Mackay Sulphate of Potash Project – Inland Waters Environmental Management Plan

PREPARED FOR AGRIMIN // APRIL 2024

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Quality Statement

Project manager	Project technical lead
Tracy Schwinkowski	**Fiona Taukulis**

PREPARED BY
Jay Puglisi, Fiona Taukulis (Stantec)

CHECKED BY
Fiona Taukulis (Stantec)

REVIEWED BY
Fiona Taukulis, Brooke Hay (Stantec)/Michael Hartley (Agrimin)

APPROVED BY
Fiona Taukulis (Stantec) /Michael Hartley (Agrimin) 30 April 2024

Revision Schedule

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			Prepared by	**Checked by**	**Reviewed by**	**Approved by**
V1.0	21/7/2023	IWEMP	J. Puglisi F. Taukulis	F. Taukulis	F. Taukulis	F. Taukulis
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Stantec Australia Pty Ltd
Ground Floor, 226 Adelaide Terrace, Perth, 6000
Tel: +61 8 9222 7000
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Abbreviations

Abbreviation	Definition
AERs	Annual Environmental Reports
Agrimin	Agrimin Limited
BC Act	*Biodiversity Conservation Act 2016*
CAR	Annual Compliance Assessment Report
CMCP	Conceptual Mine Closure Plan
Cwth	Commonwealth
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DoEE	The Commonwealth Department of Environment and Energy
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EP Act	*Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPA	Environmental Protection Authority
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
ERD	Environmental Review Document
ERT	Emergency Response Team
ESD	Environmental Scoping Document
FVEMP	Flora and Vegetation Environmental Management Plan
ha	hectare
IPA	Indigenous Protected Areas
IWEMP	Inland Waters Environmental Management Plan
IWMP	Inland Waters Monitoring Program
km	kilometre
m	metre
MNES	Matter of National Environmental Significance
NIDE	Northern Infrastructure Development Envelope
NT	Northern Territory
Off-LDE	Off-lake Development Envelope
On-LDE	On-lake Development Envelope
PEC	Priority Ecological Community
PER	Public Environmental Review
SIDE	Southern Infrastructure Development Envelope
TEC	Threated Ecological Community
TFEMP	Terrestrial Fauna Environmental Management Plan
WA	Western Australian
WAH	Western Australian Herbarium

Executive Summary

Table ES-1 summarises the purpose of the Inland Waters Environmental Management Plan (IWEMP) within the context of the Western Australia Environmental Protection Authority (EPA) objectives for the key environmental factor of Inland Waters (EPA 2018) and Subterranean Fauna (EPA 2016). The IWEMP also aligns with the Environmental Protection Authority (2024) and Commonwealth of Australia (2014) Environmental Management Plan Instructions and Guidelines. The IWEMP has been prepared for the Agrimin Proposal for Lake Mackay and specifically addresses the Inland Waters and Subterranean Fauna environmental factors associated with the Proposal.

The environmental outcomes and objectives for the environmental factor to be met through implementation of this IWEMP are presented in **Table ES-1**. The environmental criteria and management targets to measure achievement of the associated environmental outcomes and objectives are also provided.

Table ES-1: Purpose and summary of the Inland Waters Environmental Management Plan (IWEMP).

Item	Description
Proposal Title	Agrimin Lake Mackay Potash Project (the Proposal)
Proponent Name	Agrimin Limited (Agrimin)
Ministerial Statement number	N/A – Under Assessment
Purpose of the IWEMP	Development of a framework to ensure potential impacts on inland waters and subterranean fauna from the Proposal are avoided to the maximum extent practicable by: • Identifying the risks and potential impacts from the Proposal on inland waters and subterranean fauna. • Outlining management provisions for inland waters and subterranean fauna, to avoid and minimise potential project-related adverse impacts to aquatic biota and subterranean fauna. • Preparing and implementing an Inland Waters Monitoring Program for the monitoring of groundwater and the aquatic environment of Lake Mackay in relation to the Proposal; and • Proposing response actions if triggers and thresholds are exceeded to avoid adverse project-related impacts to aquatic biota and subterranean fauna.
Key Environmental Factors and Objectives	Inland Waters: The Environmental Protection Authority (EPA) Objective for Inland Waters is *'to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected'* (EPA 2018). Subterranean Fauna: The Environmental Protection Authority (EPA) Objective for Subterranean Fauna is *'to protect subterranean fauna so that biological diversity and ecological integrity are maintained'* (EPA 2016). The proponent shall manage the operations of the Proposal to meet the following Outcome-based and Objective-based management provisions.
Purpose of IWEMP	Development of a framework to ensure potential impacts on aquatic biota and subterranean fauna including significant taxa and associated habitat from the Proposal are avoided to the maximum extent practicable by: • Identifying the risks and potential impacts from the Proposal on aquatic biota and subterranean fauna within the Development Envelope. • Outlining management provisions of aquatic biota and subterranean fauna, to avoid and minimise potential impacts within the Development Envelope. • Outlining management provisions for surface and groundwater, to avoid and minimise potential impacts on habitat within the Development Envelope. • Providing Monitoring Plans for groundwater, aquatic ecology and subterranean fauna. • Proposing corrective actions if triggers and thresholds are exceeded to avoid impact on aquatic biota and subterranean fauna and associated habitat attributed to the Proposal.

Item	Description
Outcome-Based Management Provisions	• **IW1:** No unauthorised disturbance to occur within the buffer zone applied to landform islands, large, intermediate islands, and small islands or within the WA and NT exclusion zones of Lake Mackay. • **IW2:** No significant impact to low salinity or fresh groundwater from abstraction of the brine to groundwater dependent vegetation and stygofauna, relative to baseline conditions, on landform islands. • **IW3:** No significant impact to surface water levels during large inundation events from abstraction of the brine associated with the On-Lake Development. • **IW4:** Groundwater abstraction from the SIDE borefield (water supply) will not exceed licence issued under Section 5C of the *Rights in Water and Irrigation Act 1914*. • **IW5:** No significant impact to the shallow aquifer (Neogene alluvial deposit) from the SIDE borefield, reducing availability of groundwater for other bore users, groundwater dependent vegetation and stygofauna habitat. • **IW6:** Groundwater abstraction of brine from the lakebed sediments will not exceed licence issued under Section 5C of the *Rights in Water and Irrigation Act 1914*. • **IW7:** No significant decline in the aquatic invertebrate communities of Lake Mackay due to project-related activities. • **IW8:** No significant increase in contaminants in the surface waters of Lake Mackay during large inundation events, relative to baseline conditions. • **IW9:** No significant decrease in the extent and duration of surface waters in the deepest parts of the Lake Mackay basin, as a result of project-related activities.
Objective-based Management Provisions	• **MO1:** No project-related adverse impacts to aquatic biota due to habitat loss, fragmentation, or modification, from project-related disturbance. – Disturbance in the On-lake Development Envelope (On-LDE) is not to exceed: development of trenches, extraction of up to 100 GL/a of brine, and solar evaporation and harvesting ponds for potash salts, including ground disturbance of approximately 15,000 ha with the 217,261 ha On-LDE. – Buffer zones applied to landform islands, large and intermediate islands, small islands and WA and NT exclusion zones on Lake Mackay. – No unauthorised clearing within lake island buffer zones. • **MO2:** No project-related adverse impacts to aquatic biota due to changes in surface water flows and inundation during major flood events, from project development. – Verification of detailed hydrological modelling of surface water flows, including simulation 1:100-year rainfall events. – No access permitted to inundated portions of Lake Mackay when more than 20% of the lake is inundated. – Staged development of trenches via BMUs and engineering design (1 km spacing, install crossovers) to maintain natural hydrological processes. • **MO3:** No project-related adverse impacts to aquatic biota due to increased salinity in surface waters, from runoff from evaporation ponds and salt piles. – Staged development of evaporation ponds and salt piles is in place. – Evaporation pond embankment breached at closure. • **MO4:** Minimise project-related adverse impacts to aquatic biota due to changes to hydraulic connectivity and/or reduction in moisture content of lake

Item	Description
	sediment, from groundwater drawdown; or changes in salinity and/or ionic composition of groundwater from lakebed sediment abstraction: – Groundwater abstraction not to exceed ground water licence limit. – Buffer zones to be implemented. – Groundwater monitoring procedure in place. • **MO5:** Minimise project-related adverse impacts to aquatic biota due to potential disturbance and exposure of ASS during trench excavation. – Acid Sulphate Soils (ASS) Management Plan (ASSMP) and management of ASS in place. • **MO6:** No project-related adverse impacts to aquatic biota due to potential contamination of surface water and/or groundwater as a result of hydrocarbon and/or chemical spills, and landfill/wastewater treatment plant operations**:** – Hazardous Substances Management Plan (HSMP) and Procedure implemented. – Spill response training for all personnel and contractors. – Spill response equipment provided for all site vehicles. • **MO7:** Minimise project-related adverse impacts to aquatic biota due to changes in hydraulic connectivity and groundwater quality from abstraction of up to 100 GL/a of brine groundwater for the project: – Verification of detailed hydrological modelling of surface water flows, including simulation 1:100-year rainfall events. – Groundwater Monitoring Program in place. – Groundwater abstraction not to exceed ground water licence limit. – Groundwater monitoring procedure in place. • **MO8:** Minimise project-related adverse impacts to aquatic biota from: – Windblown salt from evaporation ponds/salt piles; and – Soil compaction of lakebed during development of trenches and heap and profile of salt piles. – No project related incidents of vehicles being used outside of designated operational areas such as causeways or bunding, designated construction zones or approved disturbance areas. – Demarcation and monitoring of construction boundaries in place. • **MO9:** No Project related adverse impacts to subterranean fauna on landform islands from the development of the on-LDE infrastructure (including brine abstraction) and from abstraction of groundwater from the SIDE: – No project-related adverse impacts to prospective stygofauna fauna and/or habitat on the landform islands within the On-LDE from infrastructure development, including abstraction of brine. – No project-related adverse impacts to subterranean fauna and/or prospective habitat due to groundwater drawdown from groundwater abstraction from the SIDE. • **MO10:** No project-related adverse impacts to prospective subterranean fauna habitat on the islands and SIDE due to groundwater contamination from hydrocarbon spills. – Hazardous Substances Management Plan (HSMP) and Procedure implemented. – Spill response training for all personnel and contractors. – Spill response equipment, bunding and leak detection mechanisms in place.

Item	Description
	– Bioremediation facility for the treatment of contaminated fill, soils, or sediment in place. • **MO11:** No project-related adverse impacts to prospective subterranean fauna due to altered surface hydrology from project-related clearing and disturbance, resulting in changes to groundwater flow on the islands and SIDE. – Clearing not to exceed 1,500 ha of flora and vegetation (the combined total of 200 ha of native vegetation within the 688 ha Off-LDE, and 300 ha of native vegetation within the 11,799 ha SIDE and 1,000 ha of native vegetation within the 33,928 ha NIDE). – Buffer zones applied to landform islands, large and intermediate islands, small islands and WA and NT exclusion zones on Lake Mackay. – No unauthorised clearing within lake island buffer zones. – Demarcation and monitoring of construction boundaries in place.
Condition Clauses	N/A - Under Assessment
Key Components of the IWEMP	Key provisions are detailed in **Section 3**
Proposed Construction Date	TBA
IWEMP required pre-construction?	Yes

Corporate endorsement

I hereby certify that to the best of my knowledge, the provisions within this Mackay Sulphate of Potash Project Inland Waters Environmental Management Plan are true and correct.

Name: Michael Hartley Signed: 

Designation: Chief Operations Officer: Date:30 April 2024

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1. Context, Scope and Rationale

1.1. Proposal Background

Agrimin Limited (Agrimin) proposes to develop a greenfields potash fertiliser operation, the Mackay Sulphate of Potash Project (the Proposal), approximately 490 kilometres (km) south of Halls Creek, adjacent to the Western Australian (WA) and Northern Territory (NT) borders (**Figure 1-1**). The Proposal involves the extraction of brine from a network of shallow trenches established on the surface of Lake Mackay. The brine will be transferred into evaporation ponds for the precipitation of salt which will be harvested and then processed to produce a potash fertiliser product.

Disturbance of the lake's surface and clearing of native vegetation are required for Proposal development. The Proposal is remote and extensive (263,675 ha) and comprises four Development Envelopes shown in (**Figure 1-1**). The following areas and applicable terms relevant to the Proposal and this Inland Waters Environmental Management Plan (IWEMP) are outlined below:

- **Study Area** – refers to the boundary within which all investigations and field surveys were undertaken (443,985 ha), extending beyond the Proposal Area.
- **Proposal Area** – The combined area in which the four Development Envelopes are contained.
- **Development Envelopes** – the boundary within which the elements of the Proposal are situated. The Development Envelopes occur entirely within the Study Area and comprise four components that make up the Proposal. The Proposal includes disturbance of up to 15,000 hectares (ha) of the lake's surface and clearing of approximately 1,500 ha of native vegetation. The proposed extent of the physical and operational elements includes four development envelopes (**Figure 1-1**) as follows:
  - **On-lake Development Envelope (On-LDE)**: On-lake development of trenches, extraction of up to 100 GL/a of brine, and solar evaporation and harvesting ponds for potash salts, including ground disturbance of approximately 15,000 ha with the 217,261 ha On-LDE.
  - **Off-Lake Development Envelopes (Off-LDE)**: Off-lake development of a processing plant and associated site infrastructure, including access roads, accommodation camp, airstrip, and solar farm, including clearing of approximately 200 ha of native vegetation within the 688 ha Off-LDE.
  - **Southern Infrastructure Development Envelope (SIDE)**: Development of borefield, water pipeline and access tracks for abstracting up to 3.5 GL/a of processing water and off-lake access to Lake Mackay including clearing of approximately 300 ha of native vegetation within the 11,799 ha SIDE.
  - **Northern Infrastructure Development Envelope (NIDE)**: Haul road for trucking potash product to Wyndham Port, including clearing of approximately 1,000 ha of native vegetation within the 33,928 ha NIDE.
  - **Indicative Footprint (IF)** – the area that is proposed to be directly disturbed by the Proposal. The layout of the IF may change; however, the total disturbance will not exceed the maximum disturbance for each Development Envelope. Proponent-led avoidance and mitigation measures have been implemented where possible to minimise potential impacts to areas of high ecological or heritage value through the detailed design of the IF.

1.2. Key Environmental Factors

The Proposal was referred to the Western Australian (WA) Environmental Protection Authority (EPA) on 02/01/2019 and the EPA determined the Proposal required a Public Environmental Review (PER) level of assessment on 30/01/2019. The EPA approved an Environmental Scoping Document (ESD) on 10/09/2020 identifying key environmental factors, including Inland Waters and Subterranean Fauna.

The Environmental Review Document (ERD) submitted to the EPA on 11/04/2022 was followed by a public review period that closed on 30/05/2022. The Proposal is currently being assessed under an accredited process by the State Government (EPA Assessment Number 2173) and the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). As the Proposal is still under assessment, a Ministerial Statement has not yet been issued.

