as required and in accordance with ESCP. Avoid land clearing for construction during the wet season. Develop and implement Vegetation Clearing sub plans which include areas not to be cleared (no-go areas). Development and implementation of a land stabilisation and revegetation strategy Weed removal prior to vegetation clearing so that vegetative material would be clean and able to be mulched and reused directly on site. Implementation of the Weed Management Plan (GHD 2016, Appendix X-M) for mitigation measures to control existing exotic vegetation, and to stem the spread of others. Implementation of the Water Management Plan (GHD 2016, Appendix X-L), including: Design the outlet to have a similar gradient to the existing and reduce the angle at which the diversion enters the natural channel. Support the recolonisation of riparian vegetation along the new water course.

Primary Activity	Potential Impact	Mitigating Factors	Management Action
Construction	Revegetation Disturbance during work will cause significant damage to the vegetation along Kerosene Camp Creek.	The disturbance areas are established and regularly maintained. Works are limited to within the access areas and designated disturbance areas. No known threatened flora species are in the area of disturbance.	Revegetation of land disturbed by diversion works will be undertaken progressively to stabilise surfaces, minimise sediment generation, direct seeding and planting within defined zones, and weed removal. Where practical, diversions will be revegetated with suitable native species, with a preference for locally endemic species and fast-growing species.
Construction	Cultural Heritage Site establishment (including vegetation clearing) results in physical disturbance of sites/objects of heritage significance, heritage items or places and/or sacred sites. Breach of access protocols.	No known items of historic heritage significance occur within the disturbance area. Access to the site is restricted to essential works only. Works are limited to within the designated disturbance area.	Identification of historic and cultural heritage sites and mitigation requirements as part of any Project related WHS induction to staff, contractors and other relevant personnel. Implementation of the Cultural Heritage Management Plan (CHMP) (AHMS 2016), including: Undertake further cultural heritage assessments prior to carrying out any works within areas that have not been previously disturbed or that are outside of the Project area. This assessment may range in complexity from a JHEA to a detailed specialist assessment, dependent upon the location and nature of the work. Undertake activities only within the approved disturbance areas. Minimum buffer distance of 50m surrounding identified archaeological sites and/or sacred sires Consultation and engagement with Traditional Owners and custodians. Work will be in accordance with agreed process with Traditional Owners. Obtain access permit from the Central Land Council prior to entering Aboriginal land. Undertake activities in accordance with AAPA Authority Certificates and CLC Sacred Sites clearance certificate. Compliance with Ground Disturbance Permit System, in the Nolans Project Biodiversity Management Plan (GHD 2016). If a Cultural Heritage find occurs implement the Arafura Resources Unexpected Finds Procedure.

Primary Activity	Potential Impact	Mitigating Factors	Management Action
All operational activities	Cultural Heritage Disturbance of previously unidentified of sites/objects of heritage significance, artefacts, and skeletal remains.	No known items of historic heritage significance occur within the disturbance area. Access to the site is restricted to essential works only. Works are limited to within the access areas and designated disturbed areas.	Identification of historic and cultural heritage sites and mitigation requirements as part of any Project related WHS induction to staff, contractors and other relevant personnel. Implementation of the CHMP (AHMS 2016), including: Pre-clearing/disturbance visual investigations (completed - archaeological surveys undertaken to inform the EIS). Heritage assessments are to be undertaken prior to carrying out any works within areas that have not been previously disturbed or that are outside of the Project area. This assessment may range in complexity from a JHEA to a detailed specialist assessment, dependent upon the location and nature of the work. Consultation and engagement with Traditional Owners and custodians. Undertake activities only within the approved disturbance areas. If a historic heritage find occurs implement the Arafura Resources Unexpected Finds Procedure.

