

# Appendix 1.

Department of Primary Industry and Resources (2020a) *Draft Monitoring Plan – Rum Jungle Stage 3 Rehabilitation Project.*



# Draft Monitoring Plan

Rum Jungle Stage 3 Rehabilitation Project

<b>Document title</b>	Draft Monitoring Plan
<b>Contact details</b>	Department of Primary Industry and Resources
<b>Approved by</b>	n/a – Draft Prepared for EIS Supplementary submission
<b>Date approved</b>	n/a – Draft Prepared for EIS Supplementary submission
<b>Document review</b>	On funding approval, if granted
<b>TRM number</b>	n/a

Version	Date	Author	Reviewed By	Changes made
0.1	03 June 2020	Jackie Hartnett	Megan Bailey, Glen Ewers, Ross Smith, Andy Markham, Scott Downs.	Draft Framework
0.2	16 June 2020	Jackie Hartnett	Glen Ewers	Draft for EIS Supplementary Submission
0.3	17 June 2020	Jackie Hartnett	Incorporated reviews.	Draft for EIS Supplementary Submission

Acronyms	Full form
DENR	Department of Environment and Natural Resources
DPIR	Department of Primary Industry and Resources
EBFR	East Branch Finniss River
EIS	Environmental Impact Statement (DPIR, 2020)
FR	Finniss River
LDWQOs	Locally Derived Water Quality Objectives (as established by Hydrobiology)
LFA	Landscape Function Analysis
mSv/yr	milliSieverts per year
NT	Northern Territory
TO	The Traditional Owners of the Rum Jungle site – the Warai and Kungarakan peoples
WRD	Waste Rock Dump (existing)
WSF	Waste Storage Facility (proposed)
WTP	Water Treatment Plant
*Various	*Various water chemistry acronyms are not listed here as the Proponent assumes a base knowledge level of persons required to carry out this program.

# Contents

<b>1. Project Overview.....</b>	<b>4</b>
1.1. Introduction.....	4
1.1.1. Conditional Status .....	5
1.2. Purpose .....	5
<b>2. Construction Monitoring Plan .....</b>	<b>6</b>
2.1. Objectives.....	6
2.2. Trigger Action Response Plan and Monitoring Locations.....	6
2.3. Additional Detail.....	13
2.3.1. Meteorological Conditions.....	13
2.3.2. Bush Foods .....	13
2.3.3. Riparian and Aquatic Flora and Fauna.....	13
2.4. Adaptive Management Strategy .....	14
<b>3. Stabilisation Monitoring Plan .....</b>	<b>15</b>
3.1. Objectives.....	15
3.2. Trigger Action Response Plan and Monitoring Locations.....	15
3.3. Additional Detail.....	21
3.3.1. Radiation.....	21
3.3.2. Revegetation.....	21
3.3.3. Feral Animals .....	21
3.3.4. Restoration of Flow EBFR.....	21
3.3.5. Riparian and Aquatic Flora and Fauna Survey .....	22
3.3.6. Contaminated Sites Auditor .....	22
3.4. Adaptive Management Strategy .....	22
<b>4. Rehabilitation Success Monitoring Plan.....</b>	<b>24</b>
4.1. Objectives.....	24
4.2. Trigger Action Response Plan and Monitoring Locations.....	24
4.3. Additional Detail.....	26
4.3.1. Radiation.....	26
4.3.2. Landform Stability .....	26
4.3.3. Weeds .....	26
4.3.4. Riparian and Aquatic Flora and Fauna Survey .....	26
4.4. Adaptive Management Strategy .....	27
<b>5. Reporting.....</b>	<b>27</b>
<b>6. Relationship to Management Plans.....</b>	<b>27</b>
<b>7. Role of the Contaminated Sites Auditor .....</b>	<b>28</b>
<b>8. Data Capture .....</b>	<b>28</b>
<b>9. Review .....</b>	<b>28</b>

# 1. Project Overview

## 1.1. Introduction

Since 2009, the NT Government and the Australian Government have been working under a National Partnership arrangement to complete investigative work to inform a rehabilitation plan, deliver site maintenance and continue environmental monitoring of the former Rum Jungle mine. The results of these programs have been used to develop an improved rehabilitation strategy that is consistent with the views and interests of traditional Aboriginal owners, and that meets contemporary environmental and mined land rehabilitation standards. The project's high-level objectives are two-fold and focus on environmental remediation and restoration of cultural values of the site, as described below:

- Improve the environmental condition onsite and downstream of site within the East Branch Finniss River (EBFR). This includes the following key outcomes:
  - Improved surface water quality conditions within EBFR in accordance with locally derived water quality objectives (LDWQOs).
  - Achieve chemically- and physically-stable landforms.
  - Support self-sustaining vegetation systems within rehabilitated landforms.
  - Develop physical environmental conditions supportive of the proposed Land Use Plan.
- Improve site conditions to restore cultural values. This includes the following key outcomes:
  - Restoration of the flow of the EBFR to original course as far as possible.
  - Remove culturally insensitive landforms from adjacent to sacred sites and relocate ensuring a culturally safe distance from the sacred sites.
  - Use appropriate local indigenous plant species to stabilise constructed surfaces and achieve a substantial subset of characteristic assemblage of biota present.
  - Preserve Aboriginal cultural heritage artefacts and places.
  - Isolate sources of pollution including radiological hazards.
  - Maximise opportunities for Traditional Owners to work onsite to aid reconnection to country.

It is envisaged that the achievement of these objectives may support the potential future Land Management and Use Plan (detailed within the draft Environmental Impact Statement – DPIR 2020).

The high-level delivery schedule for the rehabilitation program is shown in Figure 1-1:

SCOPE OF WORK	PRE-CONSTRUCTION STAGE 2B	ENVIRONMENTAL IMPACT STATEMENT SCOPE OF WORK - STAGE 3											MONITORING AND MANAGEMENT - STAGE 4	HAND TO FRALT
	Yr. 1-3	Site Establishment	Yr.1	Yr.2	Yr.3	Yr.4	Yr.5	Yr.6	Yr.7	Yr.8	Yr.9	Yr. 10	Yr. 1-20	Yr. 1
<b>Pre-Construction - STAGE 2B</b>														
Revegetation - Existing Landforms														
Land Management (fire and weeds)														
<b>CONSTRUCTION</b>														
Site Establishment														
Earthworks														
Water Treatment - Surface Waters														
Water Treatment - Groundwater														
Revegetation - New Landforms														
Monitoring - Construction														
Land Management (fire and weeds)														
<b>STABILISATION AND MONITORING</b>														
Revegetation - Infill														
Monitoring - Post Construction														
Landform Maintenance														
Land Management (fire and weeds)														
<b>MONITOR AND PROVE CLOSURE CRITERIA</b>														
<b>HAND TO FINNISS RIVER ALT</b>														

Figure 1-1 High Level Project Delivery Schedule (DPIR Draft EIS, 2020)

### 1.1.1. Conditional Status

It is important to note that Stage 3 project funding has not been secured, therefore this Monitoring Plan will remain as a draft until such time as the Stage 3 Rehabilitation works plan is approved and funded by both the NT and Australian Governments. Additionally, this plan is to be reviewed at such time that Stage 4 Monitoring and Management works are funded and approved.

## 1.2. Purpose

The purpose of this document is to build on information provided within the Draft EIS and provide an overview of the environmental elements of the Monitoring Plan for the future Rum Jungle Rehabilitation works. Future occupational health and safety, socio-economic and cultural monitoring programs are not included within this document. The works package for the Rum Jungle Rehabilitation Plan has been divided into three phases for the purpose of this Monitoring Plan development. These phases are directly related to the Figure 1 schedule:

- **Construction (Stage 3)** – this refers to the construction phase of the project, whereby bulk earthworks and pit backfilling are taking place.
- **Stabilisation (Stage 3)** – this refers to the stabilisation and intensive monitoring phase of the project, whereby the site's engineering erosion controls are progressively taken over by vegetation development in landform stabilisation. This is also the phase where the groundwater abstraction and remediation continues until such time as the water treatment plant is decommissioned.
- **Rehabilitation Success (Stage 4)** – this refers to the final, longer term phase, whereby revegetation and water quality trends are established to determine progress towards project success. This phase of work consists of land management activities and repairs where needed, and longer term monitoring plans.

Each phase has monitoring objectives that are matched to the purpose and potential impacts of that scope of work. These are described in the following sections.