1.2.1. Inland Waters

The EPA objective for Inland Waters is '*to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected*' (EPA 2018). Comprehensive surveying and environmental impact assessment (EIA) identified potential impacts to inland waters from the Proposal, detailed within the ERD. These include:

- Aquatic and riparian habitat loss, increased habitat fragmentation or modification, and loss of species of scientific interest or other significance, due to clearing, disturbance and construction;
- Altered surface hydrology associated with development (including under future predicted climate change scenarios), influencing surface water flows and inundation during major flooding, which may adversely affect aquatic biota and waterbirds;

- Increased salinity due to runoff from evaporation ponds and salt piles, adversely affect aquatic biota and riparian vegetation;
- Groundwater drawdown causing changes to hydraulic connectivity and/or reduction in moisture content of sediment, adversely impacting aquatic biota and riparian vegetation;
- Changes in salinity and/or ionic composition of groundwater from lake bed sediments abstraction, adversely impacting aquatic biota and riparian vegetation;
- Potential disturbance and exposure of ASS during trench excavation, adversely impacting aquatic and riparian habitat;
- Potential for contamination of surface water and/or groundwater as a result of hydrocarbon and/or chemical spills, and landfill / wastewater treatment plant operations;
- Changes in hydraulic connectivity and groundwater quality from abstraction of up to 3.5 GL/a of groundwater for processing from the SIDE borefield; and
- Fugitive dust emissions (including wind-blown salts) may negatively affect aquatic and riparian habitats or riparian vegetation.

1.2.2. Subterranean Fauna

The EPA objective for Subterranean Fauna is '*to protect subterranean fauna so that biological diversity and ecological integrity are maintained*' (EPA 2016). Comprehensive surveying and environmental impact assessment (EIA) identified potential impacts to subterranean fauna from the Proposal, detailed within the ERD. These include:

- Groundwater drawdown and loss of subterranean fauna and/or prospective habitat due to trench brine abstraction from the On-LDE;
- Groundwater drawdown and loss of subterranean fauna and/or prospective habitat due to abstraction from the SIDE borefield;
- Excavation and disturbance of prospective habitat for stygofauna and troglofauna beneath landform islands within the On-LDE due to development of infrastructure;
- Groundwater contamination on the islands and within the SIDE due to hydrocarbon spills and subsequent seepage into the subterranean environment; and
- Altered surface hydrology and topography from clearing and disturbance resulting in changes to groundwater flow paths on the islands and within the SIDE.

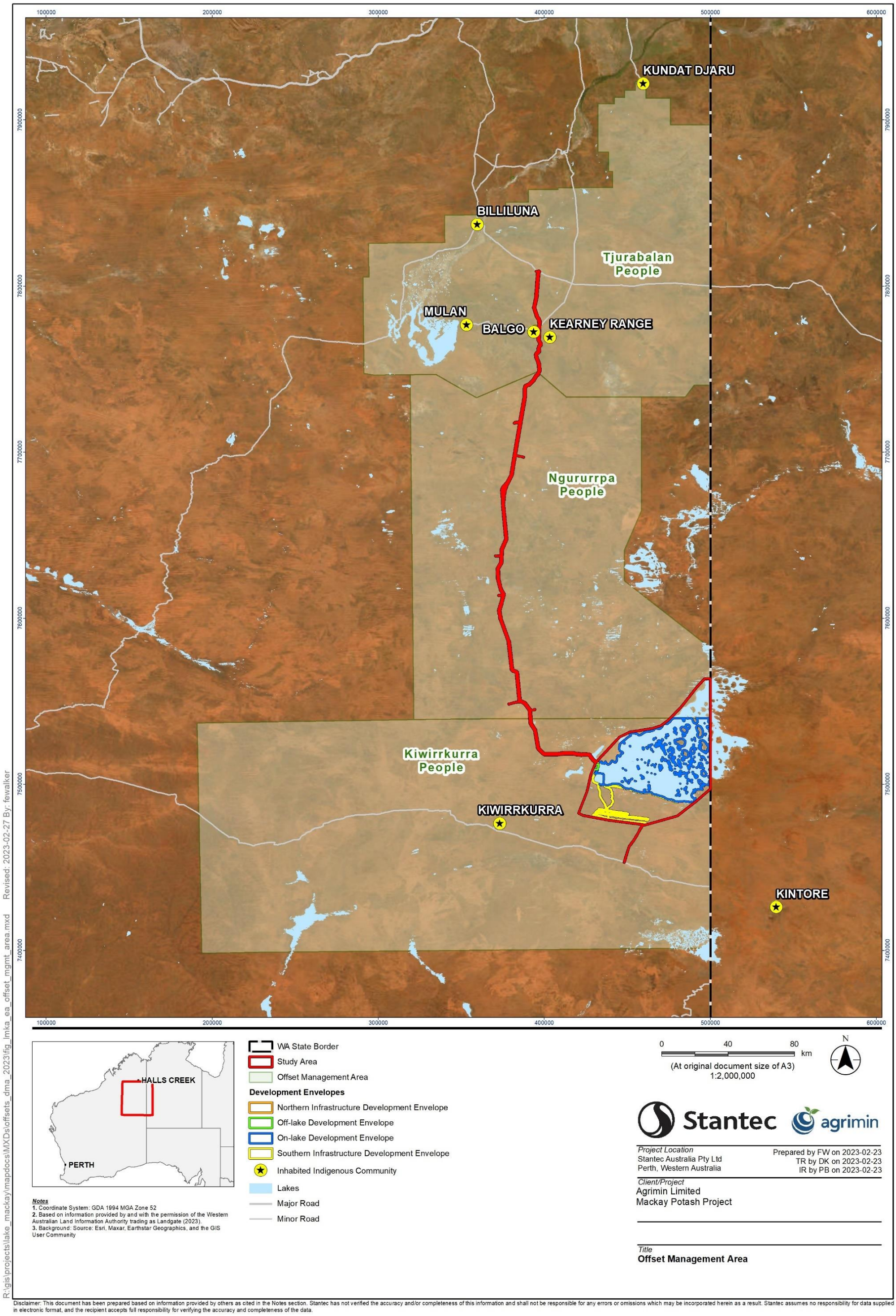

Figure 1-1: Regional location of the Agrimin Lake Mackay Potash development envelopes.

1.3. Purpose and Framework

The purpose of the IWEMP and associated monitoring program (**Appendix A**) is to:

- Ensure that the Proposal is carried out in a manner that minimises the direct and indirect impacts to inland waters and subterranean fauna;
- Ensure there is no direct or indirect adverse impacts to inland waters and subterranean fauna within the Proposal Development Envelope and immediate surrounds; and
- To actively engage with Traditional Owner (TO) groups, building capacity for Indigenous Ranger involvement, where possible.

This will be addressed by ensuring potential impacts to inland waters and subterranean fauna from the Proposal are avoided to the maximum extent practicable by:

- Identifying the risks and potential impacts from the Proposal on inland waters and subterranean fauna.
- Outlining management provisions for inland waters and subterranean fauna, to avoid and minimise potential project-related adverse impacts to aquatic biota and subterranean fauna.
- Preparing and implementing an Inland Waters Monitoring Program for the monitoring of groundwater and the aquatic environment of Lake Mackay in relation to the Proposal; and
- Proposing response actions if triggers and thresholds are exceeded to avoid adverse project-related impacts to aquatic biota and subterranean fauna.

1.4. Rationale and Approach

Agrimin is committed to avoiding and minimising potential impacts caused by the operations of the Proposal to aquatic ecology, subterranean fauna and surface and ground water quality and quantity to ensure the biodiversity and ecological integrity and function of inland waters and subterranean fauna are maintained. The IWEMP proposes a set of outcome-based management provisions including monitoring and evaluating success of management actions with respect to inland waters and subterranean fauna within the Development Envelope, driven by triggers and thresholds. Assessment of the pathways over which impacts may occur provides the rationale for choice of provisions and choice of appropriate indicators to measure against the environmental outcome and/or objective.

This IWEMP is subject to approval by the EPA and Department of Climate Change, Energy, the Environment and Water (DCCEEW) and will subsequently be implemented. Any reporting for the IWEMP will be undertaken in accordance with the DCCEEW Departmental Policy – Sensitive Ecological Data – Access and Management Policy (DoE 2016c).

1.5. Documentation

1.6. Legislation, Policy and Guidance

This IWEMP has been written in accordance with Western Australian (WA) and Commonwealth policies and guidance, including:

- Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2021; (EPA 2021a);
- Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans; (EPA 2024);
- Environmental Impact Assessment (Divisions 1 and 2) Procedures Manual (EPA 2021b);
- Environmental Management Plan Guidelines (Commonwealth of Australia 2014);
- Outcome-based conditions policy (DoE 2016b);
- Outcome-based conditions guidance (DoE 2016a);
- Environmental Factor Guideline – Inland Waters (EPA 2018);
- Environmental Factor Guideline – Subterranean Fauna (EPA 2016);
- *Biosecurity and Agriculture Management Act 2007* (WA);
- *Biodiversity Conservation Act 2016* (WA); and
- *Rights in Water and Irrigation Act 1914* (WA).

1.7. Plans and Strategies

The following management plans and strategies are also relevant to the IWEMP, specific to the Proposal and include:

- Construction Environmental Management Plan (CEMP) (Stantec 2024a).
- Flora and Vegetation Environmental Management Plan (Stantec 2024b)
- Terrestrial Fauna Environmental Management Plan (Stantec 2023)
- Mackay Sulphate of Potash Project Revised Offsets Strategy (Stantec 2024c).

State and Commonwealth plans and management prescriptions that are relevant to the inland waters and subterranean fauna include:

- Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999 (DEWHA 2013).
- Referral guideline for 14 migratory birds listed under the EPBC Act (DoE 2015).

1.8. Indigenous Protected Areas

The Proposal traverses three Indigenous Protected Areas (IPAs) comprising the Tjurabalan, Ngururrpa and Kiwirrkurra IPAs (**Figure 1-1**). IPAs are voluntarily dedicated by indigenous groups on indigenous owned or managed land or sea country, in accordance with Traditional Owner objectives. They are recognised by the Australian Government as an important part of the National Reserve System, protecting the nation's biodiversity for the benefit of all Australians.

The Ngururrpa IPA is managed through their prescribed body corporate, the Parna Ngururrpa Aboriginal Corporation and includes most of the haul road and the Proposal's NIDE. It is bounded by the Tjurabalan IPA (managed by the Tjurabalan Native Title Land Aboriginal Corporation) to the north and the Kiwirrkurra IPA (Tjamu Tjamu Aboriginal Corporation) to the south, the latter of which comprises part of Lake Mackay (On-LDE). The three IPAs contribute to a contiguous network of protected areas throughout the region.

The IPAs are managed to protect biodiversity and cultural resources, based on indigenous perspectives of connecting and looking after country, complemented by western knowledge and management principles (Tjamu Tjamu Aboriginal Corporation 2018). They are supported by a number of strategies including the Ngururrpa IPA – Plan for Country 2020-2025 (Parna Ngururrpa 2019) and Kiwirrkurra IPA – Plan for Country (Tjamu Tjamu Aboriginal Corporation 2014). These plans outline management actions to protect natural and cultural values, and provide a range of economic, educational, health and wellbeing benefits for communities. There is also a focus on Traditional Owners working collaboratively with scientists to undertake fauna surveys and monitoring, increase conservation experience, and protect habitat and manage feral animals.

Agrimin also have a Native Title Agreements (NTA) in place for the Parna Ngururrpa and Tjamu Tjamu Peoples', while the NTA for the Tjurabalan Peoples is in the final stages of acceptance. Commitments in these NTAs focus on consultation and reasonable endeavors, to avoid adverse impacts to the environment or areas of cultural concern from the Proposal. In addition, Agrimin recognised the skills and experience of Indigenous Ranger groups and will provide opportunities for engagement in environmental surveys and monitoring, and the management of feral animals and fire. These measures align with the management provisions applied in this IWEMP.

2. Inland Waters and Subterranean Fauna

2.1. Previous Surveys

A substantial body of work has been completed to understand the Inland Waters and Subterranean Fauna factors for the Proposal. More than 30 studies have been undertaken across the geology, groundwater, surface hydrology, aquatic ecology and subterranean fauna disciplines, the results of which have been collated into technical reports and memorandums (**Table 2-1; Table 2-2;Table 2-3**). These studies span from 2001 to 2021 and have included the lake and islands (On-LDE), claypans and riparian zone (Off-LDE), and the SIDE. The remoteness of the Proposal has involved significant logistical challenges associated with mobilising heavy equipment across the lake and islands for drilling programs.

Numerous exploration field work programs have been carried out between 2011 and 2020, to investigate and characterise the geology and ground water of the Proposal Area. The technical memorandums and reports based on these programs are summarised in **Table 2-1**. Extensive exploration has been undertaken focusing on the geology and groundwater of the lake bed sediments (including targeted island drilling) and potential process water supply south of the lake (SIDE). The results of extensive groundwater investigations were used to develop an integrated groundwater flow and solute transport model for Lake Mackay and contributed to the water balance modelling.

There have been several studies undertaken on Lake Mackay (**Table 2-1**), used to inform the key surface water assessment and modelling for the Proposal. This included a detailed LiDAR survey, and the compilation of climate, satellite imagery and geology data, which provided the basis for the surface water modelling. Modelling was used to assess surface water levels and the frequency, duration, and extent of flooding in relation to individual rainfall events and long-term hydrological cycles in relation to the lake's water balance. This provided an understanding of the natural hydrological regime of the lake in relation to the development of the Proposal. In addition, assessment of the salt balance and ionic composition of the lake was completed, focusing on the evaporation ponds and salt piles associated with the Proposal.

There have been several lake-based studies investigating various ecological components of Lake Mackay and the peripheral wetlands, ranging from lake sediment, aquatic biota, riparian vegetation, and waterbirds (**Table 2-2**). With some exception, much of this previous work was undertaken during prevailing dry conditions. Opportunistic field surveys undertaken in flooded conditions in early 2021, consolidated with the data from the previous surveys, have provided an understanding of the aquatic ecology of Lake Mackay and periphery during the wet and dry periods of the hydrocycle.

Three subterranean fauna studies have been undertaken for the Proposal (**Table 2-3**). Initial work included pilot and Level 1 studies by Invertebrate Solutions in 2017 which primarily targeted stygofauna within the surficial calcareous deposit within the Southern Regional area to the south of the On-LDE and east of the SIDE Borefield, with limited sampling On-LDE (islands and playa). To build on this knowledge, Stantec undertook a study comprising five separate subterranean fauna (stygofauna and troglofauna) field surveys in 2020 and 2021, focusing on sites (bores) located within the On-LDE (islands and playa), SIDE Borefield, and Southern Regional area (south of Lake Mackay).

2.2. Geology and Groundwater

2.2.1. Lake and Islands

The surface of Lake Mackay typically comprises a thin salt (predominantly halite) crust up to 5 mm thick. The salt curst is more extensive in the west of the lake, compared to the east, where it becomes patchy and interspersed with increasing proportions of gypsum and windblown quartz sands. This is underlain by a variable sequence of lakebed sediments, which varies in composition from east to west across the lake due to varying depositional processes. The eastern portion of the lake is characterised by a variably cemented, white-brown, evaporitic crust, largely comprised of halite and gypsum underlain by a sequence of largely unconsolidated and damp gypsum sand. In contrast, the western portion of the lake is characterised by a distinct white evaporite crust often underlain by a dark grey organic bed or laminations within a red-brown clay matrix, and typically interspersed with gypsum crystals of varying grain sizes.

