SUBTERRANEAN FAUNA MANAGEMENT PLAN

EPA Assessment No 2087

Prepared by Reward Minerals Ltd

9 November 2018

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RevA	Submitted as attachment to draft ERD	LC/DT		2/01/2018
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SUMMARY

This preliminary Subterranean Fauna Management Plan (SFMP) has been prepared to support the revised Environmental Review Document submitted to the WA Environmental Protection Authority (EPA) on the 9 November 2018. This document has been prepared in accordance with the *Instructions on how to prepare Environmental Protection Act 1986, Part IV Environmental Management Plans* (EPA, 2017). This is a live document that will be regularly updated throughout project development as further information becomes available.

Item	Description
Title of the proposal	Lake Disappointment Potash Project
Proponent name	Reward Minerals Ltd.
Ministerial Statement Number	
Purpose	To provide a management framework for subterranean fauna and their habitats to avoid, minimise and mitigate potential adverse impacts and support the Environmental Review Document
EPA objectives	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.
Condition clauses	TBA
Key provisions in the plan	*As described in Table 2-1 and Table 2-2*

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CONTENTS

Figures

TABLES

1 CONTEXT, SCOPE AND RATIONALE

1.1 PROPOSAL

The Lake Disappointment Potash Project proposes to produce up to 400,000 tonnes per annum (tpa) sulfate of potash (SOP) over a 20 year life-of-mine by solar evaporation and processing of potassium rich brines abstracted from sediments of the Lake Disappointment playa. Lake Disappointment is located approximately 320 km east of the town of Newman WA, in the Little Sandy Desert region of Western Australia (Figure 1-1). The proposal requires establishment of a brine supply network on the Lake Disappointment playa and associated off-playa infrastructure (Figure 1-2, Figure 1-3). This includes:

- A brine supply network to abstract up to 63 million m^3 of hyper-saline brine each year once production reaches full capacity. Consists of shallow trenches and pipelines to abstract near-surface hypersaline groundwater from sediments of the Lake Disappointment playa.

- A series of evaporation, back-mix and crystalliser ponds to progressively concentrate and crystallise potassium salts from the hypersaline ((TDS of approximately 300,000 mg/L) brine.

- An SOP plant where harvested salts are leached with process water producing a high-quality SOP product which is dried and transported for sale.

- Process water bore fields (Cory bore field and Northern bore field) to supply up to 3.4 GL per year over a period of 20 years.

- Establishment and use of offices, laboratory, workshop, accommodation village and airstrip.

The Lake Disappointment Potash project is located entirely within the determined Native Title claim area held by the Martu People (WCD2013/002) on vacant crown land. There is no pastoral tenure over any part of the project area.

1.2 SCOPE

This management plan applies to potential impacts on subterranean fauna associated with groundwater abstraction from the Northern and Cory bore fields. Unlike many resource projects, the activities proposed by Reward do not include removal of habitat through the creation of open pits or underground voids extending below the water table.