## 2. Construction Monitoring Plan

### 2.1. Objectives

The purpose of the Construction Monitoring Plan is to maintain control of the environmental impacts resulting from the rehabilitation project. The project requires action to be taken on site that may cause short term detrimental impact in order to effect long term environmental and cultural improvement. An example of this includes the deconstruction of existing waste rock dumps (WRDs) and construction of new waste storage facilities (WSFs) for the safe long term storage of mine waste rock. The waste rock materials are the current main sources of impact to the EBFR and, as such, disturbing them may result in additional temporary impact. The baseline for this project is an already-impacted legacy mine site and impacted receiving water course.

The objective of the Construction Monitoring Plan is to measure and detect unacceptable additional adverse impacts during this phase of works, where 'unacceptable additional adverse impacts' are defined as:

1. Major impact to sensitive environmental receptors, such as significant desiccation of the groundwater-dependant ecosystem (monsoon vine thicket) to the north of the Intermediate Pit.
2. Irreversible impact to downstream freshwater aquatic ecosystems, such as medium term (three month) water quality degradation beyond that which already exists within the EBFR.
3. Irreversible impact to groundwater quality surrounding the Main and Intermediate Pits, such as medium term (six months) water quality degradation beyond baseline values.
4. Irreversible impact to the terrestrial ecosystems across the project by the exacerbation of existing weed and fire impacts.
5. Significant bank erosion within the EBFR due to the water discharge operations on site.

In addition to managing adverse impacts, monitoring of the groundwater remediation shall commence, with ongoing water quality monitoring of the groundwater Seepage Interception System (SIS) over the course of the Construction phase. Qualitative monitoring of revegetation progress will also commence during this phase.

The Quality Assurance and Control monitoring relating to construction activities is specified within the Technical Specifications for each work package; however, they are also highlighted here, as they are critical to the long term success of the site rehabilitation project.

### 2.2. Trigger Action Response Plan and Monitoring Locations

The Construction Monitoring Plan requires routine inspection, sampling and review of several elements of the operational work area in order to maintain operational control and prevent unacceptable additional adverse impacts as described above. These elements, the relevant objective/s (as described above), parameters, trigger levels and an action response plan are documented in Table 2-1. Additional groundwater and surface water monitoring plan information is shown in Table 2-2. This section of the Plan is proposed for implementation during the Main Pit Backfilling and Bulk Earthworks operations.

It is acknowledged that a Waste Discharge Licence will be required for the operation of the Water Treatment Plant and discharge of treated waters to the EBFR. The requirements of the Licence may necessitate a review of this draft Monitoring Plan.

Table 2-1 Construction Monitoring and Trigger Action Response Plan

Element	Obj.'s	Parameter	Location	Frequency	Trigger Levels	Action Response Plan	Comment
Main Pit Operational Water Levels	2,3	Water level	MPO	Automated, continuous	58-59mRL	If over 59mRL, cease pit backfilling until water level is recovered. If under 58mRL, cease pit dewatering until water level is recovered. In a high rainfall event, stop groundwater recovery and focus all water treatment effort on surface waters.	Refer to Supplementary Appendix 21 SLR (2020i).
Intermediate Pit Operational Water Levels	1,2,3	Water level	IPO	Automated, continuous	49-50mRL	If over 50mRL, cease pit backfilling until water level is recovered. If under 49mRL, cease drawing from Intermediate Pit until water level is recovered. In a high rainfall event, switch off groundwater recovery system and focus all water treatment effort on surface waters.	Refer to Supplementary Appendix 21 SLR (2020i).
Groundwater bores adjacent to Main Pit	1,3	pH, EC and water levels	RN22107, RN22544	Weekly	To be established	Sample bores and analyse for sulphates to determine if surface water from Main Pit backfill is migrating into surrounding groundwater aquifer. Investigate conformance to operational water levels in the Main Pit. Escalate requirement for response plan to the Project Director.	
Groundwater bores adjacent to Main and Intermediate Pits	1,3	Water level	RN22107, RN22544, RN37722, RN37719, RN37727, RN23516, RN23517, RN23518	Weekly	n/a	n/a	Purpose is to collect a dataset to understand localised drawdown. Data to be used in relation to investigating impact to the nearby vine thicket, as well as drawdown impact on EBFR groundwater (if any).
Groundwater SIS (abstract and treat)	n/a	Water level	All Groundwater SIS bores	Weekly	n/a	n/a	Purpose is to collect data to understand the rates of Cu desorption and quality improvement (remediation performance) within the existing impacted groundwater plumes, and to monitor aquifer drawdown.
Groundwater SIS (abstract and treat)	n/a	Quality, see Table 2-2	All Groundwater SIS bores	Quarterly	n/a	n/a	An additional purpose is to collect data to understand the rates of Cu desorption and changes in quality within the existing impacted groundwater plumes.
Sediment Ponds - WSFs	2	Mud level	To be established during operations	Daily	To be established	Visual inspection of level. Clean out if upper levels triggered.	Refer to Supplementary Appendix 18 SLR (2020i).
Sediment Ponds - WSFs	2	pH, EC, turbidity	To be established during operations	Weekly	To be established	Neutralise in situ or send to WTP for treatment prior to discharge.	Refer to Supplementary Appendix 18 SLR (2020i).
Vine thicket health	1	Vegetation water stress (Normalised Difference Water Index using Sentinel data)	Entire vine thicket patch	Monthly	A significant deviation from baseline NDWI value (seasonally-adjusted) for three months in a row	If they occur, drawdown impacts will be temporary; stopping once de-watering ceases. A drier patch will be more susceptible to fire and weeds; however, that will be mitigated by the weed and fire control that will be undertaken during the entire works phase of the project. If the level of dryness is severe, it may be possible to use treated water from the pit to irrigate the patch.	Seasonal fluctuations can be taken into account by analysing data for a few years prior to the commencement of dewatering. That analysis will also identify what constitutes a 'significant deviation' from baseline. If required, that data can be coupled with regular field monitoring, such as using photo-points.
Water Treatment Plant	2,5	Flow rate to EBFR	WTPO	Automated, continuous	n/a	n/a	The purpose is to collect dataset to understand local flow conditions throughout operations. Data to be used in relation to investigating impact to downstream environs and reporting where required.
	2,5	Volume (cumulative)	WTPO	Automated, continuous	n/a	n/a	The purpose is to collect dataset to understand local flow conditions throughout operations. Data to be used in relation to investigating impact to downstream environs where required.
	2	WTP discharge quality	WTPO	Automated, continuous	To be established	Cease discharge and investigate non-conformance.	

Element	Obj.'s	Parameter	Location	Frequency	Trigger Levels	Action Response Plan	Comment
	2	Field pH, EC, alkalinity, turbidity	WTPO	Daily through commissioning , then rely on in-line automated monitoring	To be established	Trigger sampling for external analysis of same parameters. Determine if additional test work is required from external laboratory. Investigation into causes. Cease discharge to EBFR until stabilised and within range.	
	2	Quality, see Table 2-2	WTPO	Weekly on commissioning , shift to monthly when stabilised	n/a	n/a	Purpose is to collect dataset to understand local flow and quality conditions throughout operations. Data to be used in relation to investigating impact to downstream environs where required.
Downstream EBFR Zones 2 and 3	2,5	Flow rate, pH, EC, turbidity	EB@GS200, EB@GS327, EB@GS097	Continuous at gauge	n/a	n/a	Purpose is to collect dataset to understand local flow quality and conditions throughout operations. Data to be used in relation to investigating impact to downstream environs where required.
	2	Field pH, EC	EBdsLB	Weekly	LDWQOs	Investigation into cause of variation against trigger levels. Commence additional monitoring if required. Report variation internally to Project Director. If three sequential triggers in dry season, report variation to DENR case officer.	
	2	Quality, see Table 2-2	EBdsLB	Monthly	LDWQOs	n/a	Monitoring point is at site boundary within Zone 2. All weather access may not be possible in high rainfall events. Safety audit required to confirm safe access can be established (crocodiles). Trigger investigation into WTP operations.
	2	Quality, see Table 2-2	EBdsRB	Monthly	LDWQOs	Proposed WDL compliance point. Report exceedance to DENR if three sequential triggers in any season. Trigger investigation into WTP operations or if legacy water quality impacts. Trigger investigation into downstream water quality post high-rainfall event that overtops the Pit control system and if deemed necessary by the project aquatic ecologists.	Monitoring points is downstream of site within mid-Zone 3. Access all year round.
	2,5	Visual inspection - downstream erosion (qualitative)	EBdsRB	Quarterly	Significant erosion	Trigger investigation into cause of bank erosion. Commence quantitative monitoring as directed by project geomorphologist.	Visual is to be augmented with drone/surface imagery to ensure that data history is captured and that communication with project geomorphologist is enhanced for remote assessment.
Downstream EBFR Zones 4 to 6	2	Quality, see Table 2-2	See table below	Quarterly	LDWQOs	Trigger investigation to determine if changes driven by mobilisation of legacy sediments or from the rehabilitation operations.	Additional purpose is to collect local dataset to understand longer term changes.
Weed and fire break inspections	4	Borrow areas, roadsides, active work areas, topsoil stockpiles	All active areas	Monthly	Presence of declared pests Fire breaks in poor condition	Weed control undertaken as per the timing recommended for the species. Immediately inform Environment Manager. Maintain fire breaks/fuel loads in accordance with Bushfire Management Plan.	See also Section 14.5.2 of the EIS
Vegetation clearing	1,4	As per vegetation clearing procedure see EIS section 14.5.	Areas of remnant bushland subject to clearing.	As required	Non-conformance with clearance procedure	Stop vegetation clearing until operational control is regained. Report non-conformance to Environment Manager.	Section 14.5 of Draft EIS
Revegetation	n/a	Qualitative progressing to quantitative (Landscape Function Analysis and survey)	All revegetation areas	At 18 months and 3 years	Notable poor performance	Investigate cause of poor performance and enact remedial works based on findings.	See Top End Seeds (2020) for further information (Supplementary Report Appendix 27) and Draft EIS section 7.12.