Due to the differing geological composition of lakebed sediments, groundwater infiltration also varies from east to west across the lake. The eastern portion of the lake has high infiltration capacity and high hydraulic conductivity which results in surface water rapidly infiltrating the lakebed sediments following major rainfall events. Whereas, the western portion of the lake has relatively low infiltration rates and low hydraulic connectivity which results in water remaining on the surface for days to weeks (rarely months) following major rainfall events.

Lake Mackay is host to more than 270 islands of varying size within the On-LDE, with the larger landform islands, located in the eastern portion of the lake. The islands are surficial features of variable thickness and are largely composed of sand calcrete and gypsiferous sand, underlain by silty/clay lakebed sediments. Clay content increases with depth and typically marks the transition from island sediment to the lakebed sediments.

The topography of Lake Mackay is relatively flat, resulting in a very low horizontal groundwater flow gradient (<0.0002 m/m) in a northwest to southwest direction. Groundwater monitoring indicates that baseline groundwater levels range from 0.1 to 1.1 mbgl within the lakebed sediments, and from 3.4 to 4.0 mbgl on the landform islands. The average year-round depth to groundwater is approximately 0.5 mbgl, with an average annual groundwater level fluctuation of 0.3 m across the wet and dry seasons. During prolonged dry conditions, a decrease of up to 0.2 m was recorded within the lakebed sediments, while a reduction of up to 0.6 m was observed beneath a landform island. However, major rainfall events (>300 mm in one

month) result in significant recharge, saturating the vadose zone and increasing groundwater levels to within 0.2 m of the playa surface and within 0.6 mbgl beneath the islands, effectively returning the system to baseline conditions.

The largest landform islands in the eastern portion of the lake appear to host a lower salinity 'capillary fringe' within the porous gypsiferous sands that overlay the clay dominant lakebed sediments (hypersaline). The lower salinity groundwater is likely associated with the infiltration of rainfall into the shallow, permeable aeolian sediment and where present, with calcrete outcrops. This unit is a source of recharge to the underlying lakebed sediments and therefore a transitional zone exists both in the occurrence of groundwater and in water quality. Seasonal fluctuations in water levels are expected on the islands, associated with both temporal water levels within the aeolian sands and the deeper lakebed sediments.

Groundwater monitoring indicates lakebed sediments is characterised by circumneutral pH, elevated nitrate, and hypersaline water typically greater than 200,000 mg/L, up to 340,000 mg/L. The major ionic constituents of the lakebed sediments is consistent, comprising a cation dominance of Na>K>Mg>Ca and an anion sequence of Cl>SO4>HCO_3. Background concentrations of Na and Cl are approximately 100,000 mg/L and 145,000 mg/L, respectively, while potassium concentrations range from 3,000 mg/L to 3,350 mg/L. In contrast, salinities of groundwater hosted within the porous gypsiferous sands of the landform islands are typically bellow 60,000 mg/L.

2.2.1.1. Modelling

The Proposal will involve the abstraction of brine from the lakebed sediments, which is expected to result in the drawdown of groundwater. Groundwater modelling indicates that drawdown extents and depths are expected to be more pronounced in the eastern portion of the lake, due to higher permeability of lakebed sediments. As brine abstraction progresses into the southern and western portions of the lake over the first 10 years, drawdown of up to 3.0 m is predicted to occur in the immediate vicinity of the trenches, with drawdown in the areas between trenches ranging between 0.0 m to 1.5 m. As abstraction of brine progresses to the north and east and into the higher hydraulic conductivity/lower recharge zones in the eastern portion of the production area (where landform islands are present), drawdowns of 3.0 m are expected at the trenches and between 0 m and 1.8 m are expected between trenches and islands. Maximum drawdown of the lake bed sediments beneath the landform islands is expected to range from 1.25 m on the island fringes to less than 0.25 m in the centre of the islands.

Potential impacts from drawdown of lakebed sediments to groundwater quality are predicted to be minor with negligible change of major constituents, temporary over the LoM, and recovering within a short time period (approximately seven years) post-closure. During operations, there will be a shift in the ionic composition of the water in the trenches as potassium (K) is gradually depleted. However, it is also expected that while overall salinity of water in the trenches will decrease slightly over a 20-year period, Na and Cl will remain the dominant ionic constituents. It is also expected that recharge events (equivalent to a rainfall event of 300 mm within one month), will cause the system to reset (to within 0.6 mbgl), dissolving salts within the lakebed sediments and restoring the ionic equilibrium.

Natural recharge from groundwater present in the sandy/calcrete unit of the landform islands to the underlying clay lake sediments is not expected to be altered during brine abstraction and therefore groundwater quality changes associated with the islands is unlikely.

2.2.2. SIDE

The geology associated with the SIDE varies in composition from east to west, with the eastern portion comprising a sequence of sandstone, siltstone and shale and is consistent with the Carnegie/Pertatataka Formation. In comparison, the western portion of the SIDE is dominated by the Angas Hills Formation, consisting of interbedded pebble and cobble conglomerate, sandstone, pebbly sandstone and siltstone with a matrix of clayey sandstone and minor mudstone.

Two prospective aquifer units have been identified in the SIDE, with depth to groundwater between 5.8 mbgl and 8.2 mbgl. These units host groundwater characterised by circumneutral pH (mean 7.3), with salinity concentrations ranging from approximately 1,600 mg/L to 6,300 mg/L.

2.2.2.1. Modelling

Groundwater abstraction from the SIDE for groundwater supply is proposed to occur from a single line of 28 bores spaced 1 km apart. The majority of bores (23) will abstract water from the aquifer within shallow Neogene alluvials, which is approximately 88.5 m thick. The remaining five bores are predicted to source water from the deep aquifer within of the Angas Hills formation, primarily comprising conglomeritic sand and gravel. Modelling predicts a maximum groundwater level drawdown of 6 m immediately adjacent to the bores (representing <7% of total aquifer thickness), up to 0.1 m to 5.2 km from the bores, following a pumping period of 20 years.

2.2.3. Surface Hydrology

The topography of Lake Mackay is subdued and flat, with elevations ranging from approximately 360 mAHD in the east to 364 mAHD in the west. The deepest areas with the longest retention times on the WA portion of the lake occur in the southeast portion although it is likely that the NT side is deeper.

Surface water assessments determined the total catchment area of Lake Mackay is approximately 87,000 km^2, of which only 20% is considered effective. The lake is a closed system with no outflow or historic evidence of spilling into adjacent lakes. There are small ephemeral creeks and watercourses along the margins of the lake that drain the surrounding landscape and potentially contribute surface water runoff to the lake during major rainfall events.

Lake Mackay is predominantly dry and subject to irregular and infrequent inundation. Hydrological modelling indicates that the lake fills to a depth of approximately 2 m in the southeast corner of the lake on average once every five to 10 years, following rainfall events that exceed 250 mm. The lake may remain inundated for several months while subject to major flooding; however, the persistence of surface water is variable and dependent on preceding conditions. The longest inundation of Lake Mackay based on the available records occurred in 2001. This followed well-above average annual rainfall (at Balgo) during the preceding wet season of 2000 (768 mm), and again in 2001 (796 mm), causing flooding of the lake equivalent to a 1:20 or 1:50-year event.

Analysis of satellite imagery indicates that since 2000, the lake has had increased rainfall, resulting in more frequent, inundation events, likely attributed to climate change, with increased intensity of rainfall during the wet season. Flooding of more than 50% of the surface area of the lake has occurred 26 times since 2000, for an average duration of at least two weeks. However, major flood events, which result in complete inundation of the lake area for several months, such as those that occurred in 2000 and 2001 are rare, with the lake tending to dry rapidly unless subsequent top-up rainfall occurs.

2.2.3.1. Modelling

Although the Indicative Footprint for the On-LDE infrastructure represents a small portion of the total surface area of the lake, the linear trench network and associated bunding has the potential to alter hydrological processes. Hydrological modelling indicated that baseline velocities of surface water on the lakebed during natural inundation are near zero. Following development, a general reduction of velocity is expected to occur, due to the impediment caused by bunding around the trenches. However, in some areas, velocities increase where concentrated flow is confined between bunds or diverted along the perimeter of infrastructure and around evaporation ponds (at Year 20) near the shoreline. Further, where surface water flow is blocked by the presence of trench bunds, this may result in a temporary increase in water levels around the outside of the trench network.

While maximum water depth and duration of inundation may temporarily change as a result of the construction of the trench network, the overall stage-volume and stage-area relationship of the lake does not change significantly relative to the baseline condition, with the total inundated area of the lake effectively remaining equivalent to baseline conditions. Further, due to the presence of breaches in the trench network, water ultimately ponds in the deepest parts of the lake with these areas continuing to fill to approximately 2 m in depth. Modelling also indicates that the installation of crossovers along the east-west main feed canal will result in a 50 to 70% reduction in the inundation depth and extent along the southern shoreline, mitigating impacts.

Water balance modelling also indicated that the Proposal will not significantly impact Lake Mackay's overall water balance. Although a minor reduction may be observed in the number of smaller inundation events (<20% inundation extent) that cause ponding on the lake, it is expected that during larger inundation events (which are rare), there will be negligible impacts on the frequency, maximum extent, depth, and duration of surface water on the lake. However, any potential changes associated with the Proposal may be offset by the predicted increase in extreme rainfall events, due to climate change, for the region.

To support the surface water assessment, a salt balance assessment was undertaken for the Proposal. Although salts accumulated within the evaporation ponds and salt piles may cause localised salinity increases in the south west portion of the lake, the additional salt deposited is expected to dissolve and be dispersed across the lake during major flood events. In addition, relative to the existing natural salt loads within the basin, with appropriate mitigation measures, the addition of salts from the Proposal is not considered significant and will not impact the overall salt balance.

Table 2-1: Summary of key geological, groundwater and surface hydrological and hydraulic data and studies.

Reference	Area	Title
Geology and Groundwater		
Groundwater Exploration Services (2017)	On-LDE	Lake Mackay Preliminary Groundwater Modelling Study
Hydrominex Geoscience Consulting (2016)	On-LDE	Technical Report on the Lake Mackay Potash Project Western Australia
Advisian (2018)	On-LDE	Prefeasibility Study Chapter 6: Hydrological and Hydrogeological Modelling
Knight Piesold Consulting (2018)	On-LDE	Hydrogeological Modelling for the Mackay SOP Proposal Prefeasibility Study
Agrimin (2019d)	On-LDE	Closed Lysimeter Testing Memorandum
Agrimin (2020a)	On-LDE, Off-LDE	Definitive Feasibility Study
Agrimin (2019b)	On-LDE	Infill Drilling Memorandum
Agrimin (2019c)	On-LDE	Infiltration Testing Memorandum
Agrimin (2020d)	On-LDE	Regional Lake Groundwater Levels Memorandum
Agrimin (2019e)	On-LDE	Shelby Tube Sampler Memorandum
CDM Smith (2020)	SIDE	Water Supply Assessment for Mackay SOP Project
Stantec (2019b)	On-LDE	Trench Pump Test Analysis Report
Agrimin (2020c)	On-LDE	Island Impacts to Groundwater Memorandum
Stantec (2020a)	On-LDE	Integrated Groundwater Flow and Solute Transport Model Report
Agrimin (2021b)	On-LDE	Long Term Pump Test Memorandum
Stantec (2021e)	On-LDE	Lake Mackay Stage 1 and Stage 2 Surface Water Assessment
Agrimin (2020b)	On-LDE	Island Characterisation Memorandum
Stantec (2020b)	On-LDE	Recharge Assessment Memorandum
Stantec (2019a)	On-LDE	Recharge Lab Assessment Memorandum
Agrimin (2021a)	On-LDE, SIDE	Groundwater Sampling and Analysis Memorandum
Stantec (2021b)	On-LDE, Off-LDE	Lake Mackay Inundation and Water Balance Modelling Memorandum
Agrimin (2024)	On-LDE	Consolidated Island Impact Memorandum (updated from 2020) for the Lake Mackay Sulphate of Potash (SOP) Project
Surface Hydrology		
Agrimin (2019a)	On-LDE	Agrimin LiDAR survey of the Western Australia portion of Lake Mackay (1 m Digital Elevation Model)
Advisian (2018)	On-LDE	Hydrological and hydrogeological modelling for the Mackay SOP Proposal Prefeasibility Study
Agrimin (2018)	On-LDE, Off-LDE	Hydrology and hydrogeology of the Lake Mackay SOP Proposal, Western Australia
EOS Data Analytics (2020)	On-LDE	Time series function analysis of Lake Mackay inundation (1982-2020)
Stantec (2021d)	On-LDE	Salt Balance and Ionic Composition Memorandum for the Mackay SOP
Stantec (2021e)	On-LDE, Off-LDE	Lake Mackay Stage 1 and Stage 2 Surface Water Assessment
Stantec (2021b)	On-LDE, Off-LDE	Lake Mackay Inundation and Water Balance Modelling Memorandum

2.3. Aquatic Ecology

2.3.1. Surface Water Quality

During flooded conditions (February-March 2021), the pH of the surface water at Lake Mackay ranged from acidic to circumneutral (6.5 to 6.7) (Foged 1978), with circumneutral conditions also recorded for the island claypan (6.6) and peripheral wetlands (6.6 to 6.7) (**Table 2-2**). Data from limited, previous sampling and rewetting trials indicate that there is a shift towards the end of the hydroperiod, where the pH becomes acidic to alkaline at the lake and alkaline at the peripheral wetlands. Surface water salinity, measured as electrical conductivity (EC) ranged from hyposaline (29,800 µS/cm) to hypersaline (131,000 µS/cm) (Hammer 1986) at Lake Mackay during flood and increases substantially through the hydroperiod, as reflected in rewetting trial and historic (2017) data.

Nutrient concentrations at the lake were generally low under flooded conditions, as compared to the peripheral wetlands (**Table 2-2**). The higher values at the majority of peripheral wetlands were likely associated with allochthonous inputs, inputs of organic material from riparian vegetation habitats, and the release of nutrients from newly wetted sediment. The island claypan had naturally elevated nitrogen and low phosphorus concentrations. Dissolved metal concentrations in the lake were also typically low (**Table 2-2**), likely due to limited transport pathways for deposition of mineralised sediment from the catchment. In contrast, dissolved metals were higher at the peripheral wetlands, with aluminium, chromium, cobalt, copper, iron, lead, selenium and zinc exceeding the Water Quality Australia (2018) recommended toxicant default guideline values (DGVs), likely related to differences in local geology throughout the region.

2.3.2. Sediment Quality

The pH of surficial sediment at Lake Mackay ranged from neutral to alkaline (6.6 to 8.1) (Hazelton and Murphy 2007) during dry conditions, trending to alkaline when in flood (7.4 to 7.9) (**Table 2-2**). The pH at peripheral wetlands followed a similar trend during dry conditions, ranging from neutral to alkaline during dry conditions (7.3 to 8.4) although displayed greater variability during flood (5.4 to 8.5). The pH of sediment at the island claypan was neutral at time of sampling (flooded conditions only). Lake Mackay surficial sediment was characterised by elevated salinities, ranging from 74,800 mg/kg to 179,000 mg/kg, during dry conditions, with substantially lower concentrations in flood (20,700 mg/kg to 58,100 mg/kg). Similar trends were also observed from the peripheral wetlands during dry and wet conditions (78,200 mg/kg to 302,000 mg/kg, and from 80 mg/kg to 46,000 mg/kg respectively).