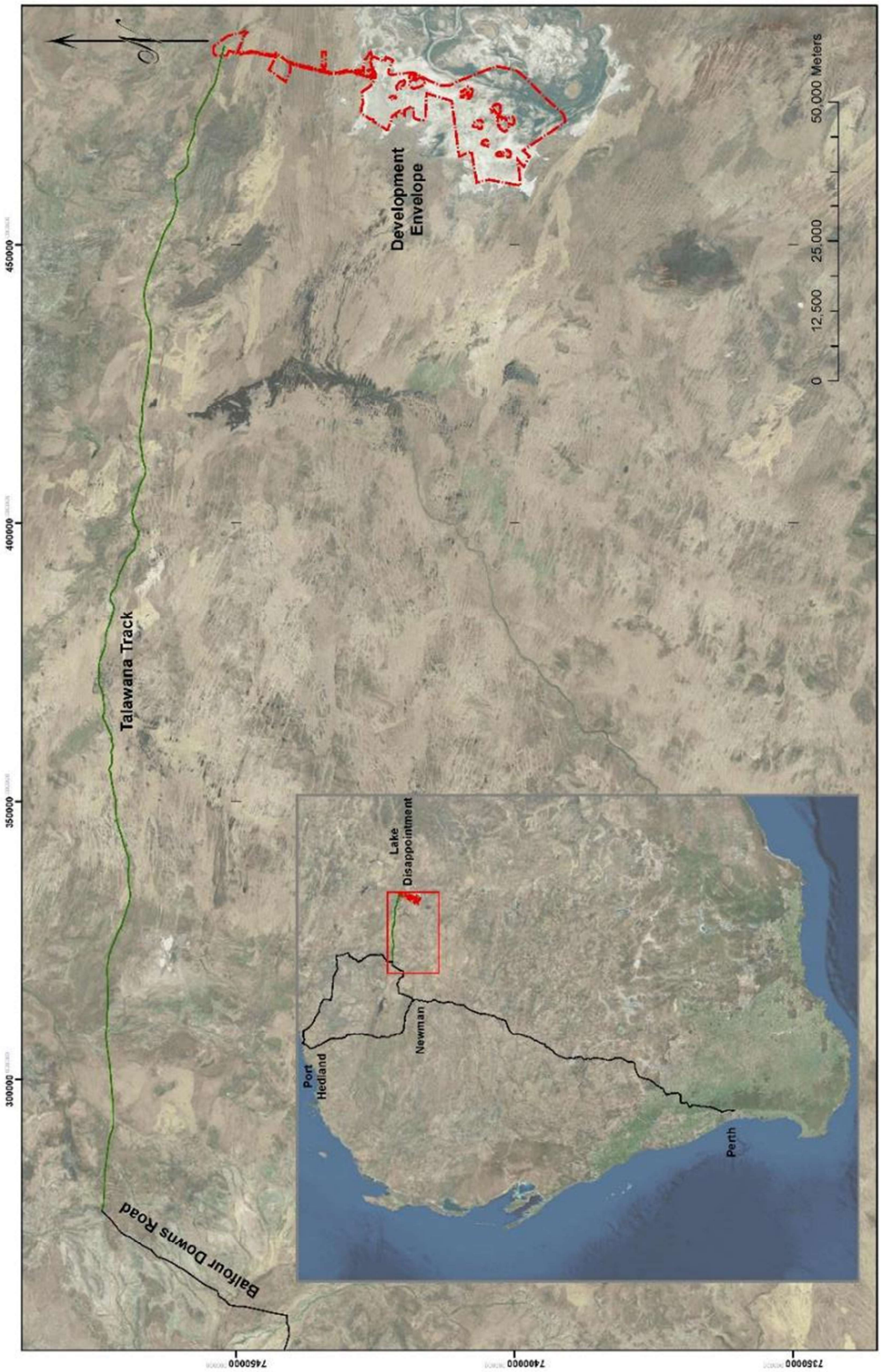


Figure 1-1: Proposal location showing access track and disturbance boundary

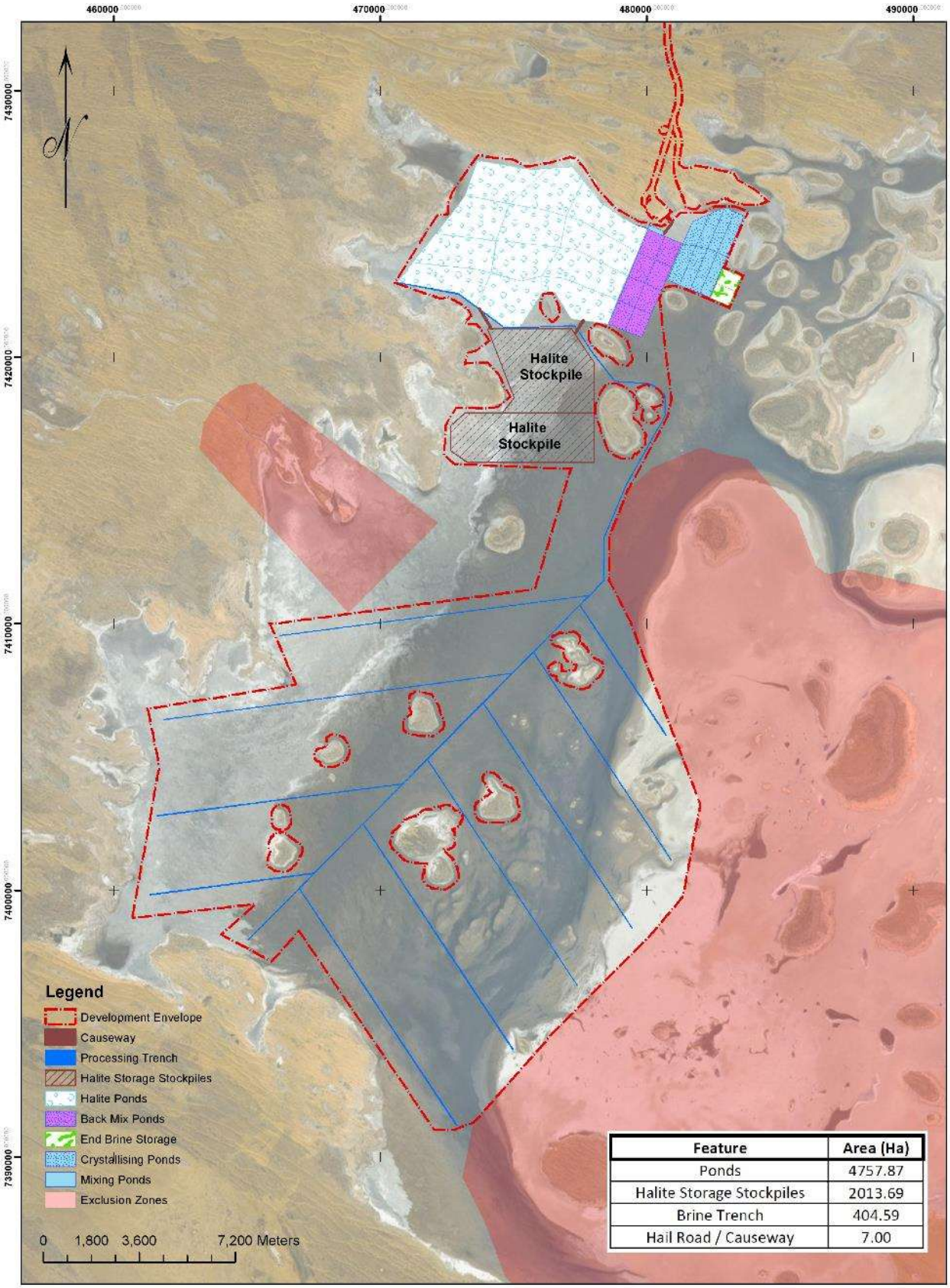
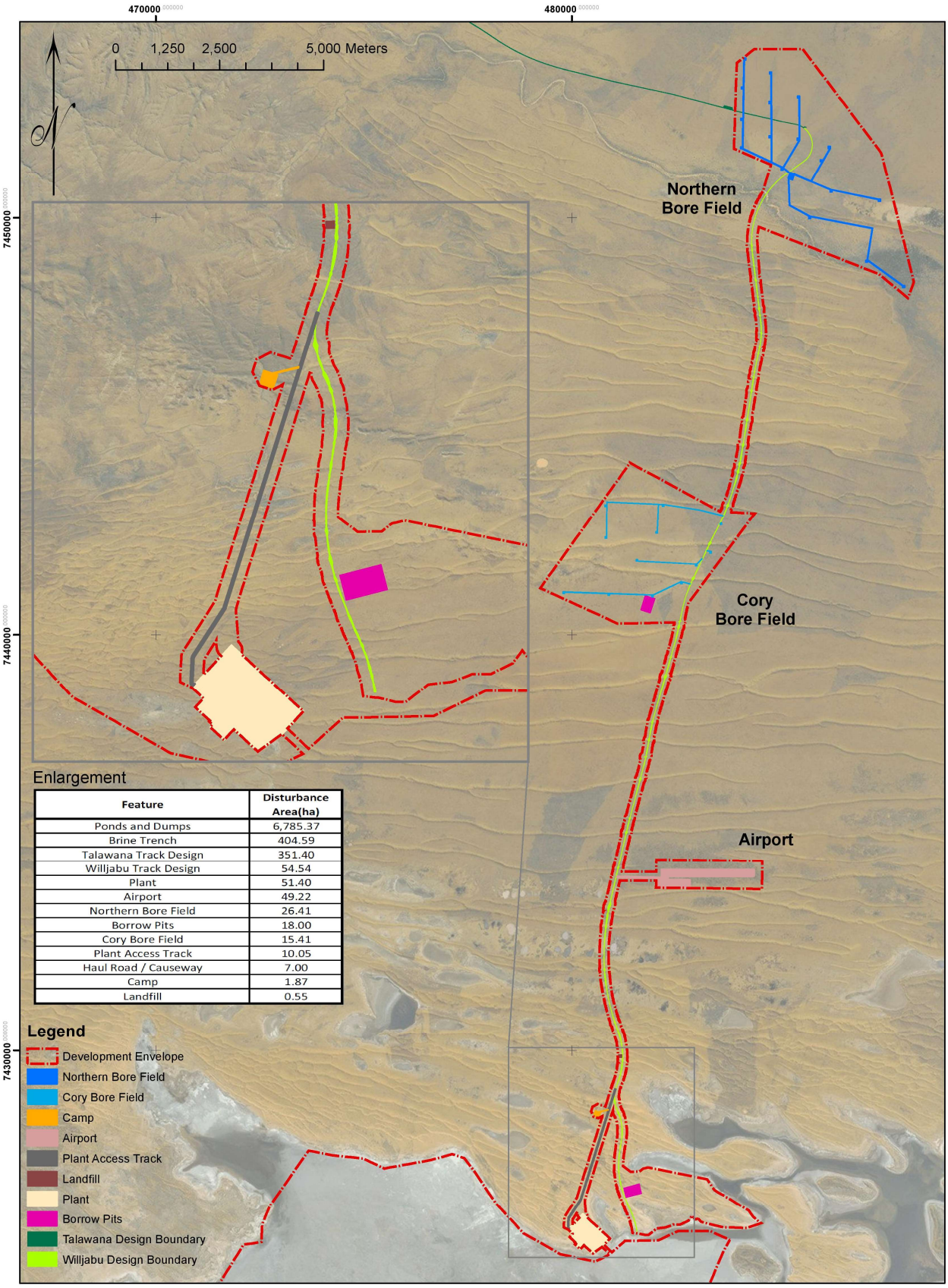


Figure 1-2: On-playa proposal layout and disturbance envelope



Feature	Disturbance Area(ha)
Ponds and Dumps	6,785.37
Brine Trench	404.59
Talawana Track Design	351.40
Willjabu Track Design	54.54
Plant	51.40
Airport	49.22
Northern Bore Field	26.41
Borrow Pits	18.00
Cory Bore Field	15.41
Plant Access Track	10.05
Haul Road / Causeway	7.00
Camp	1.87
Landfill	0.55

Figure 1-3: Off-playa proposal layout and disturbance envelope

1.3 KEY ENVIRONMENTAL FACTOR – SUBTERRANEAN FAUN

Subterranean fauna are highly specialised invertebrates adapted to living in voids in the underground environment. Subterranean fauna are difficult to observe due to their concealed habitat. Species are often morphologically similar which hinders identification. Stygofauna are considered to have inherent biodiversity value and may provide important ecological services in groundwater (EPA, 2016).

This Subterranean Fauna Management Plan (SFMP) applies to the areas within the project development envelope that potentially contain habitat suitable for subterranean fauna. The main threat to subterranean fauna from project implementation is the potential loss of habitat as a result of groundwater abstraction from the proposed process water bore fields. The proposal does not include excavation of open pits or underground voids extending below the water table.

The Lake Disappointment playa is unlikely to contain suitable habitat for subterranean fauna. Sediments typically consist of low to medium plasticity clay overlain by a thin (0.1 m – 0.2 m) layer of interlaminated silty sand and gypsum salt which is unlikely to support burrows and groundwater is shallow, about 0.5 m depth, and hypersaline with salinities recorded between 200,000 mg/L and 300,000 mg/L TDS. Troglofauna species depend upon subsurface voids above the water table for habitat and stygofauna are most commonly found at salinities less than 5,000 µS/cm (approximately 2,750 mg/L TDS), with the maximum tolerable level identified as 44,800 µS/cm (approximately 25,000 mg/L TDS) in Western Australia (4T, 2012).

Reward has identified two potential bore fields (**Error! Reference source not found.**). The proposed Cory bore field located approximately 16 km north of Lake Disappointment would draw slightly brackish (TDS ≈ 2,500 mg/litre), water from a fractured rock aquifer within a sandstone of the Tarcunyah Group. Water would be pumped from a depth of approximately 60 m at an average rate of 8 L/s.

The Northern bore field is located approximately 25 km north of the Lake Disappointment shoreline. The Northern bore field confined aquifer is hosted in Tertiary alluvium and weathered sandstone of the Tarcunyah Group at a depth of about 80 m. Water flows ranging from approximately 5 to 10 litres/second have been encountered in most of the holes drilled/tested to date at this location. The Cory bore field will target slightly alkaline and brackish groundwater (typical TDS of 2,500mg/L) of the Gunanya Sandstone fractured rock aquifer. The Northern bore field will target a slightly alkaline and brackish to saline (TDS range from 2,200 mg/L to 17,000 mg/L) confined aquifer of Tertiary age sands and clays overlying the Proterozoic rock basement. Subterranean fauna have been identified at these locations by surveys undertaken between October 2016 and October 2017 (Table 1-1, Figure 1-5)

Table 1-1: Subterranean fauna sampling effort

Sampling round	**Proposed bore fields**		**Regional bores**		**Total**
	Net	Pump	Net	Pump	
Round 1 – Northern bore field (Oct 2016)	4	0	0	2	8
Round 1 – Cory bore field (Oct 2016)	2	0			
Round 2 – Northern bore field (March 2017)	6	0	0	0	8
Round 2 – Cory bore field (March 2017)	2	0			
Round 3 – Northern bore field (June 2017)	6	0	2	3	14
Round 3– Cory bore field (June 2017)	2	1			
Round 4 – Northern bore field (October 2017)	6	0	1	4	14
Round 4 – Cory bore field (October 2017)	2	1			
Total	30	2	3	9	44