Element	Obj.'s	Parameter	Location	Frequency	Trigger Levels	Action Response Plan	Comment
Construction Quality Assurance and Control	n/a	As per the QA/QC plan established by project engineers	WSF construction areas and pit backfill construction areas	Continuous	As described in Technical Specifications	Rework areas that do not conform to QA/QC requirements on WSFs. Halt operations on pit backfill until operational control is regained on QA/QC elements. Other remedial actions for non-conformance set out in the Technical Specifications	Contaminated Sites Auditor to overview these processes on behalf of the Governance Board.
Nuisance Dust	n/a	Visual inspections and monitoring of construction activities	All active areas	Continuous	Excessive visible dust and/or complaints	Ensure dust suppression is managed under contractor's site environmental management plan/traffic management plan. Stop work during high dust generating weather conditions. Inform Environment Manager/Construction Manager of excessive dust.	
Nuisance dust	n/a	Dust deposition gauge	R3 (Mt Burton), R8, R10.	Monthly	TBC	Report exceedance to Environment Manager.	Dust deposition gauges to monitor effect and compliance at nominated receptor sites. Preferred control measure at Mt Burton (R3) is to relocate residents during operations, in which case dust monitoring will not be required at this location.

Table 2-2 Additional Groundwater and Surface Water Monitoring information

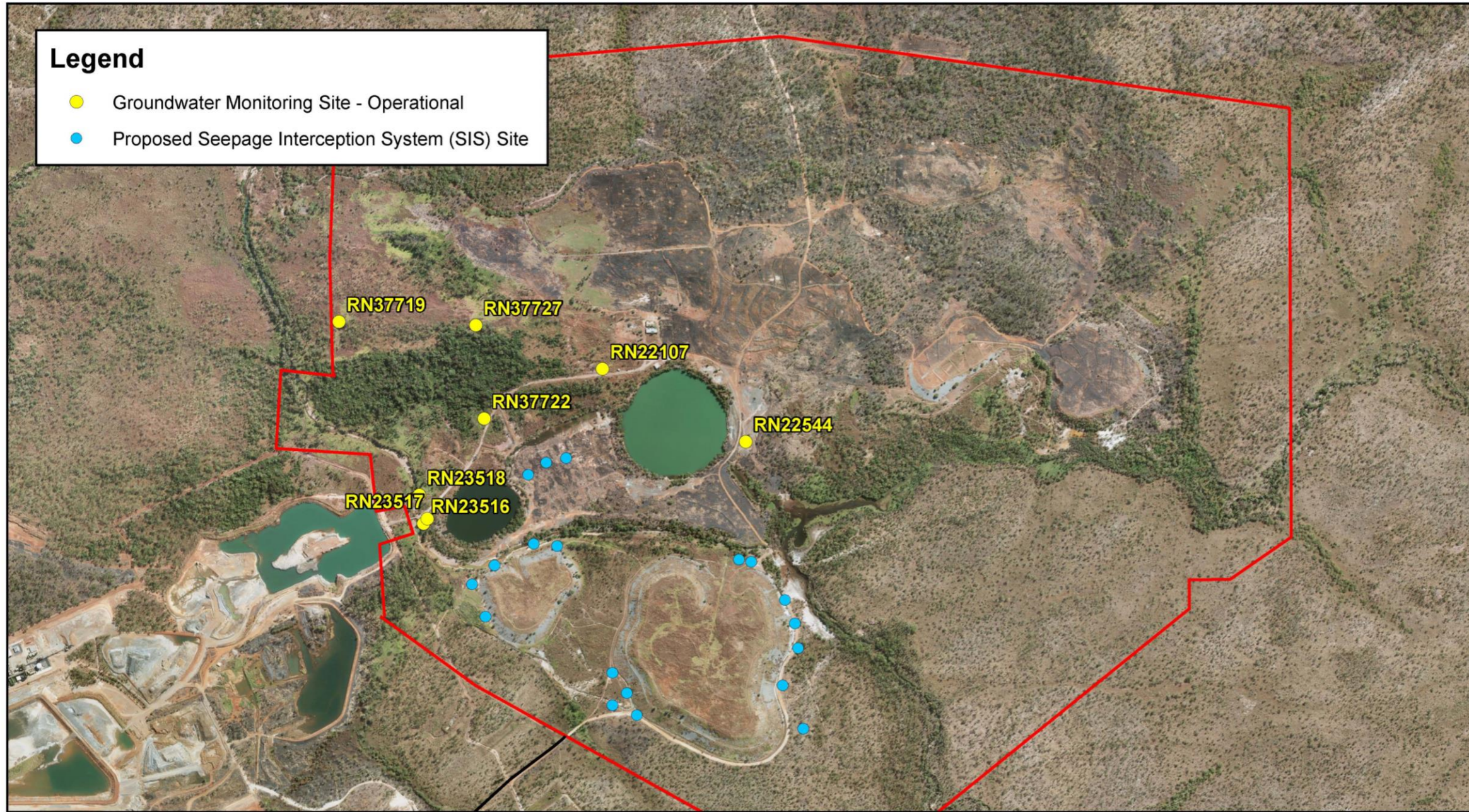
Program	Frequency	Sites	Parameters analysed
WTP Discharge	Weekly/Monthly	WTPO	pH, EC, Turbidity, Major Ions (Alkalinity, SO <sub>4</sub> , Ca, Mg, Na, K), Metals Total and Dissolved (Cu, Co, Mn, Ni, Pb, U, Zn)
EBFR Zone 2 and 3	Monthly	MP, IP, EBusWTP, EB@GS200, EB@GS097, EBG327, EBdsLB, EBdsRB	pH, EC, Turbidity, Major Ions (Alkalinity, SO <sub>4</sub> , Cl, Ca, Mg, Na, K), Metals Total and Dissolved (Al, Fe, Cd, Cu, Co, Mn, Ni, Pb, U, Zn)
Downstream Zone 4 to 6	Quarterly	EBusFR, FRusEB, FRusFC, FRdsFC.	pH, EC, Turbidity, Major Ions (Alkalinity, SO <sub>4</sub> , Cl, Ca, Mg, Na, K), Metals Total and Dissolved (Al, Fe, Cd, Cu, Co, Mn, Ni, Pb, U, Zn)
Groundwater SIS	Continuous	To be developed once SIS is installed	pH, EC, Turbidity, Major Ions (Alkalinity, SO <sub>4</sub> , Cl, Ca, Mg, Na, K), Metals Total and Dissolved (Al, Fe, Cd, Cu, Co, Mn, Ni, Pb, U, Zn)

The location of water monitoring points noted in Table 2-1 and Table 2-2 are shown in the following series of maps.