Nutrient concentrations were typically higher in peripheral wetlands and the island claypan, compared to the lake, which may reflect differences in allochthonous inputs as well as the high productivity of wetlands under flood conditions (**Table 2-2**). All metals in the sediment of Lake Mackay, the island claypan and peripheral wetlands were below the Water Quality Australia (2018) recommended toxicant default guideline values (DGVs) during dry and flooded conditions.

2.3.3. Aquatic Biota

2.3.3.1. Algae and Macrophytes

A total of 42 algal taxa from three phyla (Bacillariophyta, Cyanophyta and Chlorophyta) have been recorded across Lake Mackay and the peripheral wetlands, including benthic and planktonic algae from rewetting trials and flood sampling (**Table 2-2**). Lake Mackay was more diverse (37) than the peripheral wetlands (25), dominated by Bacillariophyta (diatoms) and Cyanophyta (cyanobacteria) with 20 and 12 taxa respectively. Chlorohytes (green alga) accounted for the remaining taxa (5). The peripheral wetlands had a similar diversity of cyanobacteria and diatoms (11 and nine taxa) and limited green alga taxa (5). In general, the taxa recorded were considered widespread, with a consistent composition to assemblages from inland waters throughout WA (Handley 2003; John *et al.* 2009; Paerl *et al.* 1993).

While no true aquatic plants were observed, the propagules of the charophyte (large green alga) *Chara* sp. were prevalent in the sediment of the peripheral wetlands, reflecting the low salinity tolerance of the genus and association with freshwater habitats (Garcia 1999). Propagules of the charophyte *Lamprothamnium* sp., commonly recorded from salt lakes throughout Australia, were also recorded from a limited number of peripheral wetlands.

2.3.3.2. Diatoms

In total 25 diatoms from 12 genera were recorded across Lake Mackay, the island claypan and peripheral wetlands (field survey and rewetting trials) (**Table 2-2**). The peripheral wetlands had a higher diversity (21) compared to Lake Mackay (14), while five taxa were recorded from the island claypan (sampled in flood only). There was greater variability in diversity between peripheral wetlands, reflecting in substrate composition and water quality, and likely, higher overall biological productivity. *Hantzschia* sp. aff. *baltica*, *Navicula* sp. aff. *incertata* and *Amphora coffeaeformis* were the most common taxa at Lake Mackay (flooding and rewetting trials) and are all well-known from salt lakes in WA (Taukulis 2007). Several genera were recorded from the peripheral wetlands and island claypan only, reflecting the lower salinity or freshwater conditions.

2.3.3.3. Aquatic Invertebrates

A total of 53 aquatic invertebrate taxa have been recorded from the lake, and peripheral wetlands, based on a consolidated dataset from the baseline ecology study, rewetting trials and earlier work (**Table 2-2**). These belonged to five higher level taxonomic groups; Insecta, Bivalvia, Branchiopoda, Maxillopoda (Copepoda) and Ostracoda. Diversity at Lake Mackay (13) was lower than the peripheral wetlands (45 taxa) while five taxa were recorded from the island clay pan. Diversities between sites were generally comparable for Lake Mackay during flood with greater variability observed between peripheral wetlands, in response to differences in water quality, substrate, and allochthonous inputs.

The aquatic invertebrate community of Lake Mackay was primarily dominated by halophilic branchiopods and copepods, with a lesser contribution from ostracods and insects (**Table 2-2**). The widespread salt-lake taxa *Parartemia laticaudata* (brine shrimp) and *Meridiecyclops platypus* (cyclopoid copepod) were predominant, both of which are broadly distributed species (Timms 2012; Timms 2006; Timms *et al.* 2006). *Parartemia* sp. and ostracod eggs were also recorded from the sediment, with *Parartemia laticaudata* and two species of ostracod hatching during rewetting trials. The peripheral wetlands supported a higher proportion of opportunistic (insect) taxa, *Branchinella* as the dominant anostracan and a higher diversity of diplostracans from the orders Cladocera (water fleas) and Spinicaudata (clam shrimp); ostracods also contributed to the peripheral wetlands.

The south-eastern portion of the lake is important in providing relatively deep, stable conditions for aquatic biota and waterbirds during large flood events. However, it is likely the NT side holds water for longer, and may therefore provide higher ecological values, particularly for waterbirds.

2.3.4. Summary of Ecological Values and Significant Taxa

Lake Mackay is a predominantly dry, highly episodic saline lake that supports a relatively low number of resilient, halophytic aquatic biota when inundated, comparable to other inland salt lakes throughout Australia. Peripheral wetlands comprise larger saltpans, with comparable characteristics to the playa. The island claypans and freshwater claypans are more diverse, while most of the taxa recorded from the lake and peripheral wetlands are considered widespread, having been documented from regional salt lakes in WA.

The algae and diatoms comprised common, ubiquitous and cosmopolitan genera and species with no significant taxa recorded and a high level of similarity in the community structure of the lake and saltpans. In contrast, the aquatic invertebrate communities were more variable, with higher diversity in the freshwater claypans, attributed to a broader range of habitat types, based on the consolidated dataset. Ten new taxa were identified including two spinicaudatans (clam shrimp) and eight ostracods (seed shrimp), the majority of which were recorded from peripheral wetlands. However, two of these taxa (the ostracods *Reticypris* `BOS1371` and *Billcypris* n.sp. `BOS1509`) were recorded from the lake and were widespread throughout the playa and likely to occur across the border into the NT (**Table 2-2; Figure 2-1**). The peripheral wetlands to the south of the lake, also support eight new aquatic invertebrate species (two spinicaudatan and six ostracod taxa).

Increased productivity during the smaller inundation events is associated with areas of the lake on the WA side that hold water for longest, corresponding to small areas associated with the north-western arm and central southern area of the lake adjacent to a small island. The predominant area of the lake with the longest water retention time is the south -eastern portion of the lake, although it is likely the NT side holds water for longer, and may therefore provide higher ecological values, particularly for waterbirds. Regardless, the south-eastern portion on the WA side of Lake Mackay is important in providing deeper, stable conditions for aquatic biota and waterbirds during the largest flood events.

Lower salinities at the beginning of the hydroperiod provide a cue for aquatic biota to emerge, providing a food source for higher order consumers including waterbirds (boom phase). During these initial stages, water quality conditions are relatively homogenous, with salinities increasing as water levels recede, before drying completely (bust phase). During the inundated period, aquatic biota (algae and aquatic invertebrates) matures and reproduces, replenishing the egg bank, contributing to the recovery of the lake and peripheral wetlands during the next flood event.

Lake Mackay is subject to a boom phase during flooding, in line with all inland wetlands in the arid zone of WA. During the largest of these events (equivalent to 1:20 or 1:50 year events), the ecological values of the lake are considered highest, due to reduced salinities. The lake, islands and peripheral wetlands support a diverse and abundant array of aquatic biota and waterbirds, while samphires in the riparian zone also flower prolifically. However, in the last 20 years, rainfall and smaller inundation events at the lake have also become more frequent, likely attributed to climate change, with more intensive rainfall occurring during the wet season. This tends to lead to partial filling of the lake, with resulting elevated salinities limiting ecological values, as they often exceed the tolerance limits required for the emergence of aquatic biota.

Table 2-2: Summary of studies that include surveying aquatic ecology values of Lake Mackay and peripheral wetlands.

Reference	Title	Sampling Location	Sampling Intensity and Methods	Key Findings	Dominant Taxa	Taxa Records	Taxa of Scientific Interest
Invertebrate Solutions (2017b)	Survey for Aquatic Macroinvertebrates and SRE Fauna for the Lake Mackay SOP Proposal, WA	• Peripheral wetlands: 3 sites.	• Single field survey. • Timed sweep using a 250 µm dip net.	• No aquatic invertebrates recorded Lake Mackay. • Common and widespread groups recorded from freshwater claypans.	• *Penthesilenula brasiliensis* • Anisops nasutus • *Cybister tripunctatus* • *Eretes australis* • *Paroster michaelseni*?	• 7 taxa in the peripheral wetlands.	• NA
Invertebrate Solutions (2018b)	Survey for Aquatic Macroinvertebrates for the Lake Mackay SOP Project, WA	• Lake Mackay: one site.	• Single field survey. • Opportunistic sampling.	• One common, widespread aquatic invertebrate species recorded from the lake.	• *Cybister tripunctatus*	• 1 taxa in the lake.	• NA
Stantec (2021a)	Baseline Aquatic Ecology Study of Lake Mackay and Peripheral Wetlands	**Dry conditions** • Lake Mackay: 21 sites • Peripheral wetlands: 7 sites. **Inundated conditions** • Lake Mackay: 11 sites. • Island Claypan: 1 site. • Peripheral wetlands: 10 sites.	• Five field surveys over three years. • Three surveys in dry conditions. • Two surveys in inundated conditions. • Sampling of multiple ecological components, including water quality, sediment quality, algae and macrophytes and aquatic invertebrates.	**Water quality** • Lake Mackay slightly acidic and hyposaline to mesosaline, trending alkaline and hypersaline as the hydroperiod progresses. • Nutrient and metals levels relatively low and homogenous. • Peripheral wetlands generally fresh, with higher and more variable nutrient and metals levels compared to the lake.	• N/A	• N/A	• NA
				Sediment quality • Lake Mackay acidic to neutral during dry conditions, trending moderately alkaline during inundation. • Moderate to high salt loads and nutrient levels within Lake Mackay and peripheral wetlands, diluting substantially under flooded conditions. • Metals below ANZG (2018) DGVs.	• N/A	• N/A	• N/A
				Algae and Macrophytes • Diatoms and blue-green algae dominant at Lake Mackay and peripheral wetlands, typical of temporary salt lakes. • No true macrophytes recorded, though the spores of freshwater charophytes (large green algae) recorded at some peripheral wetlands.	• *Hantzschia* • *Navicula* • *Nodularia* • *Phormidium* • *Amphora*	• 42 taxa in total. • 37 taxa in the lake. • 25 taxa in the peripheral wetlands.	• N/A
				Diatoms • Assemblages at Lake Mackay and peripheral wetlands characterised by halophilic and aerophilic taxa, typical of inland saline waters. • Greater diversity at freshwater claypans attributed to differing water quality and substrate type, supporting additional species reflective of these conditions.	• *Amphora coffeaeformis* • *Hantzschia* sp. aff. *baltica* • *Navicula* sp. aff. *incertata*	• 25 taxa in total. • 14 taxa in the lake • 21 taxa in the peripheral wetlands. • 5 taxa in the island claypan.	• N/A
				Aquatic Invertebrates • Relatively low diversity at Lake Mackay, generally dominated by common, halotolerant crustacean taxa. • Higher diversity in the peripheral wetlands, comprising a resident crustacean community, opportunistic taxa (insects) and a single bivalve taxon. • Greater variability in community composition between sites for peripheral wetlands compared to Lake Mackay, reflecting range of habitats, water quality and allochthonous inputs.	• *Parartemia laticaudata* • *Meridiecyclops platypus* • *Branchinella* • *Ozestheria* spp. • *Triops australiensis* • *Eretes australis*	• 53* taxa in total. • 13 taxa in the lake. • 45 taxa in the peripheral wetlands. • 5 taxa in the island claypan.	**Clam shrimp** • *Ozestheria* sp. STC13 • *Ozestheria* sp. STC14 **Ostracods** • ?*Ampullacypris* `BOS1510 • *Bennelongia* `BOS1520` • *Billcypris* n.sp. `BOS1509` • *Heterocypris* `BOS1515` • *Ilyodromus* `BOS1514` • *Mytilocypris* `BOS1521` • *Reticypris* `BOS1371` • *Riocypris* `BOS1522`

*Note: * indicates that aquatic invertebrate total taxa represents collated dataset with Invertebrate Solutions 2017, 2018.*

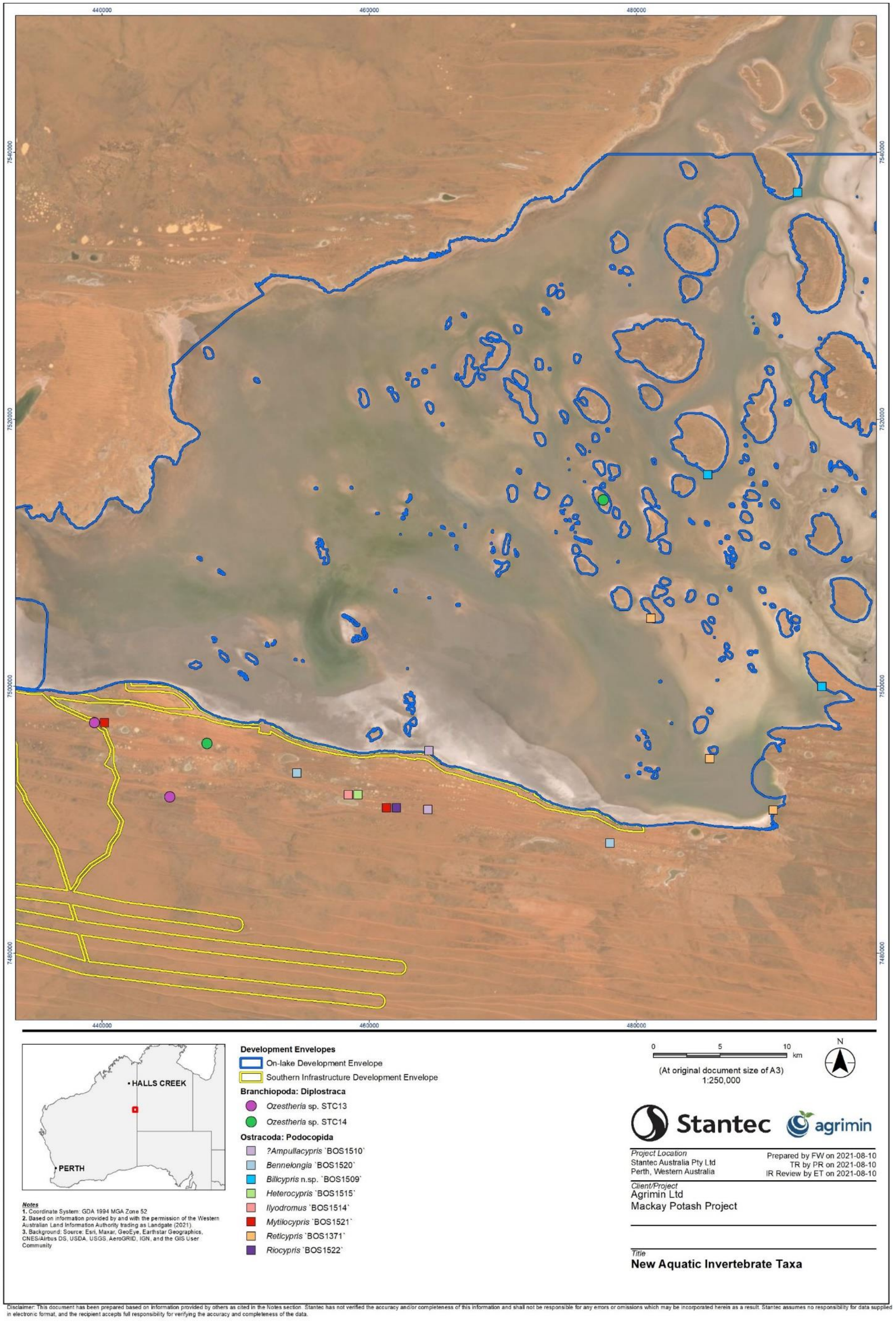

Figure 2-1: Location of aquatic invertebrate taxa of scientific interest from Lake Mackay and peripheral wetlands.