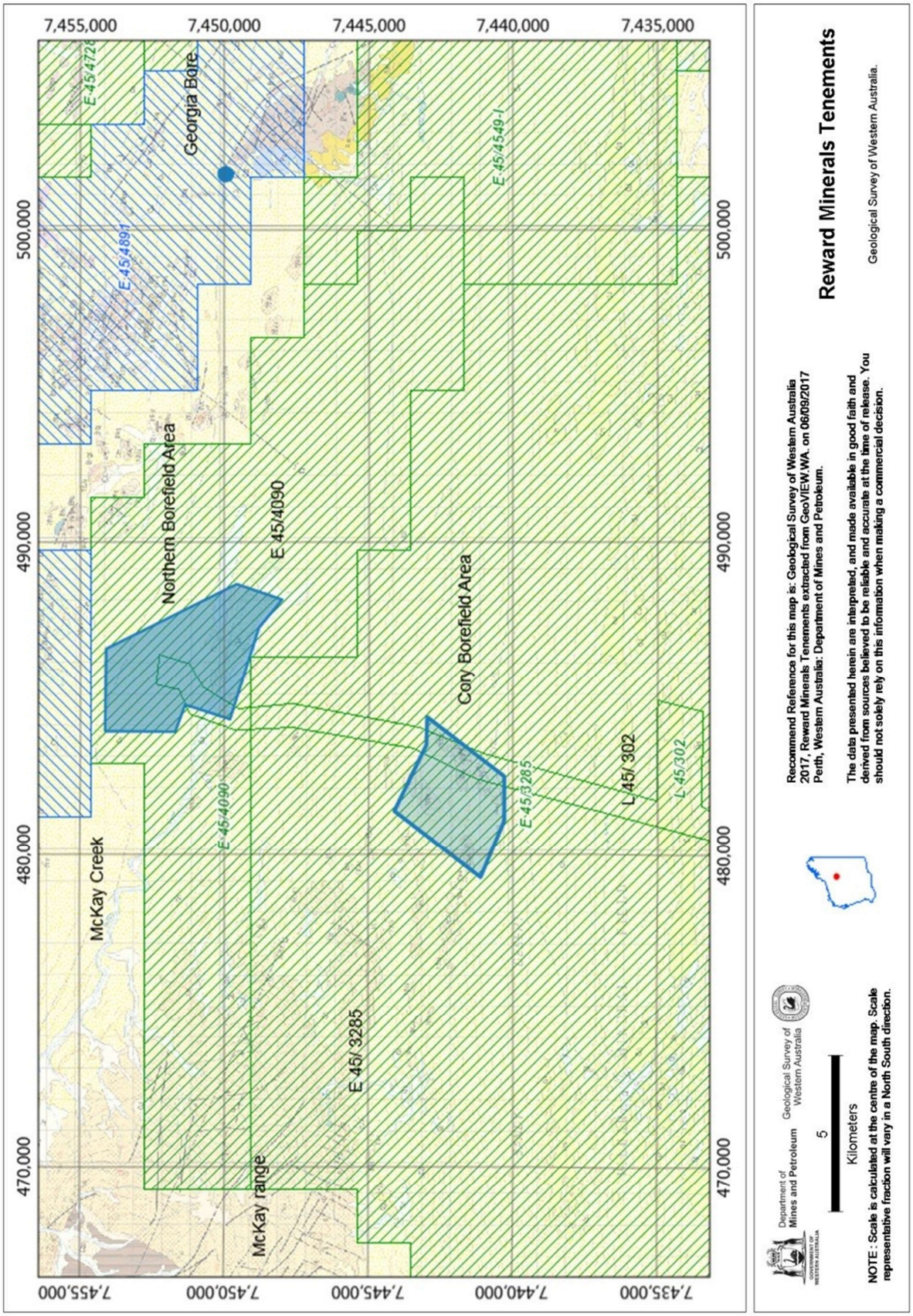


Figure 1-4: Proposed bore field locations

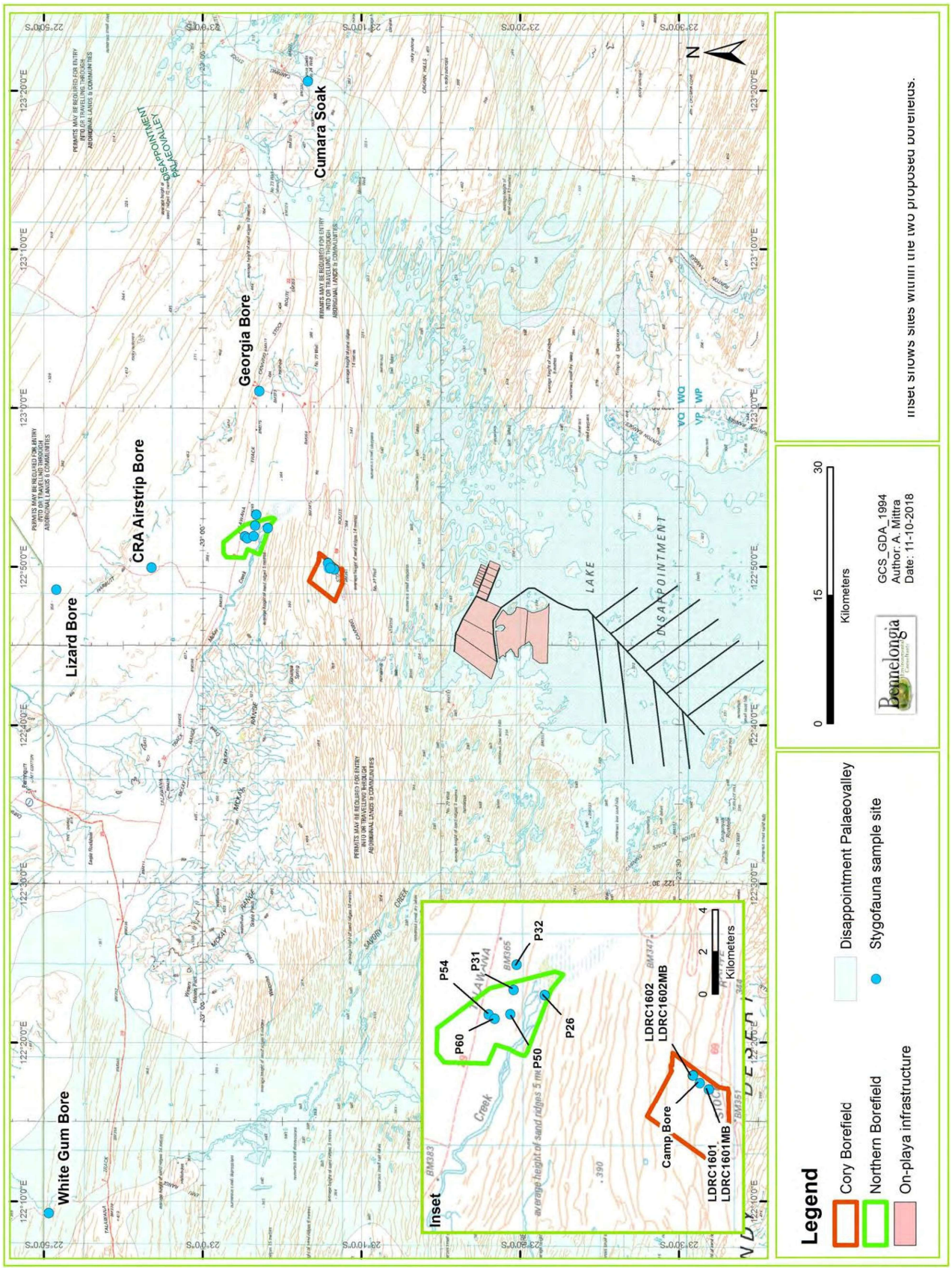


Figure 1-5: Subterranean fauna sampling locations

1.4 CONDITION REQUIREMENTS

The SFMP has been submitted in support of the ERD submitted to the EPA. As at the date of preparing this draft management plan, EPA had not completed its assessment of the Lake Disappointment potash project. Accordingly, no Ministerial Conditions have yet been recommended.

1.5 RATIONALE AND APPROACH

The SFMP adopts a risk-based approach to impact management, incorporating both outcome-focused provisions and management-focused provisions. The SFMP has been developed using a 'trigger, action, response' framework and includes trigger and threshold criteria, trigger level actions and threshold contingency actions. The management rationale adopted in the SFMP takes into account the scarcity of regional information on subterranean fauna in the project area and the relatively large natural variability in groundwater levels in the unconfined aquifers resulting from strong seasonal rainfall influences.

1.5.1 Survey and study findings

The baseline hydrogeological and subterranean fauna studies that have informed this SFMP are summarised in Table 1-2. Six species are known only from locations inside the proposed bore fields and/or inside the areas of drawdown predicted by hydrogeological modelling (Strategic Water Management 2017a, 2017b). These species are: Atopobathynella sp. B27, Dussartstenocaris sp. B08, Nitocrellopsis sp. B20, and Microcerberidae sp. B17 in the Cory bore field and Enchytraeidae sp. B18 (LD) and Enchytraeidae sp. B19 in the Northern bore field (Figure 1-6, Figure 1-7, Figure 1-8).

The actual distributions of both *Atopobathynella* sp. B27 and *Dussartstenocaris* sp. B08 are considered to be greater than shown by field survey because of (a) the likely connectivity of available stygofauna habitat throughout the Gunanya Sandstone, and (b) the locally extensive ranges of other stygofauna species recorded during survey. Sampling effort was relatively low owing to the limited availability of bores throughout the study area. Increased sampling over a larger area is proposed and could result in range extensions for these species beyond the influence of predicted drawdown.