 <b>Northern Territory Government</b>	<h2 style="margin: 0;">Former Rum Jungle Mine Surface Water Monitoring Points Operational Phase</h2>	<p><b>Details</b>                  Mapping by NT Department of Primary Industry and Resources Legacy Mines Unit (LMU).                  Data sources: Aerial photography from NT DLPE, vector data from Northern Territory Government. Map is not to be used for navigation purposes. Contact (08) 8999 6528 for further information.</p>	<table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <tr> <td style="width: 25%;">Version</td> <td style="width: 25%;">01</td> <td style="width: 25%;">Date</td> <td style="width: 25%;">11/06/2020</td> </tr> </table> <div style="text-align: center;"> <p>N</p>     <p>Km</p> </div>	Version	01	Date	11/06/2020
Version	01	Date	11/06/2020				
<p><b>Disclaimer</b>                  The Northern Territory Government bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of this map. While information appears accurate at publication, conditions and circumstances depicted in this map are constantly changing.</p>							

Figure 2-1 Surface Water Monitoring Points through Operations





 <p><b>Northern Territory Government</b></p> <p><small>Disclaimer The Northern Territory Government bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of this map. While information appears accurate at publication, conditions and circumstances depicted in this map are constantly changing.</small></p>	<h3>Former Rum Jungle Mine Groundwater Monitoring Points Operational Phase</h3>	<p><b>Details</b> Mapping by NT Department of Primary Industry and Resources Legacy Mines Unit (LMU). Data sources: Aerial photography from NT DLPE, vector data from Northern Territory Government. Map is not to be used for navigation purposes. Contact (08) 8999 6528 for further information.</p>	<table border="1"> <tr> <td>Version</td> <td>01</td> <td>Date</td> <td>11/06/2020</td> </tr> </table> <p style="text-align: center;">N</p>  <p style="text-align: center;">0 0.125 0.25 0.5 Km</p>	Version	01	Date	11/06/2020
Version	01	Date	11/06/2020				

Figure 2-2 Groundwater Monitoring Locations through Operations

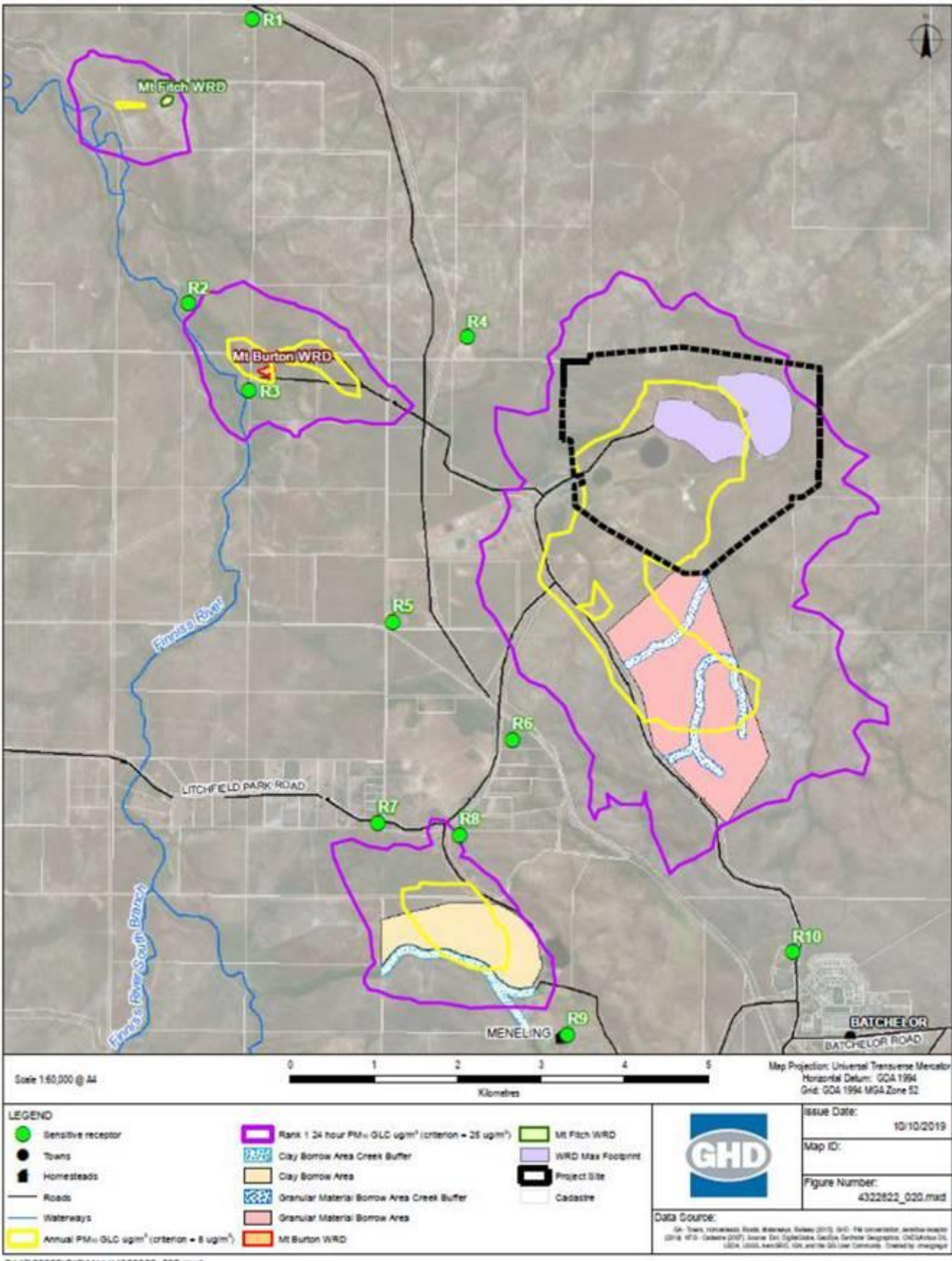


Figure 2-3 Sensitive Receptors - Dust

## 2.3. Additional Detail

This section provides additional detail about some of the elements that will be monitored in this phase.

### 2.3.1. Meteorological Conditions

As noted within the Draft EIS section 11.4.1, for the purpose of operational safety and protection of equipment and the environment, advanced warning of impending rainfall events and potential high flows is crucial in risk mitigation. Routine monitoring and utilisation of government alert systems will be required by operational personnel in order to make adequate preparations on site for pending weather events. This is particularly so for events such as cyclones.

### 2.3.2. Bush Foods

In addition to the above mentioned Operational Monitoring Plan, it is proposed that during this phase the investigation into the safety of bush foods from the Zone 8 and 9 Finniss River is carried out. This will inform the public health query around the safety of eating fish, mud crab and other commonly-harvested bush tuckers from the riparian and aquatic systems of the Finniss River. This investigation will not be for the purposes of operational control; rather the purpose of this would be to address ongoing public health queries resulting from the impacts of historic mining activities.

Riparian bush foods – including fruit, yams/tubers and vegetative material – will be collected when in season to ensure sufficient material for metal and radionuclide assay. For some species, the window of availability is narrow; however, immediate post-wet season sampling will give the greatest margin for success on most species. Vertebrate bush foods from the riparian zone include feral pigs, monitors and turtles that are more accessible during the late dry season. Sampling at that time would coincide with cultural utilisation practices and simplify sourcing sufficient material for assay. This investigation program will be designed by the project aquatic ecology and toxicology specialists, and information gathered in this study will be prepared for issue to DENR.

### 2.3.3. Riparian and Aquatic Flora and Fauna

In addition to the works described above, a program of riparian and aquatic flora and fauna monitoring will be required to establish baseline conditions within existing riparian and aquatic ecosystems along EBFR at project commencement, prior to construction works. This data will inform the improvement in riparian and aquatic flora and fauna health over time as a result of the rehabilitation works. Additionally, this data will be used to develop the EBFR reconstruction revegetation plan and set success criteria for that portion of the revegetation works. A second round of sampling would take place at approximately year 5 of the project schedule at the end of the Construction phase. Refer to the draft EIS Sections 12.4.1 and 12.4.2 for further detail of this program. It is anticipated that this sampling will include:

- Aquatic fauna sampling (zones 1 to 7) of
  - Fishes and decapod crustaceans
  - Macroinvertebrates and diatoms
  - Aquatic tetrapods
  - Tissue sampling of fishes and mussels for metal(oid) concentration and radionuclide activity concentrations
- Riparian and aquatic flora (zones 1 to 7)
- Riparian fauna, particularly water monitors (zones 1 to 6)
- Bush Tucker sampling for metal(oid) concentration and radionuclide activity (zones 1 to 7)

## 2.4. Adaptive Management Strategy

The Construction Monitoring Plan has been developed to target early identification of detrimental impacts and facilitate early management decision making to mitigate these impacts. Impacts identified, and actions taken within the Trigger-Action-Response Plan, will form the foundation for the operational adaptive management strategy whereby the data collection → information forming → management action process is an element of normal operational business.