2.4. Subterranean Fauna

In total, at least 18 stygofauna species, one potential stygofauna species, and one potential troglofauna species have been recorded from the Project area across seven separate field surveys (**Table 2-3**). No species have been recorded from lakebed sediments on the playa of Lake Mackay (**Table 2-3**). This habitat is not considered prospective for subterranean fauna, due to hypersaline groundwater and limited interconnected voids. Similarly, the SIDE borefield was also not prospective and was characterised by relatively fine textured alluvial lithology, which is likely to restrict stygofauna and troglofauna.

The On-LDE islands, predominantly landform islands in the eastern portion of the lake, host stygofauna within the calcrete and gypsiferous sands that comprise lower salinity groundwater, although this habitat is comparatively less diverse than the Southern Regional area. Three stygal copepod species have been recorded from the landform islands, including one undescribed species that may be restricted; *Schizopera* 'bradleyi' (**Table 2-3**). The only potential troglofauna species recorded was the dipluran Projapygidae-OES3 (**Table 2-3**).

The majority of stygofauna records from the Project area were associated with the surficial calcrete aquifer in the Southern Regional area (outside of the SIDE borefield). A total of 16 species were recorded from this area, including 13 undescribed species (**Table 2-3**). Only one potential stygofauna taxon (affinity to groundwater unknown); Enchytraeidae sp., was recorded from the alluvial aquifer of the SIDE borefield (**Table 2-3**), although is likely more broadly distributed throughout the region.

Table 2-3: Summary of subterranean fauna studies for the Proposal.

Reference	Title	Date	Survey Effort	Subterranean Fauna Records	Key Findings
Invertebrate Solutions (2017a)	Mackay Potash Project – Pilot Survey for Subterranean Fauna	• May 2017.	• Five stygofauna haul samples collected from five sites (bores) in the Southern Regional area. • Sampling targeted a surficial calcrete aquifer.	• 121 individual stygofauna collected, represented by 10 species from the higher-level taxonomic groups Oligochaeta, Bathynellacea, Ostracoda, Harpacticoida, Cyclopoida and Coleoptera.	• Undescribed genera and species (Southern Regional area): – *'Mackaynitocrella mouldsi'* – *'Mackaycyclops mouldsi'* • Undescribed species (Southern Regional area): – *Parapsuedoleptomesochra 'mackay'* – *Schizopera 'mackay'* – *Atopobathynella sp. 'mackay'* – *Abcandonopsis 'mackay'* – *Halicyclops 'mackay'* – *Paroster sp. 'mackay'*
Invertebrate Solutions (2018a)	Mackay Potash Project – Phase 1 Survey for Subterranean Fauna	• November 2017.	• Stygofauna – Total of 15 stygofauna haul samples collected from 15 sites (bores). – 12 samples collected from the Southern Regional area; seven from the surficial calcrete aquifer and five from the deep alluvial aquifer. – One sample collected from On-LDE islands. – Two samples collected from the On-LDE playa. • Troglofauna – Two troglofauna scrapes collected from sites to the south of the lake. – Six troglofauna litter traps deployed (four retrieved).	• Southern Regional area surficial calcrete – 222 individual stygofauna collected, represented by 16 species and four higher level taxonomic groups. • On-LDE islands – Two species of stygofauna collected from two orders of Copepoda.	• Undescribed genera and species (Southern Regional area): – *'Mackaycyclops bradleyi'* • Undescribed species (Southern Regional area): – *Schizopera 'medifurca'* – *Schizopera 'paracooperi'* – *Paroster sp. 'mackay medium'* – *Paroster? sp. 'mackay small'* • Undescribed species (Islands): – *Schizopera 'bradleyi'* • No stygofauna recorded from playa or deep alluvial aquifer within the Southern Regional area. No troglofauna recorded.
Stantec (2021c)	Mackay Potash Project - Subterranean Fauna Study 2021	• January 2020 (stygofauna and troglofauna litter trap deployment). • May/June 2020 (stygofauna only). • August 2020 (stygofauna and troglofauna litter trap deployment). • October 2020 (stygofauna only). • April 2021 (stygofauna only).	• Stygofauna – Total of 59 stygofauna samples (58 haul samples and one hand auger sample) collected from 28 sites (bores). – 24 samples collected from 11 sites (bores) On-LDE (islands). – Nine samples collected from eight sites (bores) within the On-LDE (playa). – 12 samples collected from four sites (bores) within the SIDE. – 14 samples collected from five sites (bores) within the Southern Regional area. • Troglofauna – Seven litter traps deployed at four sites in the SIDE. – 13 litter traps deployed at seven sites in the Southern Regional area.	• Southern Regional area surficial calcrete – 35 individual stygofauna collected, represented by at least two species from two higher level taxonomic groups. • SIDE – One species of potential stygofauna taxon Enchytraeidae sp. (two individuals). • Islands – Three stygofauna species (Copepoda; *Halicyclops kieferi*, *Schizopera ?'bradleyi'*) and one potential stygofauna (Enchytraeidae sp.) collected. – One potential troglofauna, Projapygidae-OES3.	• Confirmation of diverse and unique stygofauna community present within Southern Regional area (surficial calcrete). • Stygofauna confirmed from four islands (low to moderate abundance and low diversity). • Potential troglofauna recorded from one landform island. • One potential stygofauna recorded from the SIDE, though not considered to represent a significant stygofauna community. • No stygofauna recorded from On-LDE playa.

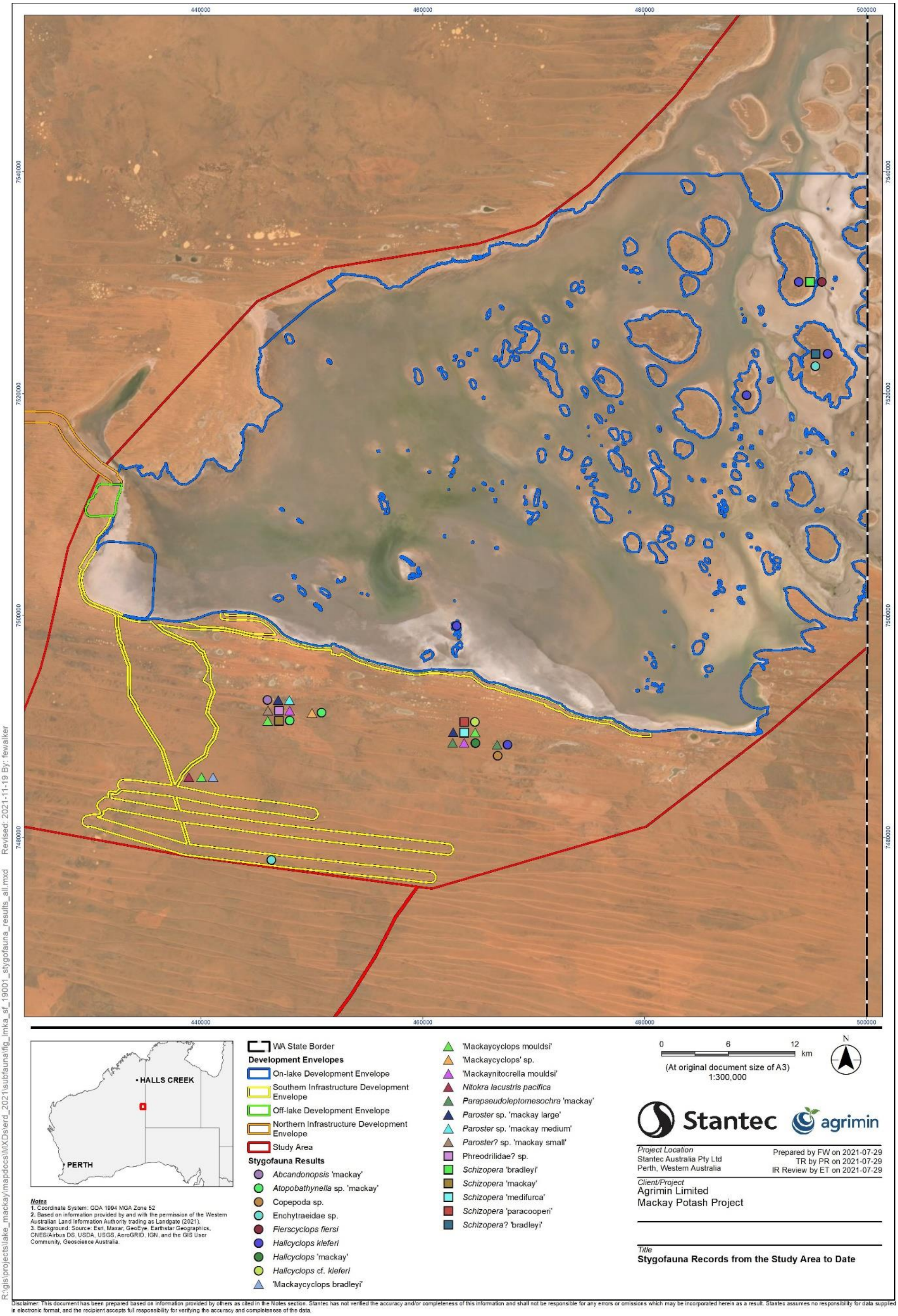

Figure 2-2: Stygofauna records from the landform islands (On-LDE), Southern Regional area and SIDE.

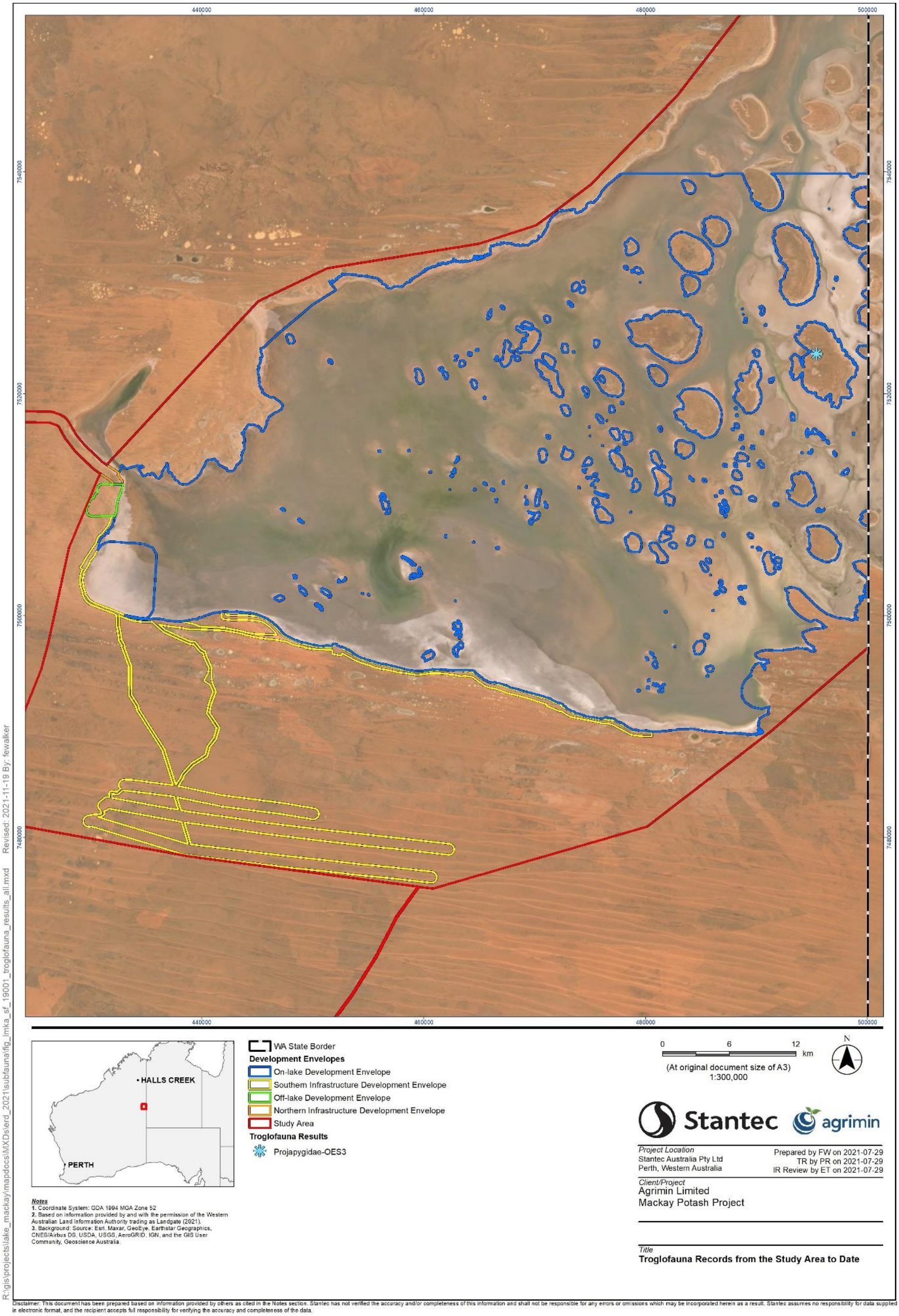

Figure 2-3: Troglofauna records from the landform islands (On-LDE).

3. Management Approach

3.1. Provisions Background

This section (**Section 3**) outlines the management approach of this IWEMP. The approach comprises outcome-based and objective-based management provisions, with appropriate indicators developed for environmental objectives and criteria, which are robust and measurable, where possible.

Outcome-based management provisions are applied where a sufficient level of information exists to measurable criteria (EPA 2024), defined to assess performance against the environmental outcome. These include:

- **Trigger Criteria** – Measures set at a conservative level (trigger criteria), to forewarn the approach of threshold criteria and ensure trigger level response actions are implemented well in advance of an environmental outcome being compromised.
- **Threshold Criteria** – Framed to represent the limit of acceptable impact beyond which there is likely to be a significant effect on the environment. This indicates there is risk that the environmental outcome will not be met.

Objective-based management provisions are applied where a level of uncertainty exists or where performance cannot be measured against trigger or threshold criteria. In this case, management targets are established to measure the success of management actions in achieving the environmental objective. Complementary provisions (including both outcome and objective-based) have also been applied to address values where a high level of management is required, and/or a degree of uncertainty and complexity exists.

3.2. Key Assumptions and Uncertainties

Agrimin is committed to supporting the conservation of inland waters and subterranean fauna within the vicinity of the Proposal. Survey work for the Proposal (Sections 8 and 9 of the ERD) has contributed substantially to the understanding of inland waters and subterranean fauna values in the region. However, it is acknowledged that there are remaining knowledge gaps, which may better inform the management of potential impacts through the implementation of this IWEMP. The key assumptions and uncertainties that apply to inland waters and subterranean fauna are summarised as follows:

- The brine abstraction strategy is preliminary, and the exact location, extent and duration of brine abstraction may change over time.
- This IWEMP has been developed based on information from preliminary modelling of surface water and groundwater and inundation events.
- The extent to which climatic factors outside of the proponent's control will impact on inland waters and subterranean fauna within the Proposal Area is also an unknown.
- Based on current available taxonomic information for aquatic and subterranean fauna, should knowledge of species increase over time this IWEMP may need to be updated accordingly.