The two enchytraeid species (Enchytraeidae sp. B18 (LD) and Enchytraeidae sp. B19) known only from in and around the Northern bore field are probably more widespread than shown by collections to date. The connectivity of suitable habitat outside the Northern bore field has been demonstrated by both hydrogeology and the ranges of other species. Further sampling would be likely to increase known ranges for these species, although the occurrence of another oligochaete, Tubificidae sp. B03 (LD) both inside the Northern bore field [including the same collection location as Enchytraeidae sp. B18 (LD)] and 15 km to the east at Georgia Bore is considered to be an adequate indication of larger ranges for both enchytraeid species. Regardless of species ranges, information in the bore field assessment suggests that minimal drawdown of primary stygofauna habitat will occur in the upper aquifer associated with McKay Creek (Strategic Water Management, 2017b) and therefore the level of impact of groundwater abstraction on stygofauna is likely to be low.

No overlapping or additive effects of groundwater drawdown are expected to result from interaction of groundwater abstraction from the two proposed bore fields. No cumulative effects on subterranean fauna populations from groundwater use by other users is likely, as there are no other significant water users in the district.

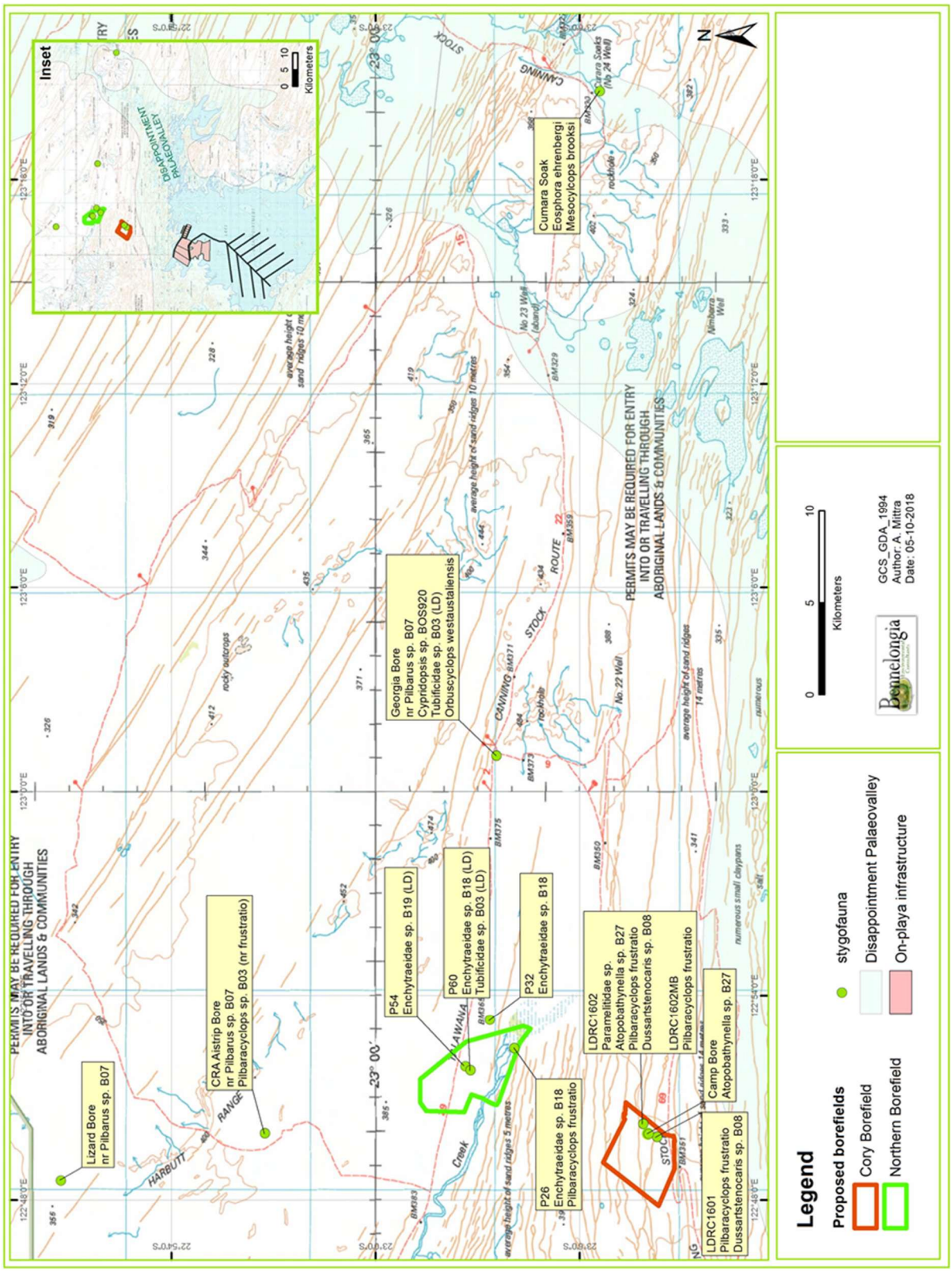


Figure 1-6: Collection locations of stygofauna species at Lake Disappointment between 2016 and 2017

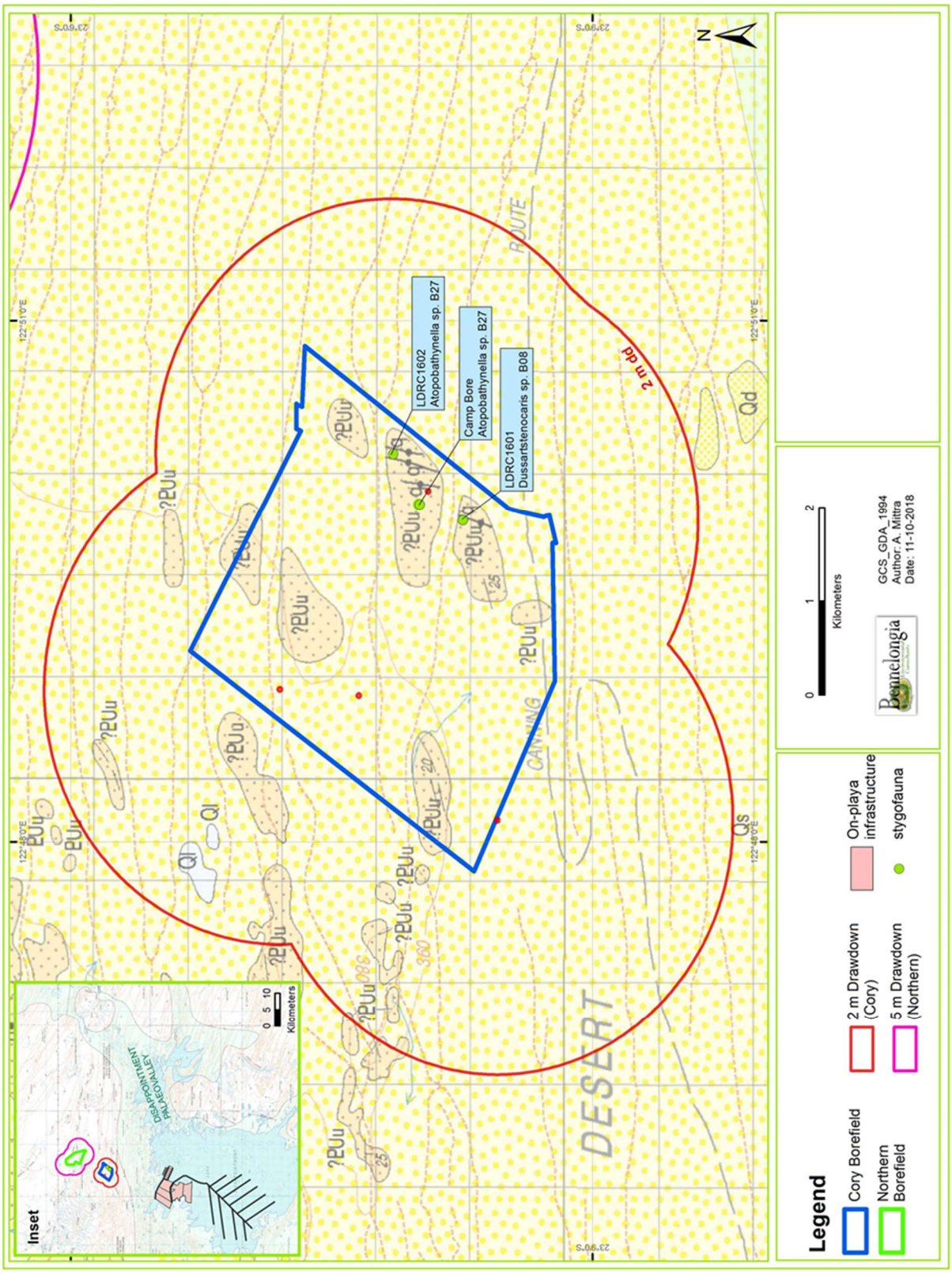


Figure 1-7: Cory bore field - locations stygofauna species known only from within the extent of 2 m drawdown