## 3. Stabilisation Monitoring Plan

### 3.1. Objectives

The objectives of the stabilisation monitoring plan are to:

1. Identify early signs and causes of landform instability, and rapidly address those causes (be it vegetation failure, erosion, fire, weeds or feral animals).
2. Measure progress towards achieving the overall objective of meeting EBFR LDWQOs, and the aquatic health improvement resulting from this.
3. Measure revegetation progression across the various landforms to establish revegetation trends and realistic climax vegetation community characteristics for each landform. These characteristics can then inform site-specific success criteria.
4. Identify any potential new impacts to groundwater quality from the newly-constructed WSFs and backfilled Main Pit.
5. Gain an understanding of the improving groundwater conditions across legacy Acid Mine Drainage impacted groundwater due to the groundwater abstraction and treatment system. From this, identifying an acceptable point at which the groundwater abstraction and treatment system can be decommissioned.
6. Measure progress towards improved site radiological conditions post-construction works in order to inform the Land Management and Use Plan.
7. Avoidance of irreversible impact from WTP operations to downstream environments such as medium term (three month) water quality degradation beyond baseline within the EBFR and bank erosion within the EBFR due to the water discharge operations on site.

### 3.2. Trigger Action Response Plan and Monitoring Locations

The Stabilisation Monitoring Plan requires routine inspection, sampling and review of several elements of the post-construction work area and downstream environs. Doing so will allow rapid responses to forces detrimental to landform stability and revegetation progression. Additionally during this phase, key decisions are to be made regarding the timing for decommissioning of the groundwater abstraction and treatment system, and the establishment of key revegetation success criteria. These elements, links to the abovementioned objectives, parameters, trigger levels and an action response plan are documented in the Table 3-1-1. This section of the Plan is proposed for implementation during post-construction phase – nominally for a period of 5 years. The duration may be extended or reduced in future depending on the performance of the revegetation works and the groundwater remediation works.

Table 3-1 Stabilisation Monitoring and Trigger Action Response Plan

Element	Obj.'s	Parameter	Location	Frequency	Trigger Levels	Action Response Plan	Comment
Fire prevention	1	Fire break condition	All revegetation areas	Monthly	Breaks in poor condition	Repair immediately. Particular attention needed at end of wet season.	
Fire impact	1	Fire impact	All revegetation areas	Event based	Unplanned fire passes through revegetation areas – controlled or uncontrolled	Fire exclusion first 5 years. Fire within this time triggers assessment and re-planting or re-sowing as needed.	Further information in Fire Management Plan (future development).
Weed impact	1	Weed presence	All revegetation areas	Monthly	Presence of high risk weeds	Notify Land Management Supervisor for immediate attention to establish early control over weed infestation.	More detail will be provided in the Weed Management Plan once it has been developed.
Feral animal impact	1	Impact to revegetation by feral animals	All revegetation areas	Monthly	Impact causing detriment	Identify species and plan for targeted response.	More detail will be provided in the Feral Animal Management Plan once it has been developed.
Erosion	1	Terrestrial, aquatic and riparian landforms	Waste Storage Facilities, EBFR channel and banks	Monthly during wet season	Serious erosion causing detriment to control structures or vegetation.	Immediately investigate erosion cause and impact. Work with technical experts to develop remedial works plans.	
WSF Lysimeters	1	Pore gas concentrations, temperature and moisture	East and West WSFs	Continuous	Significant deviation from baseline	Trigger investigation.	Establish baseline data for WSF performance and capture data for investigation work as required. Refer to Appendix 20 Section 3.5.4 of that report.
Surface water	2	See Table 3-2	Sites within EBFR and FR – see Table 3-2	Start of wet and end of wet	LDWQOs	Variation against LDWQOs triggers investigation.	An additional purpose of this data collection at this point is to track progress of improvement post-construction. Further data collection will assist in updating the groundwater/surface water fate transport modelling.
Water Treatment Plant	7	Flow rate to EBFR	WTPO	Automated, continuous	n/a	n/a	The purpose is to collect dataset to understand local flow conditions throughout operations. Data to be used in relation to investigating impact to downstream environs where required.
	7	Volume (cumulative)	WTPO	Automated, continuous	n/a	n/a	The purpose is to collect dataset to understand local flow conditions throughout operations. Data to be used in relation to investigating impact to downstream environs where required.
	7	WTP discharge quality	WTPO	Automated, continuous	To be established	Cease discharge and investigate non-conformance.	
	7	Field pH, EC	WTPO	Daily	To be established	Trigger sampling for external analysis of same parameters. Determine if additional test work is required from external laboratory. Investigation into causes.	Cease discharge to EBFR until stabilised and within range.
	7	See Table 3-2	WTPO	Monthly	n/a	n/a	The purpose is to collect dataset to understand local flow conditions throughout operations. Data to be used in relation to investigating impact to downstream environs where required.
Downstream EBFR Zone 2 and 3	2,5	Flow rate, pH, EC, turbidity	EB@GS200, EB@GS327, EB@GS97	Continuous at Gauge	n/a	n/a	Purpose is to collect dataset to understand local flow conditions throughout operations. Data to be used in relation to investigating impact to downstream environs where required.
	2,5	Field pH, EC, turbidity and alkalinity	EBdSLB	Weekly	LDWQOs	Investigation into cause of variation against trigger levels. Commence additional monitoring if required. Report variation internally to Project Director. If three sequential triggers, report variation to DENR case officer.	

Element	Obj.'s	Parameter	Location	Frequency	Trigger Levels	Action Response Plan	Comment
	2,5	See Table 3-2	EBdsLB	Monthly	LDWQOs	Trigger investigation into cause of exceedance. At this point, mixing is not complete of WTP discharge, upstream surface flows, discharge from Browns Oxide and impacted groundwater expression. Investigation triggered to understand duration and source of exceedance.	At site boundary within Zone 2. All weather access may not be possible in high rainfall events. Safety audit required to confirm safe access can be established (crops). Trigger investigation into WTP operations.
	2,5	See Table 3-2	EBdsRB	Monthly	LDWQOs	Proposed WDL compliance point. Report exceedance to DENR. Trigger investigation into WTP operations or if legacy water quality impacts. Trigger investigation into downstream water quality post high-rainfall event that overtops the Pit control system and if deemed necessary by the project aquatic ecologists.	Downstream within mid-Zone 3. Access all year round.
	2,5	Visual inspection - downstream erosion (qualitative)	EBdsRB	Quarterly	Significant erosion	Trigger investigation into cause of bank erosion. Commence quantitative monitoring as directed by project geomorphologist.	Visual is to be augmented with drone/surface imagery to ensure that data history is captured and that communication with project geomorphologist is enhanced for remote assessment.
Aquatic fauna and flora	2	Survey to be defined by project aquatic ecologists	Downstream Zone 2 to 4	One round within this phase	n/a	n/a	Purpose is to collect data to contribute to understanding of aquatic ecosystem recovery.
Groundwater	2, 4	See Table 3-2	Main Pit, Int Pit, WRDs, WSFs (new) - see Table 3-2	6 monthly	n/a	n/a	Purpose is to collect data to establish trends across site as groundwater stabilises. Data utilised in investigation where needed.
Groundwater	5	See Table 3-2	Former WRDs and Cu extraction pad	Monthly	To be established	Once pattern of desorption rates is understood and ongoing load to EBFR is reduced to a stable position, SIS and WTP to be decommissioned.	
Revegetation	3	Landscape Function Analysis	To be established - riparian and terrestrial	At 6 months, 3 years and 6 years.	Notable poor performance (criteria to be established)	Investigation into cause of performance deficiencies.	Data can be used to develop future revegetation success criteria.
Revegetation	3	Vegetation survey	To be established - riparian and terrestrial	At 18 months	To be established	To be established	Purpose of this program is to inform current and future revegetation works and improve program of works. Data can be used to develop future revegetation success criteria. See Top End Seeds (2020) for further information (Supplementary Report Appendix 27) and Draft EIS section 7.12.
Radiation	6	Radiation Dose Assessment	Rum Jungle Site	One Program	To be established	To be established	Purpose of this program is to assess the dose received from site access across the non-ingestion radiation pathways. This will be assessed against the dose reference level of 10mSv/yr and can inform future works on bushfood consumption in a total dose calculation for the final Land Management and Use Plan.