3.3. Potential Proposal Impacts

3.3.1. Inland Waters

Considering the key assumptions and uncertainties, the potential direct impacts to inland waters from the Proposal include:

- Aquatic and riparian habitat loss, increased habitat fragmentation or modification, and loss of species of scientific interest or other significance, due to clearing, disturbance and construction;

The potential indirect impacts to the inland waters from the Proposal include:

- Altered surface hydrology associated with development (including under future predicted climate change scenarios), influencing surface water flows and inundation during major flooding, which may adversely affect aquatic biota and waterbirds;
- Increased salinity due to runoff from evaporation ponds and salt piles, adversely affect aquatic biota and riparian vegetation;
- Groundwater drawdown causing changes to hydraulic connectivity and/or reduction in moisture content of sediment, adversely impacting aquatic biota and riparian vegetation; and
- Changes in salinity and/or ionic composition of groundwater from lakebed sediments abstraction, adversely impacting aquatic biota and riparian vegetation.
- Potential disturbance and exposure of ASS during trench excavation, adversely impacting aquatic and riparian habitat;

- Potential for contamination of surface water and/or groundwater as a result of hydrocarbon and/or chemical spills, and landfill / wastewater treatment plant operations;
- Changes in hydraulic connectivity and groundwater quality from abstraction of up to 3.5 GL/a of groundwater for processing from the SIDE borefield; and
- Fugitive dust emissions (including wind-blown salts) may negatively affect aquatic and riparian habitats or riparian vegetation.

3.3.2. Subterranean Fauna

Considering the key assumptions and uncertainties, the potential direct impacts to subterranean fauna from the Proposal include:

- Excavation and disturbance of prospective habitat for stygofauna and troglofauna beneath landform islands within the On-LDE due to development of infrastructure.
- Groundwater drawdown and loss of subterranean fauna and/or prospective habitat due to trench brine abstraction from the On-LDE; and
- Groundwater drawdown and loss of subterranean fauna and/or prospective habitat due to abstraction from the SIDE borefield.

The potential indirect impacts to subterranean fauna from the Proposal include:

- Groundwater contamination on the islands and within the SIDE due to hydrocarbon spills and subsequent seepage into the subterranean environment; and
- Altered surface hydrology and topography from clearing and disturbance resulting in changes to groundwater flow paths on the islands and within the SIDE.

3.4. Application of Mitigation Hierarchy

Mitigation measures for the Proposal are detailed in the ERD for the environmental factor of Inland Waters and Subterranean Fauna (Stantec 2022) and for inland waters and subterranean fauna within the IWEMP. Mitigation measures have been applied to inland waters and subterranean fauna, where relevant aligning with the management provisions. The Proposal will avoid impacts to inland waters and subterranean fauna via the following:

- Limit disturbance On-LDE (4.55%; <15,000 ha).
- Avoid impacts to NT section of the lake (16.6%; 56,506 ha).
- Exclusion heritage zones on WA side of the lake will remain undisturbed (9.5%; 32,261 ha).
- Implement buffer zones around islands (up to 500 m).
- Limit disturbance of riparian vegetation (33.13 ha).
- Avoid impacts to peripheral wetlands.
- No expected disturbance of drainage features and claypans within the SIDE.
- Avoid impacts to islands including riparian vegetation (5.9%; 20,119 ha).
- Limit disturbance on the lake from evaporation ponds and salt piles (2.7%, <9,000 ha).
- Avoid islands with infrastructure located in western portion of the lake.
- Implement a buffer zone to the riparian vegetation of up to 250 m.
- Engineering design; 1 km distance between trenches to limit drawdown.
- Residual salt crust will prevent moisture loss limiting sediment mobilisation.
- Removal of potassium (K) will not alter the dominant ionic constituents in groundwater.
- Limited acid forming material exists within the lake bed sediments.
- Avoid use of diesel for power generation by using LNG, solar and wind operation alternatives for the Proposal.
- Salt harvesters will be powered using reticulated power sources limiting diesel usage on the lake surface.
- Avoid fuel/chemical storage and transfer from occurring outside of designated areas.

- Avoid off-road driving and stay on approved access ways.
- Avoid peripheral wetlands (claypans) with the implementation of suitable buffer zones.
- Implement suitable buffer zone between evaporation ponds and salt piles and riparian vegetation.

The Proposal will avoid impacts to subterranean fauna via the following:

- Limited drawdown is expected beneath the landform islands ranging from 1.25 m on the margins to 0.25 m in the centre of the islands, at year 20.
- Several larger islands that may contain prospective habitat for stygofauna in the north and east (NT) of Lake Mackay will not be impacted by drawdown.
- Drawdown within the SIDE borefield is expected to be limited, with a maximum lateral drawdown extent of 5.2 km and a maximum drawdown depth of 6 mbgl immediately adjacent bores, after 20 years of pumping (equivalent to <7%) of total aquifer thickness.
- Avoid clearing and disturbance on the islands and within the SIDE.
- Clearing and disturbance will only occur in approved ground disturbance areas and will avoid unnecessary changes to surface topography, compaction and/or creation of hard surfaces.

4. Management Provisions

4.1. Overview

This IWEMP outlines the requirements to avoid, minimise, manage, monitor, and rehabilitate as per the EPA's mitigation hierarchy. The subsequent sections identify the management provisions that will be implemented by Agrimin for the Proposal to ensure that the environmental objectives, criteria, targets, and outcomes are met for Inland Waters. Following the implementation of this IWEMP, the EPA guidance for Inland Waters is predicted to be met, with no unacceptable environmental outcomes requiring offset strategies remaining. The IWEMP will be reviewed and updated as required, following an adaptive management approach (**Section 8**).

4.2. Outcome-Based Provisions

The IWEMP focuses on outcome-based provisions, which are performance-based and can be audited. These management provisions developed are measurable, and the success of management actions can be monitored and reported. They comprise triggers and thresholds (environmental criteria) for direct impacts that are quantifiable and specifically relate to project-related adverse impacts that may affect inland waters and subterranean fauna (**Table 4-1** and **Table 4-2**). Nine outcome-based provisions have been developed, with associated triggers and thresholds (**Table 4-1**). Where required, suitable response and corrective actions are also recommended for the environmental criteria.

The following outcome-based management objectives for the IWEMP (beginning with the prefix IW and shown in **Table 4-1**) have been established:

- **IW1:** No unauthorised disturbance to occur within the buffer zone applied to landform islands, large, intermediate islands, and small islands or within the WA and NT exclusion zones of Lake Mackay.
- **IW2:** No significant impact to low salinity or fresh groundwater from abstraction of the brine to groundwater dependent vegetation and stygofauna, relative to baseline conditions, on landform islands.
- **IW3:** No significant impact to surface water levels during large inundation events from abstraction of the brine associated with the On-Lake Development.
- **IW4:** Groundwater abstraction from the SIDE borefield (water supply) will not exceed licence issued under Section 5C of the *Rights in Water and Irrigation Act 1914*.
- **IW5:** No significant impact to the shallow aquifer (Neogene alluvial deposit) from the SIDE borefield, reducing availability of groundwater for other bore users, groundwater dependent vegetation and stygofauna habitat.
- **IW6:** Groundwater abstraction of brine from the lakebed sediments will not exceed licence issued under Section 5C of the *Rights in Water and Irrigation Act 1914*.
- **IW7:** No significant decline in the aquatic invertebrate communities of Lake Mackay due to project-related activities.
- **IW8:** No significant increase in contaminants in the surface waters of Lake Mackay during large inundation events, relative to baseline conditions.
- **IW9:** No significant decrease in the extent and duration of surface waters in the deepest parts of the Lake Mackay basin, as a result of project-related activities.

4.3. Objective-Based Provisions

Objective-based provisions relate to environmental management actions that are not specifically measurable. They specify management actions according to management targets, particularly for indirect impacts that are not quantifiable. For inland waters and subterranean fauna, as ongoing monitoring is undertaken and additional population data is gathered, these management targets may be reviewed, and quantifiable outcome-based provision(s) may be established accordingly. Eleven objective-based management provisions have been outlined in **Table 4-2**, to prevent project-related adverse impacts to inland waters and subterranean fauna (including significant species) within proximity to the Proposal with appropriate management actions and monitoring actions.

The following objectives-based provisions (beginning with the prefix MO and shown in **Table 4-2**), each with specific measurable targets for inland waters, have been established:

- **MO1:** No project-related adverse impacts to aquatic biota due to habitat loss, fragmentation, or modification, from project-related disturbance.
  - Disturbance in the On-lake Development Envelope (On-LDE) is not to exceed: development of trenches, extraction of up to 100 GL/a of brine, and solar evaporation and harvesting ponds for potash salts, including ground disturbance of approximately 15,000 ha with the 217,261 ha On-LDE.

- Buffer zones applied to landform islands, large and intermediate islands, small islands and WA and NT exclusion zones on Lake Mackay.
- No unauthorised clearing within lake island buffer zones.

- **MO2:** No project-related adverse impacts to aquatic biota due to changes in surface water flows and inundation during major flood events, from project development.
  - Verification of detailed hydrological modelling of surface water flows, including simulation 1:100-year rainfall events.
  - No access permitted to inundated portions of Lake Mackay when more than 20 % of the lake is inundated.
  - Staged development of trenches via BMUs and engineering design (1 km spacing, install crossovers) to maintain natural hydrological processes.
- **MO3:** No project-related adverse impacts to aquatic biota due to increased salinity in surface waters, from runoff from evaporation ponds and salt piles.
  - Staged development of evaporation ponds and salt piles is in place.
  - Evaporation pond embankment breached at closure.
- **MO4:** Minimise project-related adverse impacts to aquatic biota due to changes to hydraulic connectivity and/or reduction in moisture content of lake sediment, from groundwater drawdown; or changes in salinity and/or ionic composition of groundwater from lakebed sediment abstraction:
  - Groundwater abstraction not to exceed ground water licence limit.
  - Buffer zones to be implemented.
  - Groundwater monitoring procedure in place.
- **MO5:** Minimise project-related adverse impacts to aquatic biota due to potential disturbance and exposure of ASS during trench excavation.
  - Acid Sulphate Soils (ASS) Management Plan (ASSMP) and management of ASS in place.
- **MO6:** No project-related adverse impacts to aquatic biota due to potential contamination of surface water and/or groundwater as a result of hydrocarbon and/or chemical spills, and landfill/wastewater treatment plant operations:
  - Hazardous Substances Management Plan (HSMP) and Procedure implemented.
  - Spill response training for all personnel and contractors.
  - Spill response equipment provided for all site vehicles.
- **MO7:** Minimise project-related adverse impacts to aquatic biota due to changes in hydraulic connectivity and groundwater quality from abstraction of up to 100 GL/a of brine groundwater for the project:
  - Verification of detailed hydrological modelling of surface water flows, including simulation 1:100-year rainfall events.
  - Groundwater Monitoring Program in place.
  - Groundwater abstraction not to exceed ground water licence limit.
  - Groundwater monitoring procedure in place.
- **MO8:** Minimise project-related adverse impacts to aquatic biota from:
  - Windblown salt from evaporation ponds/salt piles; and
  - Soil compaction of lakebed during development of trenches and heap and profile of salt piles.
  - No project related incidents of vehicles being used outside of designated operational areas such as causeways or bunding, designated construction zones or approved disturbance areas.
  - Demarcation and monitoring of construction boundaries in place.
- **MO9:** No Project related adverse impacts to subterranean fauna on landform islands from the development of the on-LDE infrastructure (including brine abstraction) and from abstraction of groundwater from the SIDE:
  - No project-related adverse impacts to prospective stygofauna fauna and/or habitat on the landform islands within the On-LDE from infrastructure development, including abstraction of brine.
  - No project-related adverse impacts to subterranean fauna and/or prospective habitat due to groundwater drawdown from groundwater abstraction from the SIDE.
- **MO10:** No project-related adverse impacts to prospective subterranean fauna habitat on the islands and SIDE due to groundwater contamination from hydrocarbon spills.
  - Hazardous Substances Management Plan (HSMP) and Procedure implemented.

- Spill response training for all personnel and contractors.
- Spill response equipment, bunding and leak detection mechanisms in place.
- Bioremediation facility for the treatment of contaminated fill, soils, or sediment in place.

- **MO11:** No project-related adverse impacts to prospective subterranean fauna due to altered surface hydrology from project-related clearing and disturbance, resulting in changes to groundwater flow on the islands and SIDE.
  - Clearing not to exceed 1,500 ha of flora and vegetation (the combined total of 200 ha of native vegetation within the 688 ha Off-LDE, and 300 ha of native vegetation within the 11,799 ha SIDE and 1,000 ha of native vegetation within the 33,928 ha NIDE).
  - Buffer zones applied to landform islands, large and intermediate islands, small islands and WA and NT exclusion zones on Lake Mackay.
  - No unauthorised clearing within lake island buffer zones.
  - Demarcation and monitoring of construction boundaries in place.

4.4. Environmental Criteria, Targets and Justification

The development of environmental objectives and criteria for outcome-based provisions within the IWEMP are based on available data and information and align with the purpose of the IWEMP. Outcome-based provisions utilise monitoring and reporting to assess against the measurable environmental criteria. The triggers and thresholds may be revised as further data becomes available from the Monitoring Programs (**Appendix B-C**), following an adaptive management approach. In addition, typically where data or information is considered limited, objective-based provisions have been applied, with management targets to address knowledge gaps, with corresponding monitoring and reporting requirements.

During monitoring, where threshold criteria (outcome-based) or management targets (objective-based) are exceeded, and are project-related, response and corrective actions are provided, and should be implemented, where deemed appropriate. Monitoring will inform adaptive management, with the revision of environmental criteria, and response or corrective actions, as required.

Justification for the management provisions and triggers and thresholds outlined in the IWEMP are presented in the subsequent sections.

4.4.1. On-Lake Development

- The landform islands are the largest islands on the lake and support potentially sensitive environmental receptors comprising groundwater dependent vegetation and stygofauna communities, in low salinity and fresh groundwater that overlies the brine. Claypans also occur on these islands, however, have been determined to be hydraulically distinct, with a hydroperiod driven by rainfall. To prevent impacts, buffer zones around the landform islands of 500 m from the trench network have been implemented to maintain the ecological function of these islands. The landform islands are areas of high recharge, reducing the effects of predicted drawdown from brine abstraction. However, triggers and thresholds have been established to ensure disturbance, trenching and drawdown does not significantly impact these important habitats. New bores will be installed on the lake near larger islands and in the riparian zone of the islands for monitoring (**Appendix A**), to ensure that drawdown outside of precited modelling is detected early, allowing management actions to be implemented.

- Groundwater dependent vegetation have been identified from the landform islands on the lake, in central, elevated areas. There are no expected impacts with recharge from rainfall driving the groundwater system that supports this vegetation. However, monitoring of groundwater levels and quality will be undertaken to ensure there no decrease in the overlying freshwater or low salinity from brine extraction on the lake (**Appendix A**). Triggers and thresholds have been developed considering the following:
  - Predicted groundwater drawdown of brine is <0.25 m and is not anticipated to significantly alter vertical/lateral extent of low salinity island groundwater.
  - *Allocasuarina decaisneana* (potential groundwater dependent species) records are known from several landform islands, typically occurring in central areas on elevated ground, >2 km from margins.
  - Buffer zones have been implemented between the trenches and islands (up to 500 m for landform islands), to minimise drawdown of the brine below the islands.
  - Higher recharge occurs on larger islands due to dune sands, correlating to less drawdown and increased recharge, reducing potential impacts.
  - NT is an exclusion zone and has similar larger islands and habitat that may support comparable vegetation communities.
  - Triggers and thresholds have been set considering the likely hydrogeological characteristics of the aquifer and seasonal variation.