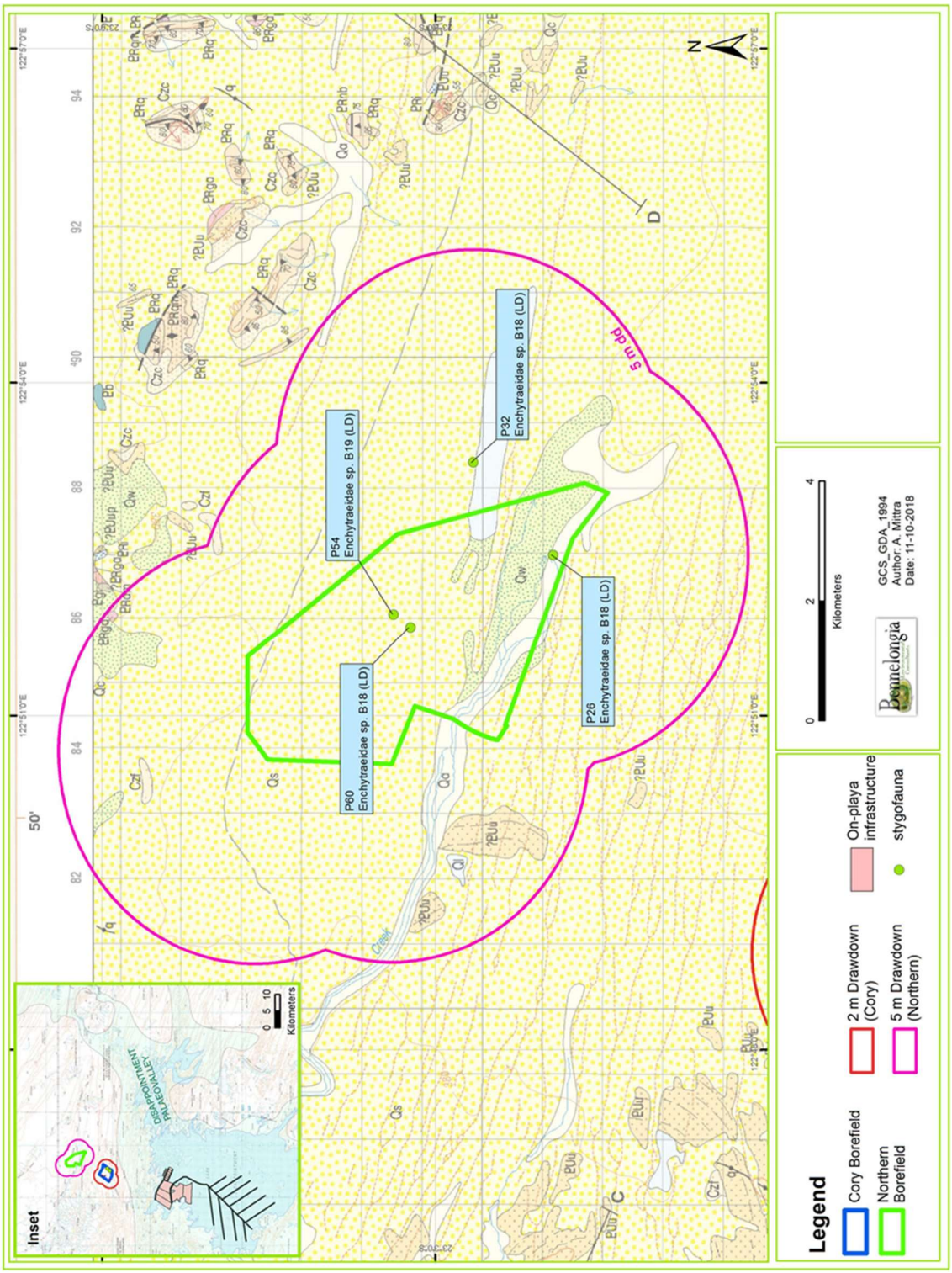


Figure 1-8: Northern bore field - locations of stygofauna species known only from within the extent of 5 m drawdown

Table 1-2: Summary of studies

Author and Title	Description
Bennelongia Environmental Consultants, 2016a. *Lake Disappointment - Subterranean Fauna Desktop Assessment*, report number 269, June 2016.	Presents the results of a desktop review conducted to assess the likelihood of subterranean fauna occurring in the Project area. Database searches covered a search area of 100 by 100 km around the Project.
Bennelongia Environmental Consultants, 2017b. *Stygofauna Values at the Lake Disappointment Potash Project*, report number 304, 22 September 2017.	Presents results of a field survey involving collection of 22 samples from nine wells in the proposed borefield and five wells in the surrounding region. The study confirmed the occurrence of stygofauna in the Project area: 16 out of 22 samples and 12 out of 14 wells yielded stygofauna. Includes preliminary assessment of potential impacts of water abstraction on subterranean fauna values.
Harewood, G., 2016b. Stygofauna Survey (Level 1) - Lake Disappointment Potash Project Reward Minerals Limited report prepared for Reward Minerals Limited December 2016.	Reconnaissance level field and desktop study conducted in October 2016. Six process water bores, located within the two proposed bore field areas, and two regional water bores located about 16km from the northern bore field were sampled. No invertebrate specimens of any type were found in samples collected from the six process bores. Samples collected from the regional bores yielded specimens from three crustacean orders: Amphipoda, Cyclopoida and Ostracoda. Some some of the amphipods specimens had affinities with stygofauna species known from other parts of the Pilbara
Strategic Water Management WA, 2017a. *Lake Disappointment - Hydrogeological Assessment of the Impact of Process Water Abstraction from the Cory Bore Field, an H2 Level Assessment for 1.5GL/year*, July 2017.	Hydrogeological assessment of the Cory bore field area. Outlines the hydrogeological investigation programme and presents the results from the analysis of test pumping and analytical modelling of the capacity to supply 1.5GL/year from the Gunanya sandstone fractured rock aquifer.
Strategic Water Management WA, 2017b. *Lake Disappointment - Hydrogeological Assessment of the Impact of Process Water Abstraction from the Northern Bore Field, an H2 Level Assessment for 2 GL/year*, September 2017.	Hydrogeological assessment of the Northern bore field area. Outlines the hydrogeological investigation programme and presents the results from the analysis of test pumping, analytical and numerical modelling of the capacity to supply 2GL/year from the Tertiary aquifer.
SKR Consulting, 2018**.** *Technical memorandum: Lake Disappointment Groundwater Review (Northern bore field and Cory bore field)*, prepared for Reward Minerals Limited, 26 September 2018.	Independent review of previous hydrogeological modelling conducted for the Lake Disappointment project, includes estimates of subfauna habitat potentially impacted by groundwater drawdown.

1.5.2 Key assumptions and uncertainties

Key assumptions

- Hypersaline groundwater (TDS >100,000 mg/L beneath the playa) is unlikely to support significant stygal populations

- Primary stygofauna habitat near the Northern bore field is probably limited to relatively small saturated zones of sand and fine gravel in the unconfined upper aquifer layer. The deeper confined aquifer targeted for mine water production is unlikely to support important stygofauna populations due to the considerable depth to the target aquifer and the presence of a substantial aquiclude which will constrain energy inflow to the target aquifer.

- The Gunanya sandstone aquifer targeted in the proposed Cory bore field is regionally extensive, extending over an area of at least 60 km2 to the south and east of the McKay Ranges.

- Seasonal rainfall is expected to result in discernible recharge of the Gunanya aquifer in most years and net effective recharge of approximately 5 – 10 m every 10 years. The influx of meteoric water will influence the magnitude and extent of groundwater drawdown near the Cory bore field.

- Annual variations in depth to groundwater are in the order of 3 m to 5 m. Typical end of dry season depth to groundwater is approximately 10m to 12m below ground level.

- Hydraulic connections between the proposed Cory bore field and the proposed Northern bore field are minimal and accordingly no overlapping or additive effects of drawdown are expected to result from interaction of groundwater abstraction from the two proposed bore fields. The subterranean fauna assemblages in each bore field are distinct from one another, with only one species, *Pilbaracyclops frustratio*, which is widespread outside the survey area, recorded in both borefields.

- Groundwater drawdown in the upper unconfined aquifer overlying the proposed Northern bore field is likely to be minimal, providing water production bores are screened only in the deeper, confined aquifer.

- Recovery of groundwater levels in the fractured rock Gunanya Sandstone aquifer is expected to be rapid (within 12 to 24 months) after cessation of groundwater abstraction.

- Cumulative effects from other groundwater users or from overlapping or additive effects of drawdown between the two proposed bore fields are unlikely.

Uncertainties

- The extent of groundwater drawdown at any given time in the Gunanya sandstone is difficult to predict due to the fractured character of the aquifer and the variable influence of rainfall recharge.

- Given the relatively large seasonal variability in depth to groundwater, it is uncertain what rate and / or magnitude of groundwater drawdown would impose an ecological stress on the local subterranean fauna community.

- The distributions of *Atopobathynella sp.* B27 and *Dussartstenocaris sp*. B08 (observed at the proposed Cory bore field) and of *Enchytraeidae sp*. B18 (LD) and *Enchytraeidae sp*. B19 (observed at the proposed Northern bore field) beyond the project locality are unknown.

1.5.3 Management approach

Baseline hydrogeological and subterranean fauna studies provide a basis for Reward's proposed management of potential impacts on subterranean fauna habitats. The mitigation hierarchy of avoid, minimise, rehabilitate and offset has been employed to limit impacts as low as reasonably achievable and the results of risk assessments have defined the outcome based management criteria.

For the Northern bore field, management of impacts on subterranean fauna is based on limiting water abstraction from the shallow unconfined aquifer, thereby avoiding changes in the more prospective subterranean fauna habitat.

For the Cory bore field, management of impacts is based on implementing a distributed water supply system that can be managed adaptively to limit the magnitude and duration of water drawdown effects, while progressively acquiring more regional information about the stygal fauna of the Gunanya Sandstone system.