Primary Activity	Potential Impact	Mitigating Factors	Management Action
Vegetation management	Unauthorised impacts on fauna and flora. Soil Erosion Contamination/impacts to livestock.	The disturbance areas are established and regularly maintained. Works are limited to within the access areas and designated disturbance areas. No known threatened flora species are in the area of disturbance.	Undertake vegetation management only within approved access areas. Refer to alignment sheets and or survey plans to positively identify the approved clearing boundaries. Minimise disturbance to vegetation adjacent to waterways and drainage lines. Retain vegetation in these areas where possible. Refer to the CHMP (AHMS 2016). Minimise disturbance to groundcovers. Set grader blades to an appropriate height to retain as much ground cover as possible. Avoid disturbance to existing erosion control berms. Reinstate damaged or degraded berms. Retain cleared vegetation matter on-site to provide ground cover. Re-spread along the creek line. Seek further advice if planning works in areas that have fauna habitat present (nests, hollows, large trees, burrows), have not been regularly maintained, or contain known significant plants or animal species. Additional permits and mitigation measures may be required. Retain significant flora species and habitat features where possible / required. **Herbicide** Review land access requirements for chemical use prior to application. Consult with landholders where required to clarify requirements on herbicide usage and potential impacts on livestock. Where herbicide use occurs, maintain a record of usage as required under the Agricultural and Veterinary Chemicals Act. Herbicide application only by licenced and trained operators as per Act.

Primary Activity	Potential Impact	Mitigating Factors	Management Action
All operation activities	Spread of declared weeds and biosecurity matter	Access to the site is restricted to essential works only. Vegetation and weed management activities occur within the clearance site.	Manage the spread of weeds and biosecurity matter in accordance with Arafura's Weed Management Plan (GHD 2016, Appendix X-M). Implement site and landholder-specific hygiene measures. Prior to entering a 'clean' area/site or exiting an infested area/site the clean-in clean-out principle shall apply. This includes as a minimum: Wash down all mobile plants (including vehicles, machinery and portable equipment or infrastructure) with either compressed air or water at a designated wash-down bay/area and ensure all soil and vegetative material has been removed; Ensure clothing and footwear is free of soil and vegetative material (wash or brush-down personnel items); If required to address a specific biosecurity hazard, use cleaning chemicals to ensure sterilisation during wash-down (e.g. Phytoclean or methylated spirits). Undertake targeted weed control where required to meet statutory obligations. Control activities should be undertaken in conjunction with landholder / third-party stakeholder control programs. Record and notify any new declared weed infestation sightings.
All operation activities	Land and/or water contamination from oil, fuel or chemical spill	Minimal quantities of chemicals are used. Equipment, machinery and vehicles are well-maintained. Drip trays are used where required.	Manage chemicals and storage areas in accordance with Arafura's Hazardous Substances Management Plan (GHD 2016, Appendix I) Maintain a readily accessible register and manifest of hazardous chemicals present on each site. Maintain a readily accessible copy of Safety Data Sheets for each chemical on site. Manage chemical spills in accordance with Arafura's Hazardous Substances Management Plan (GHD 2016, Appendix I) Ensure appropriate spill kits are available to respond to a chemical spill. All mobile plants shall have appropriate spill kits available on site. Minimise quantities of chemicals stored on-site. Clean up spills, including contaminated soils. Dispose of any waste resulting from spill containment and clean up as regulated/listed waste via a licenced waste contractor. Store chemicals within a containment system / bunded areas in accordance with AS 1940:2017.