- Prospective subterranean fauna habitats have been identified from the low salinity groundwater that overlies the brine on the landform islands. Monitoring of groundwater levels and quality will be undertaken to ensure there is no drawdown associated with brine extraction that affects stygofauna habitat (**Appendix C**). The established triggers and thresholds have been rationalised based on the following:
  - Predicted groundwater drawdown of brine is <0.25 m (within seasonal variation) and is not anticipated to significantly alter vertical/lateral extent of low salinity island groundwater.
  - Most of the stygal copepod records are from approximately >1 km from island margins on elevated areas, although are likely dispersed across most of the larger islands.
  - Buffer zones have been implemented between the trenches and islands (up to 500 m for landform islands), to minimise drawdown of the brine below the islands.
  - Large islands are recharge zones, with higher infiltration rates following rainfall, limiting drawdown.
  - NT is an exclusion zone and has similar larger islands and habitat that may support comparable subterranean fauna communities.
  - Triggers and thresholds have been set considering the likely hydrogeological characteristics of the aquifer and seasonal variation.
- Drawdown of the brine in the lake sediments has the potential to impact the duration of inundation events on the lake. However, water balance modelling indicates that the largest and most productive of these events, attracting waterbirds, are unlikely to be impacted, with intense rainfall events (occurring more frequently), assisting with recharge and resetting groundwater levels. An on-lake groundwater monitoring program for assessment against triggers and thresholds (**Appendix A**) will ensure that drawdown of the brine remains within the modelled limits and maintains the ecological values and functions of the lake. Specifically:
  - The lake supports the highest ecological values during rare, major inundation events, and aquatic biota and waterbirds are widespread across the playa during these periods.
  - Modelled drawdown on the lake varies according to hydrogeological characteristics and increases in the east due to higher permeability of lakebed sediments.
  - Average drawdown across the lake is typically within natural seasonal groundwater level fluctuations, with <10% of average saturated aquifer thickness expected to be affected during LoM.
  - Water balance modelling indicates that there will be no significant impacts on the duration, surface extent, depth, and frequency of larger inundation events on the lake (considered rare).
  - Large rainfall events (>300mm) are predicted to reset groundwater to baseline levels.
  - Triggers and thresholds have been set considering modelling results and hydrogeological characteristics, as well as seasonal variation.
  - In the event thresholds are exceeded, adaptive management of BMUs will occur to limit abstraction and drawdown to sensitive areas of the lake, where possible.
  - Analysis of groundwater, surface water, aquatic ecology and riparian vegetation monitoring will include interpretation of findings (**Appendix B**), to detect any changes.
- The Proposal has the potential to impact on aquatic invertebrate communities, including significant species, through direct and indirect impacts. While surface hydrology is expected to be maintained through engineering design and based on water balance modelling, a monitoring program has been developed for aquatic biota. This will detect changes in the diversity of aquatic invertebrates, in comparison to baseline conditions and relative to reference sites, to inform adaptive management where required.
- Proposal activities have the potential to increase concentrations of salts or other contaminants within Lake Mackay, which may impact on aquatic biota. Monitoring of surface water quality during major inundation events will be conducted to ensure contaminants do not exceed potentially toxic levels under flooded conditions and will inform adaptive management where required.
- The linear trench network and associated bunding has the potential to alter surface water flows and inundation patterns on Lake Mackay during major flood events. The most significant aquatic ecology values of Lake Mackay occur in the deepest parts of the basin located in the south-eastern portion of the lake. Monitoring of aquatic biota during major floods, and analysis of the extent and duration of surface water in the deeper sections of the lake will be undertaken to ensure hydrological and ecological function is maintained and inform the need for corrective actions as required.

4.4.2. SIDE Borefield

- There are no expected significant impacts from the operation of the SIDE borefield on other groundwater users or potentially sensitive environmental receptors (such as claypan ecosystems, groundwater dependent vegetation or stygofauna). However, triggers and thresholds have been established to protect users of an unregistered hand pump and potentially sensitive receptors in the vicinity, although outside of the predicted drawdown zone. These measures are considered precautionary only. The hand pump bore is located outside of the maximum predicted drawdown extent of 0.1 m (at 20 years) and likely occurs in a perched calcrete deposit that is not hydraulically connected to the regional

aquifer systems. Groundwater from the hand pump is used infrequently and likely represents less than 10% reduction in the available storage in the calcrete aquifer. Similarly, claypans in the area are hydraulically distinct and surface water systems driven by rainfall.

- There is no groundwater dependent vegetation in the vicinity of the SIDE borefield, with several nearby records of vadophyte species (accessing soil moisture in the soil) outside of the predicted drawdown zone. However, monitoring of groundwater levels and quality will be undertaken to ensure there are no changes outside of this zone (**Appendix A**), with triggers and thresholds developed considering the following:
  - There are no groundwater dependent flora species records within the SIDE or the predicted drawdown extent of 0.1 m (at 20 years).
  - The predicted reduction in saturated aquifer thickness across a lateral extent for most of the area (approximately 65%) is 10% or less.
  - The nearest receptor (*Eucalytpus vitrix*) is a vadophyte and is located 300 m from the southeastern margin of the 0.1 m drawdown contour (at 20 years).
  - Triggers and thresholds have been set considering likely hydrogeological characteristics and possible seasonal variation.
  - Triggers and thresholds consider maintaining saturated aquifer thickness of Neogene deposit (up to 50m) and potential receptor habitat but may be adaptively managed and revised.
  - In the event monitoring indicates threshold criteria are exceeded, pumping may be reduced from nearby bores to limit drawdown impacts (noting drawdown is conservative and demand is lower than modelled).
- Prospective subterranean fauna habitats in the region have been identified as occurring within the low salinity aquifers associated with the southern regional area (outside of the Proposal Area). Monitoring of groundwater levels and quality will be undertaken to ensure there is no interaction with aquifers from expected drawdown associated with extraction for water supply in the SIDE borefield (**Appendix A**). Triggers and thresholds have been rationalised based on the following:
  - There is only one record of a potential stygal taxon with an unknown affinity to groundwater within the SIDE and the predicted drawdown extent of 0.1 m (at 20 years).
  - The predicted reduction in saturated aquifer thickness across a lateral extent for most of the area (approximately 65%) is 10% or less.
  - The nearest stygal receptors are located 1.8 km from the northwestern margin of the 0.1 m drawdown contour (at 20 years).
  - The Neogene deposit is regionally extensive providing comparable habitat on a broad scale.
  - Triggers and thresholds have been set considering likely hydrogeological characteristics and possible seasonal variation.
  - Triggers and thresholds consider maintaining saturated aquifer thickness of Neogene deposit (up to 50m) and potential receptor habitat but may be adaptively managed and revised.
  - In the event monitoring indicates threshold criteria are exceeded, pumping may be reduced from nearby bores to limit drawdown impacts (noting drawdown is conservative and demand is lower than modelled).
- There is no expected saline water intrusion expected within the SIDE, confirmed by particle tracking over the 20-year abstraction period. In addition, while groundwater is more saline in the north, groundwater quality in the SIDE is generally consistent between the Neogene deposits and the Angas Hills Formation. However, monitoring of groundwater will ensure there are no changes outside of those predicted (**Appendix A**).

Table 4-1: Inland waters outcome-based management provisions.

EPA Factor and Objective		Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.						
IWEMP Purpose		*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*						
Key Impacts and Risks		Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.						
Indicators		Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.						
Outcome-based Management Provisions		**Trigger and Threshold Criteria**		**Trigger and Threshold Response Actions**		**Monitoring**	**Timing / Frequency of Monitoring**	**Reporting**
		Trigger Criteria	**Threshold Criteria**	**Trigger Level Actions**	**Threshold Criteria and Corrective Actions**			
	No adverse impacts to riparian vegetation as a result of the Proposal.	Refer to the Flora and Vegetation Environmental Management Plan (FVEMP), which contains: • Triggers and thresholds relating to riparian vegetation. • Riparian vegetation trigger and threshold criteria and response actions. • Monitoring and reporting requirements specific to riparian vegetation.						
	No adverse impacts to waterbirds as a result of the Proposal.	Refer to the Terrestrial Fauna Environmental Management Plan (TFEMP), which contains: • Triggers and thresholds relating to waterbirds. • Waterbird trigger and threshold criteria and response actions. • Monitoring and reporting requirements specific to waterbirds.						
IW1	**No unauthorised disturbance to occur within the buffer zone applied to landform islands, large intermediate islands, and small islands or within the WA and NT exclusion zones of Lake Mackay.**	Disturbance occurs without an authorised internal permit within the Development Envelope but outside of the buffer zones: 500 m buffer zone applied to landform islands (>2,000 ha). OR 250 m buffer zone applied to large (>500 to 1,500 ha) and intermediate (>100 to 500 ha) islands. OR 100 m buffer zone applied to small islands (<100 ha). OR WA and NT exclusion zones on Lake Mackay.	Unauthorised disturbance occurs within the buffer zones: 500 m buffer zone applied to landform islands (>2,000 ha). OR 250 m buffer zone applied to large (>500 to 1,500 ha) and intermediate (>100 to 500 ha) islands. OR 100 m buffer zone applied to small islands (<100 ha). OR WA and NT exclusion zones on Lake Mackay.	• Report internally as an incident in accordance with internal procedures. • Investigate potential cause of exceedance: – Undertake in field inspection and record the nature and extent of direct disturbance that has occurred and record within the internal register. • Review management strategies and implement changes to prevent future occurrences which may include the following: – Audit and review of training and staff inductions (increase staff training and awareness to include information on buffers around islands, legislative requirements, and appropriate disturbance procedures). – Review impact(s) of unauthorised disturbance and report any non-compliance to Department of Water and Environmental Regulation (DWER) within 7 days of identification. – Installation of signage where appropriate. – Undertake rehabilitation of unauthorised disturbance as required, in accordance with rehabilitation procedures.	• Temporarily cease land disturbance activities. • Report as a non-compliance to DWER within 7 days of identification. • Review impact of disturbance on subterranean fauna and aquatic habitat, in consultation with a suitable qualified consultant. • Undertake additional investigations as required, to determine source of exceedance. • If investigations indicate threshold exceedance is attributed to the Project-related, undertake review to determine if impact can be minimised and implement threshold level response actions as soon as practicable, for example: – Rehabilitation of cleared area to be considered to re-instate habitat. • Submit Investigation report to DWER with remediation actions proposed within 28 days of incident report.	1. Internal audit against areas of disturbance. 2. Monitor aquatic biota and subterranean fauna as appropriate.	1. As required during land disturbance activities. 2. As required during land disturbance activities, in accordance with the AEMP (**Appendix A**).	• Annual Environmental Reporting. • Land Disturbance Register. • Internal disturbance permits. • Survey data. • AEMP reporting (**Appendix A**). • Incident reports.
IW2	**No significant impact to low salinity or fresh groundwater from abstraction of the brine to groundwater dependent vegetation and stygofauna, relative to baseline conditions, on landform islands.**	Drawdown exceeds 2 m at new groundwater monitoring bores on lake and in riparian zone in the vicinity of large and landform islands AND Subsequent investigation determines the change is related to abstraction.	Drawdown exceeds 3 m at new groundwater monitoring bores on lake and in riparian zone in the vicinity of large and landform islands AND Subsequent investigation determines the change is related to abstraction.	• Report internally as an incident in accordance with internal procedures. • Investigate potential cause of exceedance and if attributed to the Project, undertake a review to determine if impact can be minimised and implement trigger level response actions, for example: – Review climatic and rainfall conditions. – Review existing conceptual groundwater and hydrological models. – Review groundwater monitoring data. – Review brine abstraction rates and volumes.	• Report as a non-compliance to DWER within 7 days of identification. • Review impact of drawdown on subterranean fauna habitat, in consultation with a suitable qualified consultant. • Undertake additional investigations as required to determine source of threshold exceedance. • If threshold exceedance is attributed to the Project, undertake review to determine if impact can be minimised. • Implement threshold level response actions as soon as practicable, for example:	1. Monitor groundwater levels in accordance with GWMP (**Appendix B**). 2. Monitor groundwater levels in accordance with applicable DWER Groundwater Abstraction Licence. 3. Monitor stygofauna in accordance with SMP (**Appendix C**). 4. Monitor potential groundwater dependent	1. According to schedule in GWMP (**Appendix B**). 2. According to schedule of groundwater monitoring for applicable DWER Groundwater Licence. 3. According to schedule in SMP (**Appendix C**). 4. According to schedule in FVEMP.	• Monitoring data. • GWMP reporting (**Appendix B**). • SMP reporting (**Appendix C**). • Incident reports • Annual Environmental Reporting.

EPA Factor and Objective	Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.							
IWEMP Purpose	*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*							
Key Impacts and Risks	Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.							
Indicators	Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.							
Outcome-based Management Provisions	**Trigger and Threshold Criteria**		**Trigger and Threshold Response Actions**		**Monitoring**	**Timing / Frequency of Monitoring**	**Reporting**	
	Trigger Criteria	**Threshold Criteria**	**Trigger Level Actions**	**Threshold Criteria and Corrective Actions**				
			– Review design and layout of linear trench network and associated bunding. – Review BMU staging. • Undertake an options assessment study to identify management actions that may be implemented in the short or long-term.	– Review climatic and rainfall conditions. – Revise existing conceptual groundwater and hydrological models as required. – Review groundwater monitoring data. – In the event that groundwater monitoring indicates the threshold criterion is exceeded, investigate options to reduce pumping from nearby trenches to limit drawdown impacts. – Modify brine abstraction rates, forecasting and strategy. – Modify BMU staging strategy, where required. – Adjust design and layout of linear trench network and associated bunding. – Extend buffers from trenches to islands, where possible. – Appropriate management and mitigation identified from the options assessment study. Submit Investigation report to DWER with remediation actions proposed within 28 days of incident report.	vegetation in accordance with the FVEMP.			
IW3	**No significant impact to surface water levels during large inundation events from abstraction of the brine associated with the On-Lake Development.**	Drawdown exceeds 2 m at on-lake groundwater monitoring bores AND Subsequent investigation determines the change is related to abstraction.	Drawdown exceeds 3 m at on-lake groundwater monitoring bores AND Subsequent investigation determines the change is related to abstraction.	• Report internally as an incident in accordance with internal procedures. • Investigate potential cause of exceedance and if attributed to the Project, undertake a review to determine if impact can be minimised and implement trigger level response actions, for example: – Review climatic and rainfall conditions. – Review existing conceptual groundwater and hydrological models. – Review groundwater monitoring data. – Review brine abstraction rates and volumes. – Review design and layout of linear trench network and associated bunding. – Review BMU staging. • Undertake an options assessment study to identify management actions that may be implemented in the short or long-term.	• Report as a non-compliance to DWER within 7 days of identification. • Review impact of drawdown on aquatic ecology and riparian vegetation habitat, in consultation with a suitable qualified consultant. • Undertake additional investigations as required to determine source of threshold exceedance. • If threshold exceedance is attributed to the Project, undertake review to determine if impact can be minimised. • Implement threshold level response actions as soon as practicable, for example: – Review climatic and rainfall conditions. – Revise existing conceptual groundwater and hydrological models as required. – Review groundwater monitoring data. – In the event that groundwater monitoring indicates the threshold criterion is exceeded, investigate options to reduce pumping from nearby bores to limit drawdown impacts. – Modify brine abstraction rates, forecasting and strategy. – Modify BMU staging strategy, where required.	1. Monitor groundwater levels in accordance with GWMP (**Appendix B**). 2. Monitor groundwater levels in accordance with applicable DWER Groundwater Abstraction Licence. 3. Monitor lake ecology in accordance with AEMP (**Appendix B**). 4. Monitor waterbirds in accordance with the TFEMP. 5. Monitor riparian vegetation in accordance with the FVEMP.	1. According to schedule in GWMP (**Appendix B**). 2. According to schedule of groundwater monitoring for applicable DWER Groundwater Licence. 3. According to schedule in AEMP (**Appendix B**). 4. According to schedule in TFEMP. 5. According to schedule in FVEMP.	• Monitoring data. • GWMP reporting (**Appendix B**). • AEMP reporting (**Appendix B**). • Incident reports • Annual Environmental Reporting.