The management and mitigation measures that will be implemented to prevent or minimise adverse impacts on stygofauna include:

- Screening of production bores in the Northern bore field only in the deeper confined aquifer, to avoid producing groundwater drawdown in the more prospective shallow groundwater aquifer associated with McKay Creek.
- Establishment and monitoring of additional subterranean fauna monitoring bores in the Gunanya Sandstone.
- Establishment of distributed production bore networks with some redundancy so that selected bores can be temporarily shut off if unacceptable drawdown effects become apparent during bore field operation.
- Operation and monitoring of both the Cory and the Northern bore fields in accordance with groundwater operating strategies approved by the DWER. The operating strategies will include specific trigger values to support an adaptive management framework aimed at minimising impacts on subterranean fauna habitat.
- At least 3-yearly update/recalibration of the groundwater models based on input of actual monitoring and abstraction data. This will allow comparison of predicted and actual groundwater drawdowns and will enable the stygofauna impact assessment to be updated.

1.5.4 Rationale for choice of provisions

Northern bore field

The rationale for the proposed management approach to subterranean fauna impacts associated with water abstraction may be summarised as follows:

> *By maintaining existing hydrological processes in the unconfined aquifer, core subterranean fauna habitat will be protected. Water abstraction from the deeper confined aquifer is unlikely to materially alter groundwater processes in the unconfined aquifer due to the protective effect of the intervening low permeability aquiclude*.

The target outcome for factor 'subterranean fauna' as it relates to proposed water abstraction from the Northern bore field is to maintain pre-development groundwater levels in the unconfined aquifer. The indicators that will be used to assess the target outcome are:

- Bore construction records (showing that water draw points are limited to the confined aquifer)
- Water level measurements in the confined and unconfined aquifer
- Groundwater trends and responses to seasonal wetting and drying events (variation relative to pre-development seasonal water level variability)

The threshold level set for groundwater drawdown in the unconfined aquifer (1 m) relies on observations of natural groundwater level changes during the period October 2016 to October 2017. It is possible that continuing groundwater monitoring will show natural groundwater variability to be greater than that observed to date. However adopting the 1 m drawdown as a provisional threshold value provides a conservative basis for managing impacts on the unconfined aquifer and the biota supported by that aquifer.

The assumption that primary stygofauna habitat near the Northern bore field is probably limited to relatively small saturated zones of sand and fine gravel in the unconfined upper aquifer layer will be tested through ongoing sampling of selected bores established in the unconfined and confined aquifers.

Cory bore field

The proposed management approach to subterranean fauna impacts associated with water abstraction from the Cory bore field may be summarised as follows:

> *The bore field will be operated so that extent of groundwater drawdown equal to or greater than 2m below the usual seasonal standing water level does not extend beyond a distance of 3 km from a given production bore. If drawdowns greater than 2m persist for more than 12 months in the area beyond the 3 km impact radius, bores will be 'rested' to allow local recovery of groundwater levels.*

The rationale for the proposed management approach relies on the observation that local seasonal variations in groundwater levels in Gunanya Sandstone aquifer are in the order of 4m (Strategic Water Management, 2017b) and also takes into account the fact that the aquifer is regionally extensive and likely to be hydraulically continuous with the part of the aquifer from which water is proposed to be abstracted. Accordingly, the management strategy seeks to limit the effects of groundwater abstraction to a magnitude and duration that will not give rise to significant reduction in available subterranean fauna habitat.

The indicators that will be used to assess the effectiveness of the proposed management strategy are:

- Compliance with authorized water abstraction limits and other elements of the approved groundwater operating strategy
- Water level measurements in the Gunanya Sandstone aquifer
- Groundwater responses to seasonal wetting and drying events

The assumption that the fractured rock Gunanya Sandstone aquifer offers an extensive and continuous habitat that hosts species known to occur in the proposed Cory bore field will be tested through ongoing sampling of selected bores established in both inside and outside the estimated 2m drawdown contour. The hydraulic properties of the aquifer will be periodically reviewed and updated through reviews of the bore field hydrogeological model.

2 EMP PROVISIONS

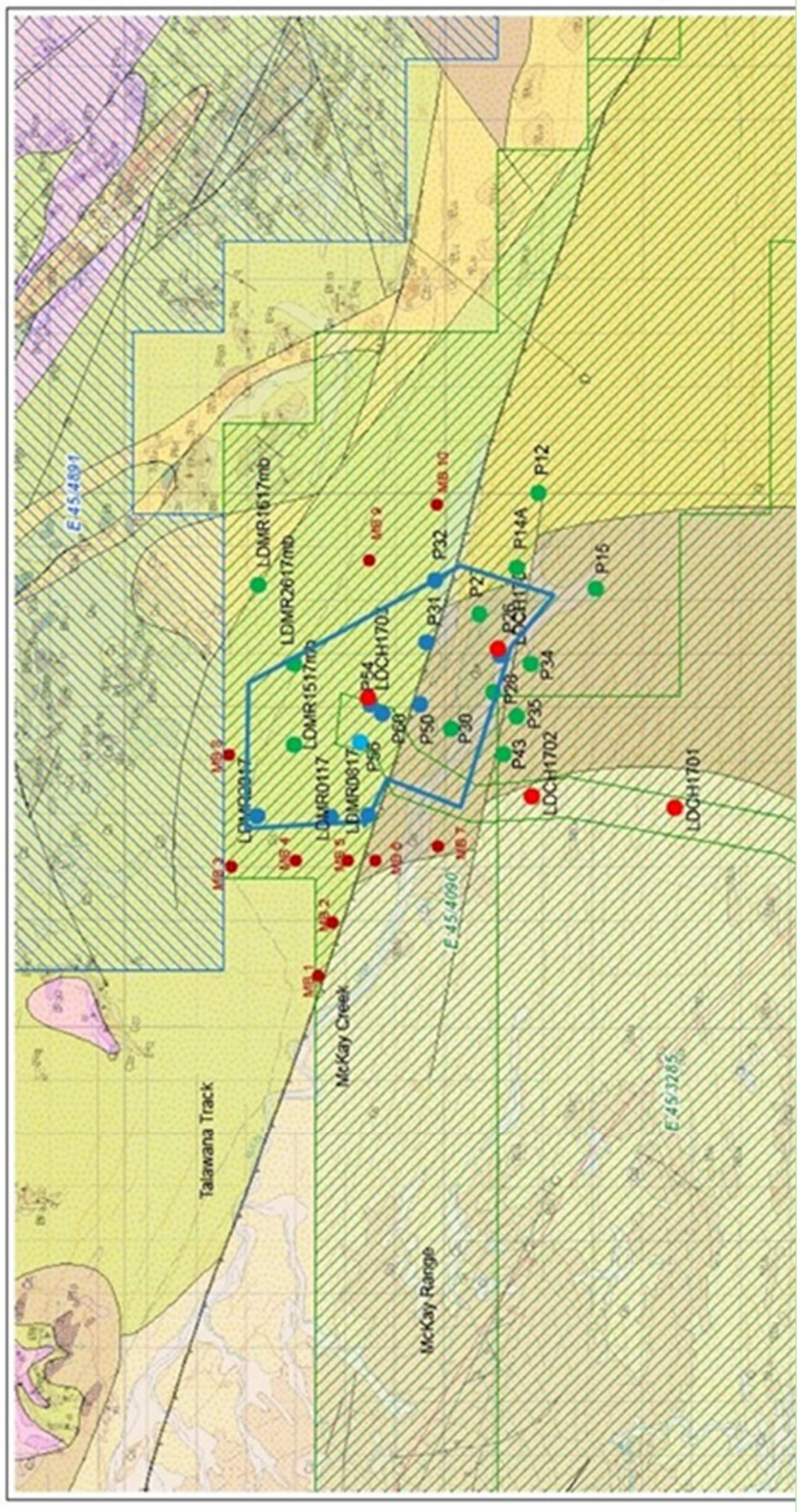
2.1 NORTHERN BORE FIELD

EPA factor and objectives: To protect subterranean fauna so that biological diversity and ecological integrity are maintained

Outcomes: Pre-development groundwater hydrological processes in unconfined aquifer are not significantly altered

Key risks and associated impacts: Groundwater abstraction causes drawdown of water table (beyond usual seasonal drawdown) and reduces habitat available to subterranean fauna during bore field operations.

Outcome-based provisions			
Environmental criteria	Response actions	Monitoring	Reporting
Trigger criterion 1: monitoring bores in	Review water abstraction records Consider water levels in context of weather data.	Continuous collection of groundwater level information – reviewed monthly. Continuous monitoring of water abstraction amounts – reviewed monthly.	Annual compliance reporting to DWER
Threshold criterion 1: monitoring bores in unconfined aquifer show response to water abstraction in confined aquifer (drawdown is ≥1m)	Temporarily halt water abstraction from bores within 1 km of affected monitoring bore. Review water abstraction records.		Exceedance reporting as per Environmental Compliance Plan.
Management-based provisions			
Management actions	Management targets	Monitoring / evidence	Reporting
Management action 1: screen production bores only in confined aquifer [Priority 1; timing – prior to operational use of bore field]	All production bores screened only in confined aquifer, with appropriate seals to prevent leakage between aquifers.	Bore construction logs	Annual aquifer report to DWER
Management action 2: Establish monitoring bores in the	Establish a network of 10 paired (shallow and deep) monitoring bores equipped with groundwater level loggers	Data logger data (downloaded monthly)	Annual aquifer report to DWER

confined and unconfined aquifers [Priority 2; timing – prior to operational use of bore field]	( Figure 2-1).		
Management action 3: Conduct additional sampling for subterrane	Complete 3 rounds of follow up subfauna sampling within 3 years of establishing monitoring bore network.	Subfauna monitoring results.	Annual Part IV compliance report to DWER

an fauna [Priority 2; timing – starting 3 to 6 months after completion of additional monitoring bores]			
Management action 4: Operate bore field in accordance with DWER approved groundwater operating strategy [Priority 1; timing – during operational use of the bore field]	No non-compliance with approved groundwater operating strategy.	Water abstraction records and groundwater monitoring results.	Annual aquifer report to DWER