Table 3-2 Surface Water and Groundwater Monitoring Program

Program	Frequency	Sites	Parameters analysed
Surface water	Start and end of wet season	WTPO, WCus, WCusEB, FC@LB, EB@LB, TCus@LB, MP, IP, EBusWTP, EB@GS200, EB@GS097, EB@GS327, TC@LB, EBdsLB, EBdsRB, EBusFR, FRusEB, FRusFC, FRdsFC.	pH, EC, Turbidity, Major Ions (Alkalinity, SO <sub>4</sub> , Cl, Ca, Mg, Na, K), Metals Total and Dissolved (Al, Fe, Cd, Cu, Co, Mn, Ni, Pb, U, Zn)
Water Treatment Plant Discharge	Monthly	WTPO	pH, EC, Turbidity, Major Ions (Alkalinity, SO <sub>4</sub> , Cl, Ca, Mg, Na, K), Metals Total and Dissolved (Al, Fe, Cd, Cu, Co, Mn, Ni, Pb, U, Zn)
EBFR Zone 2 and 3	Monthly	MP, IP, EBusWTP, EB@GS200, EB@GS097, EB@GS327, EBdsLB, EBdsRB	pH, EC, Turbidity, Major Ions (Alkalinity, SO <sub>4</sub> , Cl, Ca, Mg, Na, K), Metals Total and Dissolved (Al, Fe, Cd, Cu, Co, Mn, Ni, Pb, U, Zn)

Program	Frequency	Sites	Parameters analysed
Groundwater	Six monthly	MB17-24D/S, RN23304, MB14-06D/S, RN22544, RN23419, RN37711, RN23791, RN23792, MB14-20D/S, RN37725, RN22107, RN22107.	pH, EC, Turbidity, Major Ions (Alkalinity, SO <sub>4</sub> , Cl, Ca, Mg, Na, K), Metals Total and Dissolved (Al, Fe, Cd, Cu, Co, Mn, Ni, Pb, U, Zn)
Groundwater	Monthly	To be developed once SIS installed.	pH, EC, Turbidity, Major Ions (Alkalinity, SO <sub>4</sub> , Cl, Ca, Mg, Na, K), Metals Total and Dissolved (Al, Fe, Cd, Cu, Co, Mn, Ni, Pb, U, Zn)

The surface water and groundwater monitoring points noted in Table 3-1 and Table 3-2 are mapped in Figure 3-1 and Figure 3-2.






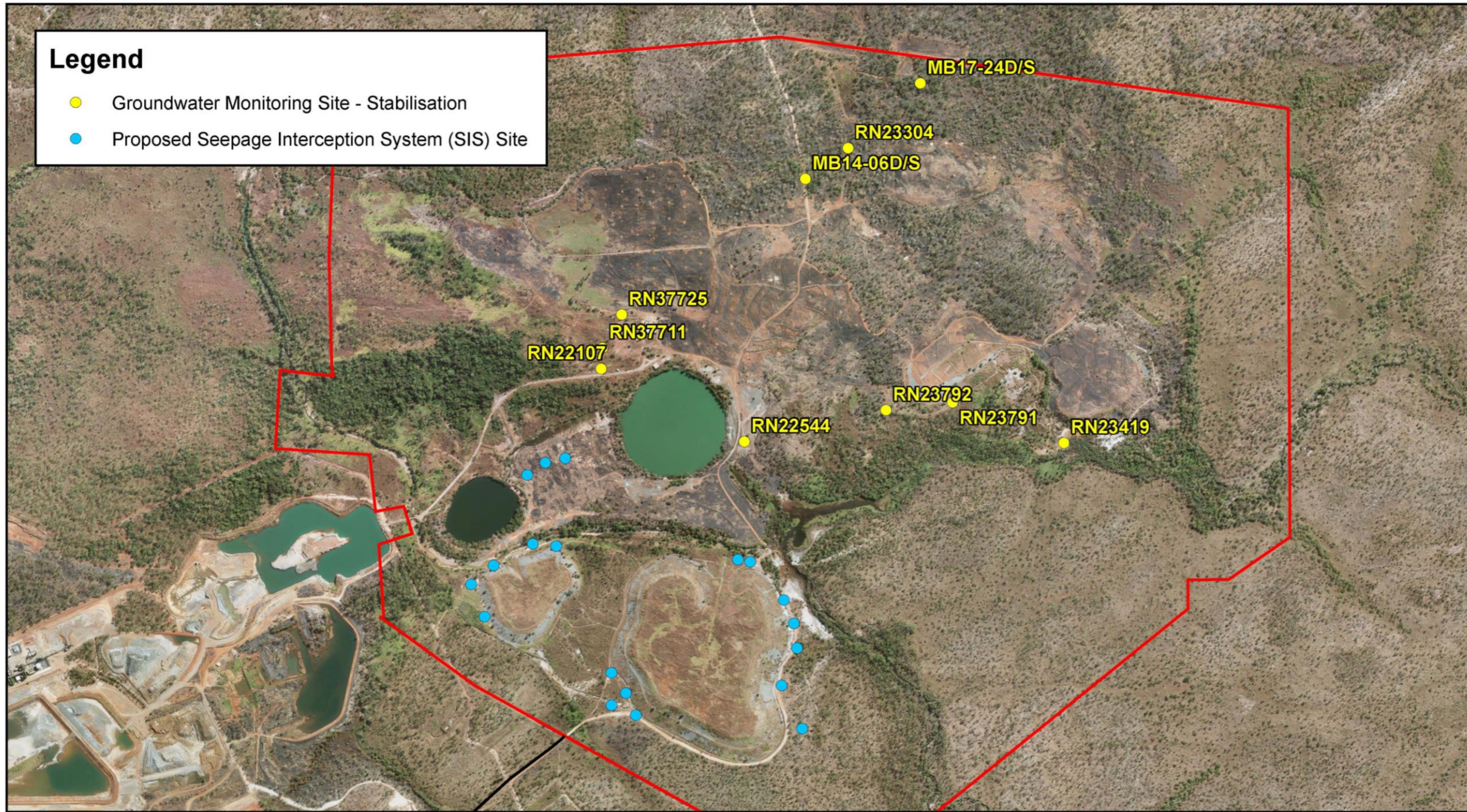
 <b>Northern Territory Government</b>	<h2 style="margin: 0;">Former Rum Jungle Mine Surface Water Monitoring Points Stabilisation Phase</h2>	<p><b>Details</b>                  Mapping by NT Department of Primary Industry and Resources Legacy Mines Unit (LMU).                  Data sources: Aerial photography from NT DLPE, vector data from Northern Territory Government. Map is not to be used for navigation purposes. Contact (08) 8999 6528 for further information.</p>	<table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <tr> <td style="width: 25%;">Version</td> <td style="width: 25%;">01</td> <td style="width: 25%;">Date</td> <td style="width: 25%;">11/06/2020</td> </tr> </table> <div style="text-align: center;"> <p>N</p>     <p>Km</p> </div>	Version	01	Date	11/06/2020
Version	01	Date	11/06/2020				
<p><b>Disclaimer</b>                  The Northern Territory Government bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of this map. While information appears accurate at publication, conditions and circumstances depicted in this map are constantly changing.</p>							

Figure 3-1 Surface Water Monitoring Locations After Operational Works





 <p><b>Northern Territory Government</b></p> <p><small>Disclaimer The Northern Territory Government bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of this map. While information appears accurate at publication, conditions and circumstances depicted in this map are constantly changing.</small></p>	<h3>Former Rum Jungle Mine Groundwater Monitoring Points Stabilisation Phase</h3>	<p><b>Details</b> Mapping by NT Department of Primary Industry and Resources Legacy Mines Unit (LMU). Data sources: Aerial photography from NT DLPE, vector data from Northern Territory Government. Map is not to be used for navigation purposes. Contact (08) 8999 6528 for further information.</p>	<table border="1"> <tr> <td>Version</td> <td>01</td> <td>Date</td> <td>11/06/2020</td> </tr> </table> <p style="text-align: center;">N</p>  <p style="text-align: center;">0 0.125 0.25 0.5 Km</p>	Version	01	Date	11/06/2020
Version	01	Date	11/06/2020				

Figure 3-2 Groundwater Monitoring Locations After Operational Works

### 3.3. Additional Detail

This section provides additional detail about some of the elements that will be monitored in this phase.

#### 3.3.1. Radiation

During the Stabilisation phase, knowledge gaps on radiation pathways onsite can be investigated. After completion of Stage 3 earthworks, a final radiological assessment of the major dose pathways can be completed. The total dose in context of the site dose reference level (10 mSv/yr) can then be utilised to give guidance on the safe use of the land and water, and the safe consumption of bush foods. It is expected that additional bush foods ingestion pathway investigations will be required during the final Rehabilitation Success monitoring plan to inform the Land Management and Use Plan for site. The timing of this will be dependent on the availability of bush foods within the revegetated areas, and will align with the refined Land Management and Use Plan for the site at this time.