Primary Activity	Potential Impact	Mitigating Factors	Management Action
Excavation	Spread of contaminated soil	No known areas of contaminated land occur within the site.	If suspected contamination is identified, seek further advice prior to proceeding. Dispose of any contaminated soil as listed waste following required characterisation testing. Source fill material from approved locations within the project area or a certified 'clean' external source.
Excavation, Survey and Inspection Activities.	Disturbance to watercourses Water pollution	The region experiences long periods of minimal rainfall.	Rising stage samplers have been installed in Kerosene Camp Creek and the western tributary of the Kerosene Camp Creek where the intended diversion will flow. Use existing access tracks only. Where new access crossings are required obtain a permit or exemption to alter a waterway. Where practical, schedule works to be undertaken in the dry season. Design works to limit changes to surface water flow. Install erosion and sediment control measures before and during works to minimise potential impacts. Reinstate and stabilise the site upon completion. Stockpile topsoil separately and reinstate in order of natural profile. Remove all waste from the waterway, including spoil and vegetation waste.
All operational activities	Erosion	The region experiences long periods of minimal rainfall.	Implement repair and reinstatement works to address identified erosion. Separate and stockpile topsoil during excavation for reuse as part of reinstatement. Reinstate original soil profiles following disturbance. Subsoil material shall not be left exposed, particularly in areas with dispersive clay subsoils. Where high-risk areas are disturbed, or subject to ongoing erosion issues, seek specialist input into repair and stabilisation methods. Stabilisation may require soil amelioration, seed and fertiliser application, temporary stabilisation and or engineering controls. Install diversion banks where required to divert water away from mine infrastructure. Minimise the length and duration of disturbance. Establish work area boundaries to avoid unnecessary disturbance. Use existing access tracks only.

Primary Activity	Potential Impact	Mitigating Factors	Management Action
All operational activities	Impacts to native fauna or stock	Access to the site is restricted to essential works only.	Contact landholder as per land access requirements to minimise impacts to mustering and other activities. Travel in accordance with Arafura driving procedures and project site speed limits. Prior to disturbing areas of fauna habitat, engage a fauna spotter/ecologist to identify fauna management requirements. Example locations include hollow-bearing trees, areas that have not been regularly maintained, or where there are signs of regular fauna use. Engage a licenced fauna handler for any fauna handling that is required. Progressively backfill excavations to minimise the risk of fauna entrapment. Provide fauna escape ramps and/or fencing/barricading around excavations that are left open overnight. Fauna ramping should be installed at 45 degrees or less to allow fauna to escape on their own accord.
All operational activities	Listed wasteland or water contamination	Minimal quantities of hazardous materials and chemicals are used. Equipment, machinery and vehicles are well-maintained.	Identify potential listed and hazardous wastes as part of maintenance planning. Undertake screening tests where required to classify wastes and inform subsequent waste disposal. Provide details of waste characteristics to waste transport and disposal contractors. Where waste has been confirmed to not contain NORMs, dispose of as listed waste via a licenced contractor. Double bagged and securely stored listed waste such as filters and oily rags. Packaging that is listed waste is stored as listed waste at the depot. Engage a licenced waste contractor to remove listed waste from the depot. Minimise the quantity and duration of wastes stored on site.
All operational activities	Litter Impacts to fauna	Minimal quantities of litter are produced.	Remove all waste from remote work sites. Securely store waste at the depot. Disposal via waste contractor.

References

Archaeological & Heritage Management Solutions (AHMS) 2016, *Nolans Project Cultural Heritage Management Plan*, Arafura Resources limited, Darwin.

GHD 2016, *Nolans Project Environmental Impact Statement,* Arafura Resources limited, Darwin

GHD 2017, *Nolans Project Environmental Impact Statement, Appendix 14 Diversion Management Plan*, Arafura Resources Limited, Northern Territory

GHD 2016, *Nolans Project Environmental Impact Statement, Appendix X-D Biodiversity Management Plan*, Arafura Resources Limited, Northern Territory

GHD 2016, *Nolans Project Environmental Impact Statement, Appendix X-E Cultural Heritage Management Plan (written by Archaeological & Heritage Management Solutions),* Arafura Resources Limited, Northern Territory

GHD 2016, *Nolans Project Environmental Impact Statement, Appendix X-L Water Management Plan*, Arafura Resources Limited, Northern Territory

GHD 2016, *Nolans Project Environmental Impact Statement, Appendix X-M Weed Management Plan*, Arafura Resources Limited, Northern Territory