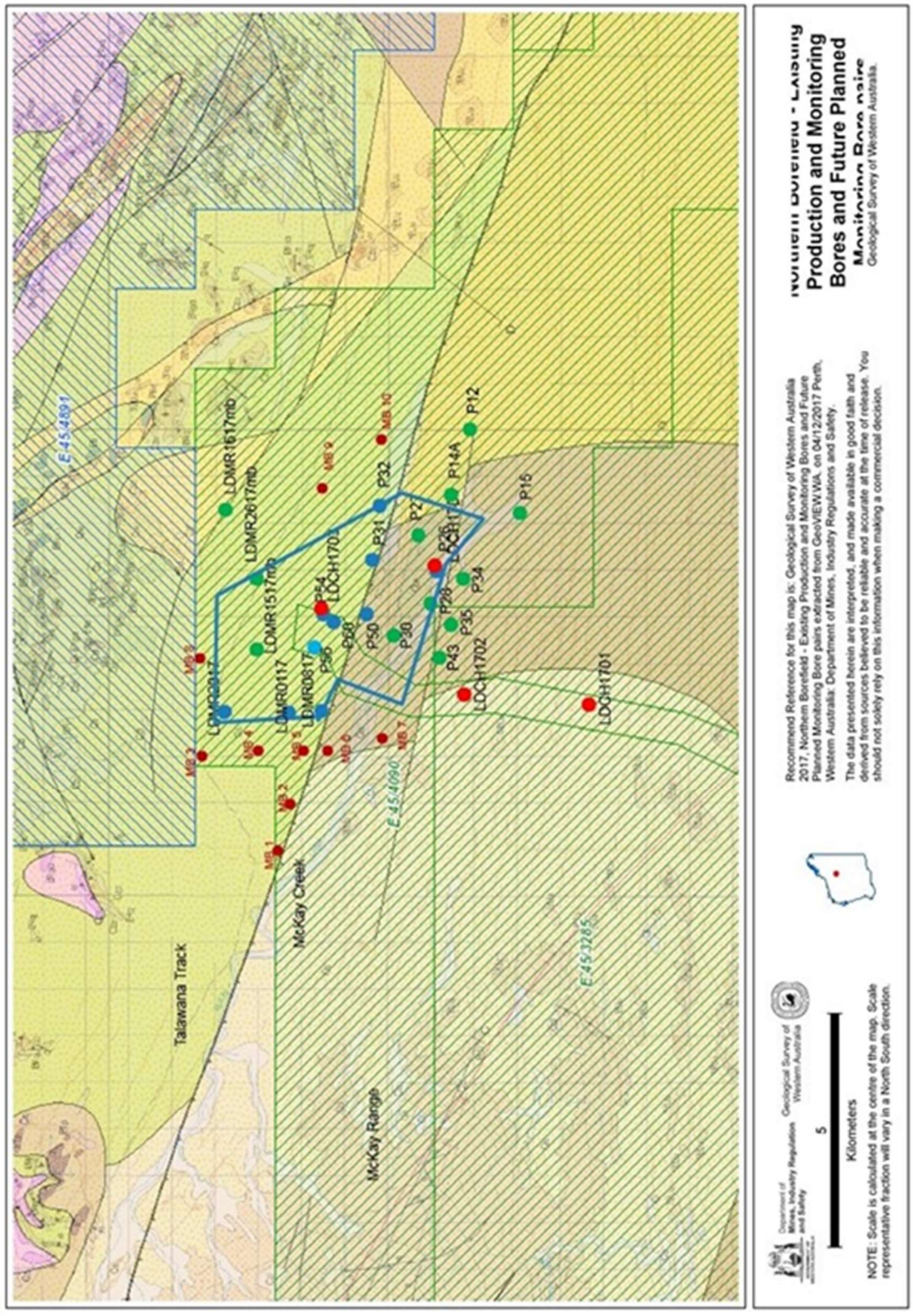


Figure 2-1: Northern bore field – groundwater monitoring network (indicative locations)

2.3 CORY BORE FIELD

EPA factor and objectives: To protect subterranean fauna so that biological diversity and ecological integrity are maintained

Outcomes: Extent of persistent (>12 months in a row) 2m groundwater drawdown contour does not extend further than 3 km from any production bore.

Key risks and associated impacts: Groundwater abstraction causes drawdown of water table (beyond usual seasonal drawdown) and reduces habitat available to subterranean fauna during bore field operations.

Outcome-based provisions

Environmental criteria	Response actions	Monitoring	Reporting
Trigger criterion 1: end of wet season (nominally May / June) groundwater levels in monitoring bores are equal to or lower (deeper) than end of dry season (Nov/Dec) levels of preceding year.	Review water abstraction records Consider water levels in context of weather data.	Continuous collection of groundwater level information – reviewed monthly. Continuous monitoring of water abstraction amounts – reviewed monthly.	Annual compliance reporting to DWER.
Threshold criterion 1: 1.5m groundwater drawdown contour for any production bore extends further than 2 km from the production AND persists for 12 or more months.	Temporarily halt water abstraction from bores within 1 km of affected monitoring bore. Review water abstraction records.		Exceedance reporting as per Environmental Compliance Plan.

Management-based provisions

Management actions	Management targets	Monitoring / evidence	Reporting
Management action 1: Establish additional monitoring bores at	Establish a network of at least one monitoring bore (equipped with groundwater level logger) per production bore	Data logger data (downloa	Annual aquifer report to DWER

least 3 km from the proposed production wells [Priority 1; timing – prior to operational use of bore field]	(	ded monthly)	

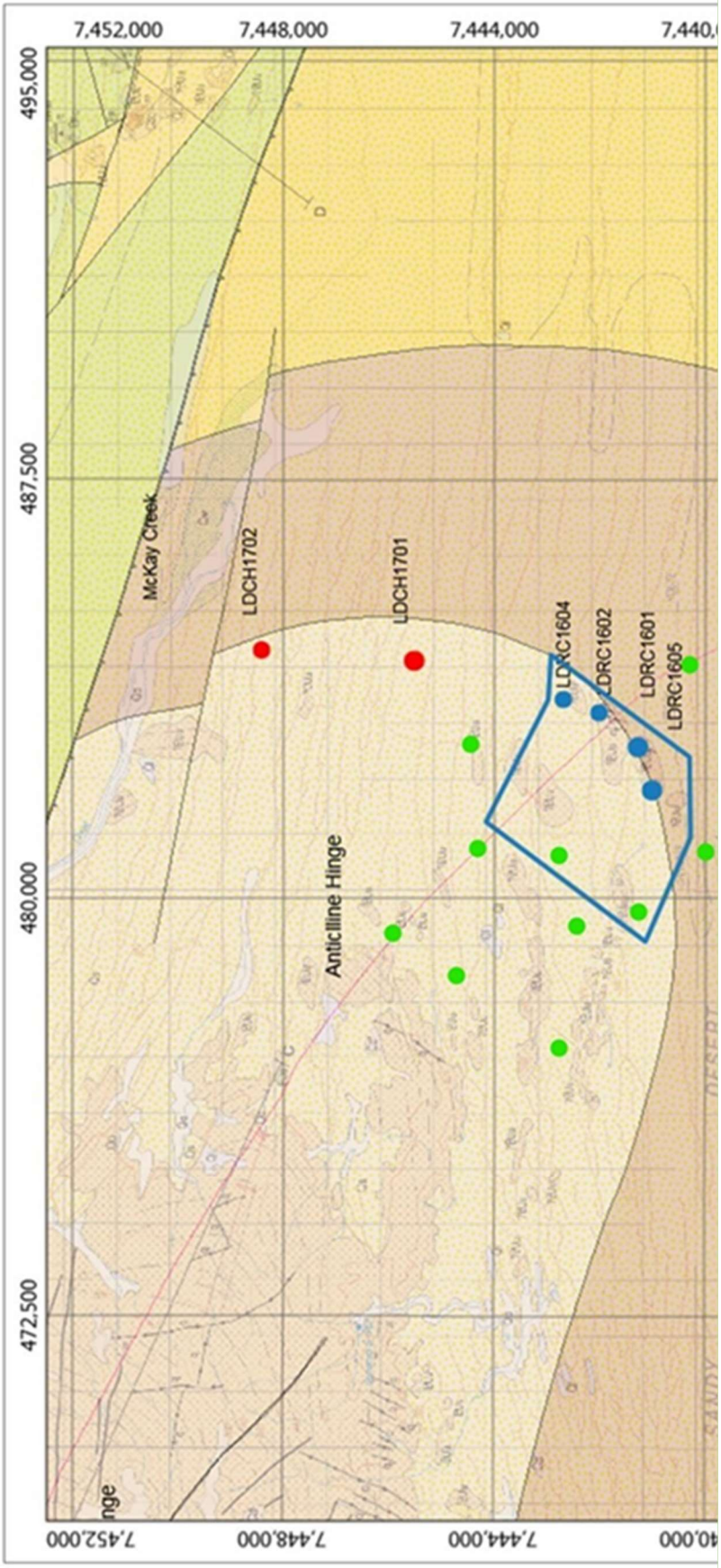


	Figure 2-2).		
Management action 2: Conduct additional sampling for subterranean fauna [Priority 1; timing – starting 3 to 6 months after completion of additional monitoring bores and before start of full scale bore field operations.]	Complete 3 rounds of follow up subfauna sampling within 3 years of establishing monitoring bore network.	Subfauna monitoring results.	Annual Part IV compliance report to DWER
Management action 3: Operate bore field in accordance with DWER approved groundwater operating strategy [Priority 1; timing – during operational use of the bore field]	No non-compliance with approved groundwater operating strategy.	Water abstraction records and groundwater monitoring results.	Annual aquifer report to DWER
Management action 4: Review hydrogeological model to check likely aquifer recovery time following cessation of water abstraction [Priority 2; timing – within 4 years of commencement of bore field operations]	Updated hydrological model.	Water abstraction records and groundwater monitoring results.	Triennial aquifer review report to DWER