This sampling and study program is to be coupled with a study on metal uptake within the terrestrial food plants that may be present on site and comparing values with food safety standards for metals.

#### 3.3.2. Revegetation

A more detailed Revegetation Monitoring Plan is to be established during the Construction phase that is aligned with the principles of Landscape Function Analysis (LFA) as described in the Revegetation Strategy Framework. Top End Seeds propose a modified LFA program utilised by several other regional mine revegetation work areas (Bootu Creek and Cosmo). The revegetation program monitoring is strongly linked to the effectiveness of the fire and weed management for the site as the revegetation areas mature. The introduction of controlled fire into the revegetation area requires careful consideration and planning and, as such, will be guided by revegetation and fire management advice sought locally.

Importantly, through this Stabilisation phase, as site-specific knowledge is developed, key revegetation success criteria can be established. This will require a pragmatic approach that melds the assessment of site revegetation progression and performance with the aspirations of the Traditional Owners for the final vegetation state. Particularly, the end state of the constructed landforms will be a modified vegetation state that is similar to, though not identical to, surrounding bushland qualities.

#### 3.3.3. Feral Animals

Feral animals pose a significant risk to revegetation and rehabilitation areas particularly the planned EBFR watercourse areas. Impact to newly established surfaces and vegetation by grazing herbivores, hoof and digging impacts by both herbivores and omnivores are likely to be significant if uncontrolled. The purpose of management plan is to reduce this impact and allow sufficient time for the newly restored surfaces to stabilise and vegetation to establish. Monitoring will include camera trapping and routine inspection to establish habits and impacts from which to develop targeted response plans. Target ferals will include buffalo, pigs, donkeys and cattle.

#### 3.3.4. Restoration of Flow EBFR

It is estimated that the riparian vegetation system that is established within the original EBFR watercourse will require 5 to 8 years to establish before full flow of the EBFR can be restored through this original course. This will require specialist advice in developing a series of indicators as to when the system will be ready for this change. This is likely to occur within the Stabilisation phase of the project. If feasible, low flow 'wetting flows' will be allowed through the reinstated channel prior to full flow re-instatement, or the channel will be allowed to hold water prior to full opening to assist vegetation establishment.

Sediment transport processes are likely to be temporarily disrupted during reinstatement of the original flow path. Therefore, the project geomorphologist will assist in development of an appropriate monitoring plan for this at a later stage. Elements of the monitoring plan are likely to include:

- Regular and flow event-based visual inspections and drone-base imagery of the physical integrity of the channel and transition zones, based on established protocol for diversion and channel maintenance monitoring
- Review of the success and resilience of revegetation both prior to and subsequent to flow reinstatement
- Sediment deposition levels in the Main Pit as a guide to the likely duration of sediment-deficit conditions in the reinstated channel.

### 3.3.5. Riparian and Aquatic Flora and Fauna Survey

The expected improvement in water quality within the EBFR as a result of the site rehabilitation works is likely to see recovery of flora and fauna values within the EBFR. Over the five year Stabilisation period, one sampling round is proposed to monitor recovery in addition to the round undertaken at the end of Construction phase. The details of the works program are to be established by the project aquatic ecology specialists. It is anticipated that this work would complement the existing studies that describe the impacted values within the EBFR and FR. Therefore, it is anticipated to include:

- Aquatic fauna sampling (zones 1 to 7) of:
  - Fishes and decapod crustaceans
  - Macroinvertebrates
  - Diatoms
  - Aquatic tetrapods
  - Tissue sampling of fishes and mussels for metal(oid) concentration and radionuclide activity concentrations
- Riparian and aquatic flora (zones 1 to 7);
- Riparian fauna, particularly water monitors (zones 1 to 6); and
- Bush Tucker including sampling for metal(oid) concentration and radionuclide activity concentrations (zones 1 to 7).

### 3.3.6. Contaminated Sites Auditor

During this period, the Auditor will oversee progress towards the rehabilitation objectives and conformance to the monitoring plan and report findings to the Governance Board for information and actioning if required. This independent third party overview provides a recognised level of independent quality assurance and control over the project.

## 3.4. Adaptive Management Strategy

In the Stabilisation phase, the timing for decommissioning of the groundwater abstraction and treatment system can be estimated. The actual delivery schedule of the WRD deconstruction, copper desorption rates from the WRD saturated/unsaturated zones, and performance of the pump and treat system will determine the decommissioning point. Monitoring of the ground and surface water quality response to the rehabilitation program of works will inform future decision-making on the timing of decommissioning.

The management of the revegetation system will also require an adaptive management approach. As knowledge from both qualitative and quantitative monitoring matures across the site, so too will the

management approach to revegetation and land systems. Examples of this include remedial and maintenance works on erosion and sediment control structures, introduction of fire, weeding practices and the management of surrounding lands to improve successful outcomes within the developing final landforms.

## 4. Rehabilitation Success Monitoring Plan

### 4.1. Objectives

The purpose of the rehabilitation success monitoring program is to establish a sufficient dataset to confirm that the project's whole-of-site rehabilitation objectives are being met. It is expected that the rehabilitation success metrics will be refined over time; however, two objectives of rehabilitation success were included in the draft EIS namely:

1. Meeting the LDWQOs within the EBFR.
2. Ensure that the radiation dose assessment for the site is below 10 mSv/yr.

It is anticipated that revegetation success metrics will be established as the project's revegetation works are developed over the Construction and Stabilisation monitoring phases, and in conjunction with Traditional Owners and revegetation practitioners. Ecosystem recovery monitoring is also likely to provide valuable information to inform the final Land Management and Use Plan. Therefore, additional objectives are:

3. Evaluate revegetation and landform success.
4. Monitor and evaluate aquatic ecosystem health recovery.

### 4.2. Trigger Action Response Plan and Monitoring Locations

The Rehabilitation Success Monitoring Plan is proposed for implementation during the post-construction phase – nominally for a period of 1 to 20 years depending on progress made in Stage 3 works. It involves routine inspection, sampling and review of several elements of the site and downstream environs in order to respond to forces detrimental to landform stability and revegetation progression. Additionally, during this phase, success in meeting the LDWQOs and revegetation criteria is established. These elements, links to objectives, parameter, trigger levels and an action response plan are documented in the following Table 3-1. . The duration may be extended or reduced in the future depending on the performance of the site and potential future land claim resolution (see draft EIS for further information).

Table 4-1 Rehabilitation Success Monitoring Plan and Trigger Action Response Plan

Element	Objectives	Parameter	Location	Frequency of Monitoring	Trigger Levels	Action Response Plan	Comment
Surface water	1	See Table 4-2	Sites within EBFR and FR	Start and end of wet season	LDWQOs	Variation against LDWQOs triggers investigation. LDWQOs may require amendment during this phase.	Purpose of this data collection at this point is to track progress of improvement post-construction.
Groundwater	1	See Table 4-2	Main Pit, Int Pit, WRDs, WSFs (new).	Six monthly	n/a	n/a	Data utilised in investigation where needed.
Radiation dose	2	Radiation Dose Assessment	Rum Jungle Site	One program	n/a	n/a	Purpose of this program is to complete site dose assessment by undertaking the ingestion pathway assessment. This will be assessed against the dose reference level of 10mSv/yr and inform the final Land Management and Use Plan.
Fire prevention	3	Fire break condition	All revegetation areas	End of wet season	Breaks in poor condition	Repair at end of wet season.	
Fire impact	3	Fire impact	All revegetation areas	Event based	Fire passes through revegetation areas – controlled or uncontrolled	Monitor revegetation response to fire.	
Weed impact	3	Weed presence	All revegetation areas	Seasonal	Presence of high risk weeds	Notify Land Management Supervisor for immediate attention.	More detail will be provided in the Weed Management Plan once it has been developed.
Ferals impact	3	Impact to revegetation by feral animals	All revegetation areas	Six monthly	Impact causing detriment	Identify species and plan for targeted response.	More detail will be provided in the Feral Animal Management Plan once it has been developed.
Erosion	3	Terrestrial, aquatic and riparian landforms	Waste Storage Facilities, EBFR channel and banks	Monthly during wet season	Serious erosion causing detriment to control structures or vegetation.	Immediately investigate erosion triggers and impact. Work with technical experts to develop remedial works plans.	
WSF Lysimeters	3	Pore gas concentrations, temperature and moisture	East and West WSFs	Continuous	Significant deviation from baseline	Trigger investigation.	Establish baseline data for WSF performance and capture data for investigation work as required. Refer to Appendix 20 Section 3.5.4 of that report.
Revegetation	3	Landscape Function Analysis	To be established – all revegetation areas	3 yearly intervals	Notable poor trend performance	Investigation into cause of performance deficiencies.	See Top End Seeds (2020) for further information (Supplementary Report Appendix 27) and Draft EIS section 7.12.
Aquatic fauna and flora	4	Survey to be defined by project aquatic ecologists	Downstream Zones 2 to 6	5 yearly intervals	n/a	n/a	Purpose is to collect data to contribute to understanding of aquatic ecosystem recovery.