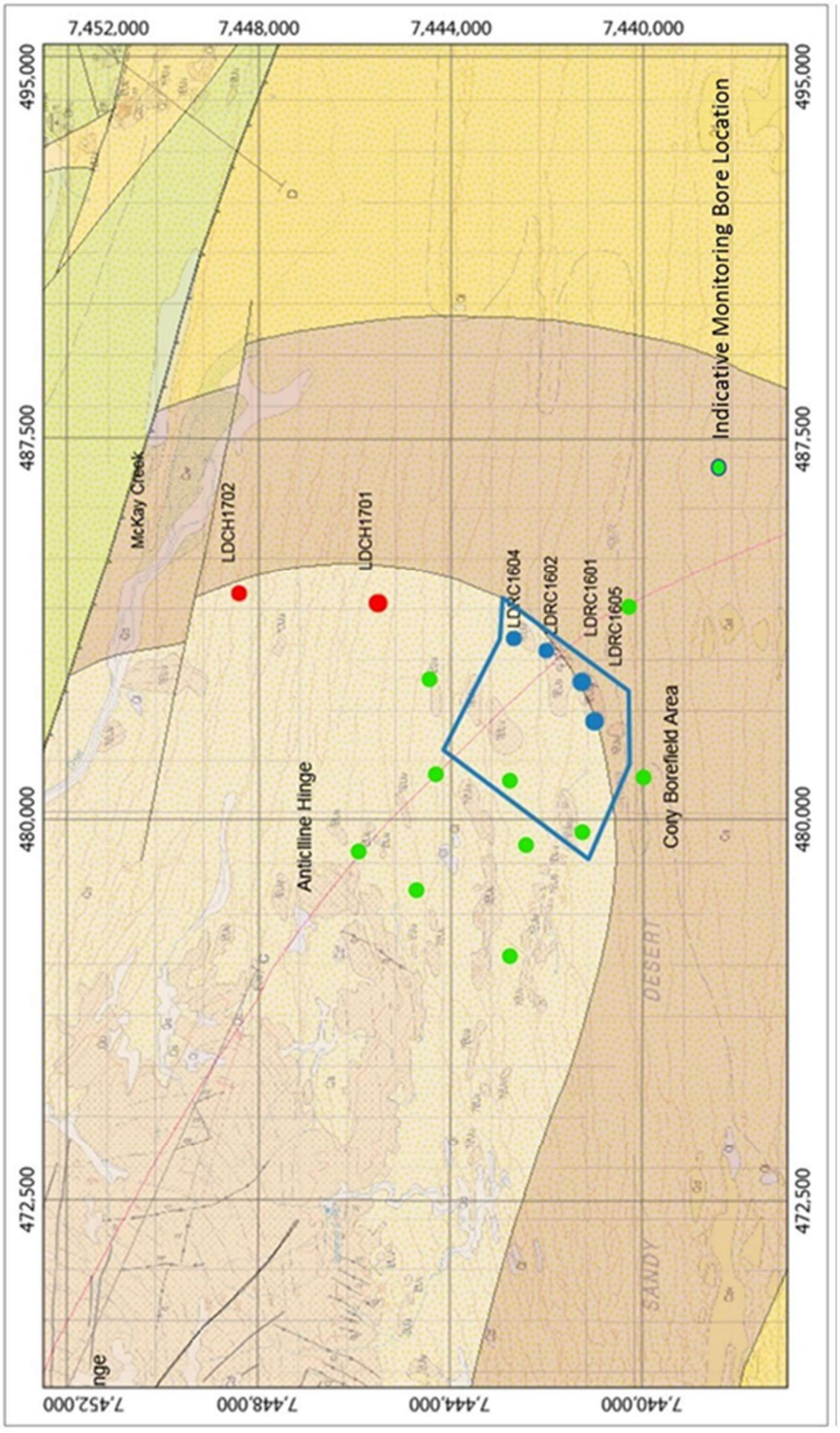


Figure 2-2: Cory bore field – groundwater monitoring network (indicative locations)

3 ADAPTIVE MANAGEMENT AND REVIEW OF THE EMP

The provisions outlined in the previous section rely on the following key assumptions:

- The key threat to subterranean fauna populations from project implementation arises from changes in groundwater hydrology as a result of water abstraction from the proposed Northern bore field and Cory bore field.
- Changes in depth to groundwater that do not exceed natural seasonal variations will not result in adverse impacts on subterranean fauna.
- Subterranean fauna populations similar to those observed in proposed impact areas are likely to exist in surrounding areas, providing those areas are hydraulically connected and have similar hydrogeochemical properties.
- The failure to detect a particular subterranean fauna species during any given sampling event is not proof positive that the species is absent from the formation sampled.
- Cessation of water abstraction will result in relatively rapid recovery of water levels in affected aquifers.

Given these assumptions, Reward's adaptive management regime focuses on actions to preserve subterranean fauna habitats by controlling water abstraction and managing the magnitude and extent of drawdowns. Direct management of subterranean fauna is not possible. In practical terms, adaptive management for the proposed Cory and Northern bore fields will mean that groundwater abstraction may need to be reduced or the location of water abstraction may need to be modified in order to limit groundwater drawdown effects. Complementary actions to these adaptive management responses include: i) follow up subterranean fauna surveys and monitoring and ii) periodic reviews of hydrogeological modelling.

Findings that will trigger review of this EMP include:

- Evidence that subterranean fauna so far recorded only within the proposed bore fields are much more widely distributed.
- Groundwater monitoring shows aquifer responses that differ materially to those currently expected (includes response to water abstraction and to cessation of water abstraction)
- Updated hydrogeological modelling predicted significant changes in the extent, duration or magnitude of groundwater drawdowns predicted from modeling upon which this management plan relies (Strategic Water Management 2017a, b)

The EMP would also be reviewed if any significant changes to the groundwater operating strategy (for example, extension of the mine life) were proposed.

4 STAKEHOLDER CONSULTATION

This subterranean fauna management plan, provided as an appendix to Reward's Lake Disappointment ERD, will serve as the basis for discussions with DBCA, DWER and others with an interest in the conservation of subterranean fauna. Discussions held to date with DWER concerning abstraction of water from the proposed Northern bore field and Cory bore field are summarised in Table 4-1.

Table 4-1: Summary of stakeholder consultation

Stakeholder	Date	Issues/topics raised	Reward response/outcomes
DWER	30/1/2017	Face to face meeting and presentation to DWER on the assessment approach for the Cory and Northern bore fields (proposed field programme and H2 reporting process).	Overall approach agreed with DWER including the provision of an analytical model only for the Cory borefield.
DWER	23/10/2017	DWER comments on Cory bore field H2 hydrogeological report: • Amendment to the licence application for construction only until approvals received for operation. • Amendment to the volume to 700ML/year • Requirement to complete and submit a Groundwater operating Strategy by 31/01/17. • •DWER is prepared to issue a 1.5GL/year licence once all related project approvals have been granted.	• Agreed to change of use (construction, but not mineral processing) until approvals received. • Requested that the licence be for 1GL/year for construction purposes - DWER agreed to this in subsequent correspondence. • GWOS in preparation and will be submitted prior to 31/1/2018.
DWER		Comments on Northern bore field H2 hydrogeological report:	

5 REFERENCES

4T Consultants Pty Ltd, 2012. Desktop Assessment of the Likelihood of Stygofauna Occurrence in the Bowen Basin.

Bennelongia Environmental Consultants, 2016a. Lake Disappointment - Subterranean Fauna Desktop Assessment, report number 269, June 2016.

Bennelongia Environmental Consultants, 2017b. Identification of subterranean fauna collected in Lake Disappointment locality in Oct / Nov 2017.

Bennelongia Environmental Consultants, 2018. Stygofauna Values at the Lake Disappointment Potash Project, report number 304, prepared for Reward Minerals Limited, October 2018.

Environmental Protection Authority, 2016, Environmental Factor Guideline: Subterranean Fauna, EPA, Western Australia.

Harewood, G., 2016b. Stygofauna Survey (Level 1) - Lake Disappointment Potash Project Reward Minerals Limited report prepared for Reward Minerals Limited December 2016.

SRK Consulting, 2018. Technical memorandum: Lake Disappointment Groundwater Review (Northern bore field and Cory bore field), prepared for Reward Minerals Limited, 26 September 2018.

Strategic Water Management WA, 2017a. Lake Disappointment - Hydrogeological Assessment of the Impact of Process Water Abstraction from the Cory Bore Field, an H2 Level Assessment for 1.5GL/year, July 2017.

Strategic Water Management WA, 2018. Lake Disappointment - Hydrogeological Assessment of the Impact of Process Water Abstraction from the Northern Bore Field, an H2 Level Assessment for 2 GL/year, June 2018.