Table 4-2 Summary of Water Monitoring Program

Program	Frequency	Sites	Parameters
Surface Water	Six monthly	WCus, WCusEB, FC@LB, EB@LB, TCus@LB, MP, IP, EBusWTP, EB@GS200, EB@GS097, EB@GS327, TC@LB, EBdsLB, EBdsRB, EBusFR, FRusEB, FRusFC, FRdsFC.	To be modified and rationalised based on previous stage data, but based on LDWQOs.
Groundwater	Six monthly	SIS bores – reduce to 4 for monitoring purposes based on previously collected data, MB17-24D/S, RN23304, MB14-06D/S, RN22544, RN23419, RN37711, RN23791, RN23792, MB14-20D/S, RN37725, RN22107, RN22107.	To be modified and rationalised based on previous stage data.

The surface water and groundwater monitoring points noted in the Table 4-1 are listed in Table 4-2 and mapped above in Figure 3-1 and Figure 3-2.

## 4.3. Additional Detail

This section provides additional detail about some of the elements that will be monitored in this phase.

### 4.3.1. Radiation

It is expected that additional bushfoods ingestion pathway investigations will be required during the final Rehabilitation Success monitoring plan to inform the Land Management and Use Plan for site. The timing of this will be dependent on the availability of bushfoods within the revegetated areas and will align with the refined Land Management and Use Plan for the site at this time.

### 4.3.2. Landform Stability

Terrestrial, riparian and aquatic zones may require additional long term qualitative and quantitative monitoring depending on the progress made during earlier stages. Visual inspections for erosion, fire and feral impact will also be required but the program for this will be developed in future if required.

SLR outlines erosion monitoring requirements in the WSF Construction and General Site Civil Works report Appendix C titled *Erosion Assessment for the new Waste Storage Facility* (Section 7 of this report). Elements include phot monitoring, LiDAR survey, visual inspection, tunnel erosion assessment and high resolution imagery for normalised difference vegetation index assessment. This section also includes a trigger action response table.

Additional lysimeter specifications are included within the WSF Construction and General Site Civil Works report.

### 4.3.3. Weeds

Weed management is likely to be required over the long term as the site is surrounded by heavily impacted land parcels. The weed monitoring and management plan for Stage 4 works will be developed at a later stage and informed by the progress made during Stage 3 works.

### 4.3.4. Riparian and Aquatic Flora and Fauna Survey

- The expected improvement in water quality within the EBFR as a result of the site rehabilitation works is likely to see recovery of flora and fauna values within the EBFR. Over the rehabilitation success period, aquatic flora and fauna survey is proposed for a 5 yearly basis. The details of the works program are to be established by the project aquatic ecology specialists. It is anticipated that this work would complement the existing studies that describe the impacted values within the EBFR and FR. Aquatic fauna sampling (zones 1 to 7) of
  - Fishes and decapod crustaceans
  - Macroinvertebrates
  - Diatoms
  - Aquatic tetrapods
  - Tissue sampling of fishes and mussels for metal(oid) concentration and radionuclide activity concentrations
- Riparian and aquatic flora (zones 1 to 7);
- Riparian fauna, particularly water monitors (zones 1 to 6); and
- Bush Tucker including sampling for metal(oid) concentration and radionuclide activity concentrations (zones 1 to 7).

## 4.4. Adaptive Management Strategy

The details of the Stage 4 Land Management and Use Plan will be derived and driven by the needs of Traditional Owners, with the Proponent providing the foundation information around radiological assessment and engineering requirements for the site. The final Land Management and Use Plan will need to adapt to the findings of the radiological assessment, and incorporate the management and maintenance needs of the site to support stabilisation and revegetation processes. The timing of future access may be staged whereby, for example, Traditional Owners can walk on country sooner than bushfoods can be sourced from country. Results from weed, revegetation and landform stability monitoring will inform the adaptive management strategy for the site as the land management practices mature for the post-construction condition.

## 5. Reporting

Reporting of exceptions and trigger events during the Construction and Stabilisation phases will be carried out through the Project's reporting structure, including reporting of progress internally via the Governance Board reporting cycle.

Reporting of progress and data to DENR and the public is expected to be carried out annually during the Construction phase, then two yearly post-operations. Reporting of operational compliance matters are to be established within the Waste Discharge Licence.

## 6. Relationship to Management Plans

It is important to note that elements of this draft Monitoring Plan are related to content of planned future management plans. These are presented throughout this document (Tables 2-1, 3-1 and 4-1) and also here in Table 6-1 at a high level for the purpose of demonstration of the conceptual management, monitoring and reporting framework for Stage 3 and Stage 4.

Table 6-1 Links to planned future management plans

Management Plan	Monitoring Requirements	Link to draft EIS
Cultural Heritage	Contained within the MP and relate to Construction Phase only, as post-construction works there are no planned activities impacting on cultural heritage elements.	8.4
Radiation	Construction phase objectives relate to worker and public safety. Post-construction objectives relate to guidance of the Land Management and Use Plan and site user safety during late Stage 3 and Stage 4.	7.12.1, 16.3, 16.4
Revegetation	Ranges from establishment of baseline and analogue conditions, tracking of development progress, establishment of completion criteria and tracking against those criteria during Stage 3 and 4.	7.11.3, 7.12.1, 12.4.1
Weeds	Requirements based on risk mitigation during Stage 3 and Stage 4.	14.5.2
Fire	Requirements based on risk mitigation during Stage 3 and Stage 4.	8.3.6, 15.4.3,
Feral Animal	Requirements based on risk mitigation during Stage 3 and Stage 4.	7.11.4, 7.12.1, 17.4.1

Water	As documented within this plan. Ranges from Construction phase operational control through to long term monitoring of rehabilitation completion criteria during late Stage 3 and Stage 4.	7.12.1, 10.7.1, 10.7.2, 11.4,
-------	---	-------------------------------

In addition to the above listed plans, various site operational procedures may require monitoring elements – such as the Vegetation Clearance Procedure and the Cycad Salvaging Procedure. These will be determined in future, should Stage 3 works achieve approval and funding.

## 7. Role of the Contaminated Sites Auditor

Throughout the Stage 3 and Stage 4 works program, the Contaminated Sites Auditor will perform a key quality assurance role and report directly to the Governance Board. This overarching role will include routine review of conformance with construction quality assurance/quality control parameters as established within the construction technical specifications. Additionally, the Auditor will review progress towards achieving the overall project objective of improving the water quality within the EBFR. Progress on impacted elements that may constrain future land use (e.g. radiological material clean-up, groundwater clean-up, revegetation and aesthetics) will also be reviewed routinely by the Auditor. The purpose of this is to ensure that the Auditor can advise on and issue a Land Management and Use Plan for the site after the Stage 3 works are complete.

It is envisaged that although Stage 4 long term monitoring may not be complete, safe restricted access may return for the Traditional Owners of the site at the advice of the relevant specialists (radiation, contaminated sites) and after a system of approved access is developed. This would foster continuation of reconnection to country and progressive steps towards resolving the outstanding land claim. The role of the Auditor will therefore be to advise the Governance Board on conformance to the site's quality processes and progress towards rehabilitation objectives, and certifying progressive steps towards a positive future land use.

## 8. Data Capture

All monitoring data captured for the project will continue to be stored within the Department's current database system – ESDAT. Hard copy records, photographic records, calibration records and other pertinent supporting data will be kept within the monitoring team's record keeping system. This data will be required to support external reporting and the role of the Contaminated Sites Auditor. NATA-accredited environmental water laboratories will be utilised for environmental sample analysis, and calibrated equipment will be used for field data collection.

## 9. Review

This draft Monitoring Plan is to be finalised during the preliminary phases of project establishment, should the funding approval be granted for this project. After this time, the plan is to be reviewed annually during the Stage 3 works. At the commencement of Stage 4 works, the plan should be refocused on rehabilitation progression and success and, as such, reviewed on a two-yearly basis.