EPA Factor and Objective		Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.						
IWEMP Purpose		*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*						
Key Impacts and Risks		Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.						
Indicators		Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.						
Outcome-based Management Provisions		**Trigger and Threshold Criteria**		**Trigger and Threshold Response Actions**		**Monitoring**	**Timing / Frequency of Monitoring**	**Reporting**
		Trigger Criteria	**Threshold Criteria**	**Trigger Level Actions**	**Threshold Criteria and Corrective Actions**			
					– Appropriate management and mitigation identified from the options assessment study. • Submit Investigation report to DWER with remediation actions proposed within 28 days of incident report.			
IW4	**Groundwater abstraction from the SIDE borefield (water supply) will not exceed licence issued under Section 5C of the *Rights in Water and Irrigation Act 1914*.**	Abstraction of groundwater from the SIDE borefield for the Project reaches 3 GL/a (only 0.5 GL remaining in Annual Water Entitlement).	Abstraction of groundwater from the SIDE borefield for the Project reaches 3.5 GL/a (full Annual Water Entitlement).	• Report internally as an incident in accordance with internal procedures. • Investigate potential cause of trigger exceedance and if attributed to the Project, undertake a review to determine if impact can be minimised and implement trigger level response actions, for example: – Review climatic and rainfall conditions. – Review existing conceptual groundwater and hydrological models. – Review groundwater monitoring data. – Review groundwater abstraction requirements. – Review whether an amendment to the Groundwater Licence is required to remain compliant. • Undertake an options assessment study to identify management actions that may be implemented in the short or long-term.	• Report as a non-compliance to DWER within 7 days of identification. • Implement threshold level response actions as soon as practicable, for example: – Review climatic and rainfall conditions. – Revise existing conceptual groundwater and hydrological models as required. – Review groundwater monitoring data. – Review groundwater abstraction requirements, forecasting and strategy. – Modify groundwater abstraction strategy and bore pumping schedule. – Appropriate management and mitigation identified from the options assessment study. • Submit Investigation report to DWER with remediation actions proposed within 28 days of incident report. • In the event that groundwater monitoring indicates the threshold criterion is exceeded, investigate options to reduce pumping rates. • Investigate options for an additional water supply source, considering potentially sensitive environmental receptors and approvals requirements (including hydrogeological assessment).	1. Monitor groundwater levels in accordance with GWMP (**Appendix A**). 2. Monitoring groundwater levels in accordance with applicable DWER Groundwater Abstraction Licence.	1. According to schedule in GWMP (**Appendix A**). 2. According to schedule of groundwater monitoring for applicable DWER Groundwater Licence.	• Monitoring data. • GWMP reporting (**Appendix A**) • Incident reports • Annual Environmental Reporting.
IW5	**No significant impact to the shallow aquifer (Neogene alluvial deposit) from the SIDE borefield, reducing availability of groundwater for other bore users, groundwater dependent vegetation and stygofauna habitat.**	Drawdown exceeds 0.5m, 1.0m and 1.5m at 5, 10 and 20 years, respectively at groundwater monitoring bores: MBHC1, MBHC2 (other groundwater users); OR MBGDV1, MBGDV2 (groundwater dependent vegetation); OR MBS1, MBS2 – (stygofauna habitat); AND Subsequent investigation determines the change is related to groundwater abstraction.	Drawdown exceeds 2m at: MBHC1, MBHC2 (other groundwater users); OR MBGDV1, MBGDV2 (Groundwater dependent vegetation); OR MBS1, MBS2 (stygofauna habitat); AND Subsequent investigation determines the change is related to abstraction.	• Report internally as an incident in accordance with internal procedures. • Investigate potential cause of exceedance and if attributed to the Project, undertake a review to determine if impact can be minimised and implement trigger level response actions, for example: – Review climatic and rainfall conditions. – Review existing conceptual groundwater and hydrological models. – Review groundwater monitoring data. • Undertake an options assessment study to identify management actions that may be implemented in the short or long-term.	• Report as a non-compliance to DWER within 7 days of identification. • Review impact of drawdown on other users, groundwater dependent vegetation or subterranean fauna and habitat, in consultation with a suitable qualified consultant. • Undertake additional investigations as required to determine source of threshold exceedance. • If threshold exceedance is attributed to the Project, undertake review to determine if impact can be minimised. • Submit Investigation report to DWER with remediation actions proposed within 28 days of incident report. • Implement threshold level response actions as soon as practicable, for example: – Review climatic and rainfall conditions.	1. Monitor groundwater levels in accordance with GWMP (**Appendix B**). 2. Monitor groundwater levels in accordance with applicable DWER Groundwater Abstraction Licence.	1. According to schedule in GWMP (**Appendix B**). 2. According to schedule of groundwater monitoring for applicable DWER Groundwater Licence.	• Monitoring data. • GWMP reporting (**Appendix B**). • Incident reports • Annual Environmental Reporting.

EPA Factor and Objective	Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.							
IWEMP Purpose	*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*							
Key Impacts and Risks	Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.							
Indicators	Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.							
Outcome-based Management Provisions	**Trigger and Threshold Criteria**		**Trigger and Threshold Response Actions**		**Monitoring**	**Timing / Frequency of Monitoring**	**Reporting**	
	Trigger Criteria	**Threshold Criteria**	**Trigger Level Actions**	**Threshold Criteria and Corrective Actions**				
				– Revise existing conceptual groundwater and hydrological models as required. – Review groundwater monitoring data. – Review groundwater abstraction requirements, forecasting and strategy. – Modify groundwater abstraction strategy. – Appropriate management and mitigation identified from the options assessment study. • In the event that groundwater monitoring indicates the threshold criterion is exceeded, investigate options to reduce pumping from bores near potentially sensitive receptors to limit drawdown impacts (noting drawdown is conservative and demand is lower than modelled). • Investigate options for an additional water source, considering potentially sensitive environmental receptors and approvals requirements (including hydrogeological assessment).				
IW6	**Groundwater abstraction of brine from the lakebed sediments will not exceed licence issued under Section 5C of the *Rights in Water and Irrigation Act 1914*.**	Abstraction of brine groundwater for the Project reaches 95 GL/a (only 5 GL remaining in Annual Water Entitlement).	Abstraction of brine groundwater for the Project reaches 100 GL/a (full Annual Water Entitlement).	• Report internally as an incident in accordance with internal procedures. • Investigate potential cause of trigger exceedance and if attributed to the Project, undertake a review to determine if impact can be minimised and implement trigger level response actions, for example: – Review climatic and rainfall conditions. – Review existing conceptual groundwater and hydrological models. – Review groundwater monitoring data. – Review groundwater abstraction requirements. – Review whether an amendment to the Groundwater Licence is required to remain compliant. • Undertake an options assessment study to identify management actions that may be implemented in the short or long-term.	• Report as a non-compliance to DWER within 7 days of identification. • Implement threshold level response actions as soon as practicable, for example: – Review climatic and rainfall conditions. – Revise existing conceptual groundwater and hydrological models as required. – Review groundwater monitoring data. – Review groundwater abstraction requirements, forecasting and strategy. – Modify groundwater abstraction strategy and BMU schedule and implementation. – Appropriate management and mitigation identified from the options assessment study. • Submit Investigation report to DWER with remediation actions proposed within 28 days of incident report. • In the event that groundwater monitoring indicates the threshold criterion is exceeded, investigate options to reduce abstraction rates. • Investigate options for an additional brine source, considering potentially sensitive environmental receptors and approvals requirements (including hydrogeological investigations).	1. Monitor groundwater levels in accordance with GWMP (**Appendix A**). 2. Monitoring groundwater levels in accordance with applicable DWER Groundwater Abstraction Licence.	1. According to schedule in GWMP (**Appendix A**). 2. According to schedule of groundwater monitoring for applicable DWER Groundwater Licence.	• Monitoring data. • GWMP reporting (**Appendix A**) • Incident reports • Annual Environmental Reporting.
IW7	**No significant decline in aquatic invertebrate communities of Lake Mackay due to project-related activities.**	A statistically significant change in aquatic invertebrate community composition during a monitoring survey of a	A statistically significant change in aquatic invertebrate community composition during monitoring surveys of	• Report internally as an incident in accordance with internal procedures. • Investigate potential cause of exceedance and if attributed to the Project, undertake a review to determine if impact can be	• Report as a non-compliance to DWER within 7 days of identification. • Review impact on aquatic invertebrates inhabiting Lake Mackay, in consultation with a suitable qualified consultant.	1. Monitor aquatic ecology, including aquatic invertebrate communities, in	1. According to schedule in AEMP (**Appendix A**).	• Monitoring data. • AEMP reporting **(Appendix A**). • Incident reports.

EPA Factor and Objective	Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.							
IWEMP Purpose	*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*							
Key Impacts and Risks	Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.							
Indicators	Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.							
Outcome-based Management Provisions	**Trigger and Threshold Criteria**		**Trigger and Threshold Response Actions**		**Monitoring**	**Timing / Frequency of Monitoring**	**Reporting**	
	Trigger Criteria	**Threshold Criteria**	**Trigger Level Actions**	**Threshold Criteria and Corrective Actions**				
	major inundation event, compared to baseline (and suitable reference sites), attributed to the Project. OR A loss of one or more aquatic invertebrate species of scientific interest during a monitoring survey of a major inundation event, compared to baseline (and suitable reference sites), attributed to the Project.	two consecutive major inundation events, compared to baseline, attributed to the Project. OR Persistent loss of one or more aquatic invertebrate species of scientific interest during monitoring surveys of two major inundation events, compared to baseline, attributed to the Project.	minimised and implement trigger level response actions, for example: – Review climatic and rainfall conditions. – Review existing conceptual groundwater and hydrological models. – Review brine abstraction rates and volumes. – Review design and layout of linear trench network and associated bunding. – Review BMU staging. • Undertake an options assessment study to identify management actions that may be implemented in the short or long-term.	• Undertake additional investigations as required to determine source of exceedance and if attributed to the Project, undertake review to determine if impact can be minimised and implement threshold level response actions as soon as practicable, for example: – Review climatic and rainfall conditions. – Revise existing conceptual groundwater and hydrological models as required. – Modify brine abstraction rates, forecasting and strategy. – Modify BMU staging strategy. – Adjust design and layout of linear trench network and associated bunding. – Appropriate management and mitigation identified from the options assessment study. • Submit Investigation report to DWER with remediation actions proposed within 28 days of incident report. • In the event that aquatic invertebrate monitoring indicates the threshold criterion is exceeded, implement adaptive management of BMUs to limit abstraction and drawdown to sensitive areas of the lake, where possible.	accordance with AEMP (**Appendix A**).		• Annual Environmental Reporting.
IW8	**No significant increase in contaminants within surface waters of Lake Mackay during a major inundation event, relative to baseline conditions.**	Water quality monitoring of Lake Mackay during a major inundation event demonstrates statistically significant exceedances of potential contaminants (such as salinity, suspended solids, and metals) compared to baseline (and suitable reference sites) and applicable guideline values, attributed to the Project.	Water quality monitoring of Lake Mackay during two consecutive major inundation events demonstrates statistically significant exceedances of potential contaminants (such as salinity, suspended solids, and metals) compared to baseline (and suitable reference sites) and applicable guideline values, attributed to the Project.	• Report internally as an incident in accordance with internal procedures. • Investigate potential cause of exceedance and if attributed to the Project, undertake a review to determine if impact can be minimised and implement trigger level response actions, for example: – Review climatic and rainfall conditions. – Review existing conceptual groundwater and hydrological models. – Review brine abstraction rates and volumes. – Review design and layout of linear trench network and associated bunding. – Review BMU staging. • Undertake an options assessment study to identify management actions that may be implemented in the short or long-term. • Review against reference sites	• Report as a non-compliance to DWER within 7 days of identification. • Review impact on surface water and sediment quality and aquatic biota of Lake Mackay, in consultation with a suitable qualified consultant. • Undertake additional investigations as required to determine source of exceedance and if attributed to the Project, undertake review to determine if impact can be minimised and implement threshold level response actions as soon as practicable, for example: – Review climatic and rainfall conditions. – Revise existing conceptual groundwater and hydrological models as required. – Modify brine abstraction rates, forecasting and strategy. – Modify BMU staging strategy. – Adjust design and layout of linear trench network and associated bunding. – Appropriate management and mitigation identified from the options assessment study.	1. Monitor surface water and sediment quality in accordance with AEMP (**Appendix A**).	1. According to schedule in AEWP (**Appendix A**).	• Monitoring data. • AEMP reporting (**Appendix A**). • Incident reports. • Annual Environmental Reporting.

EPA Factor and Objective		Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.						
IWEMP Purpose		*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*						
Key Impacts and Risks		Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.						
Indicators		Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.						
Outcome-based Management Provisions		**Trigger and Threshold Criteria**		**Trigger and Threshold Response Actions**		**Monitoring**	**Timing / Frequency of Monitoring**	**Reporting**
		Trigger Criteria	**Threshold Criteria**	**Trigger Level Actions**	**Threshold Criteria and Corrective Actions**			
					• Submit Investigation report to DWER with remediation actions proposed within 28 days of incident report.			
IW9	**No significant decrease in the surface water extent and duration, in the deepest parts of the Lake Mackay basin as a result of project-related activities.**	Analysis and mapping of satellite imagery during a major inundation event demonstrates a statistically significant decrease in the extent and duration of surface water in the deepest parts of Lake Mackay, compared to historic trends, attributed to the Project.	Analysis and mapping of satellite imagery during consecutive major inundation events demonstrates a statistically significant decrease in the extent and duration of surface water in the deepest parts of Lake Mackay, compared to historic trends, attributed to the Project.	• Report internally as an incident in accordance with internal procedures. • Investigate potential cause of exceedance and if attributed to the Project, undertake a review to determine if impact can be minimised and implement trigger level response actions, for example: – Review climatic and rainfall conditions. – Review existing conceptual groundwater and hydrological models. – Review brine abstraction rates and volumes. – Review design and layout of linear trench network and associated bunding. – Review BMU staging. • Undertake an options assessment study to identify management actions that may be implemented in the short or long-term.	• Report as a non-compliance to DWER within 7 days of identification. • Review impact on aquatic biota and habitat, in consultation with a suitable qualified consultant. • Undertake additional investigations as required to determine source of exceedance and if attributed to the Project, undertake review to determine if impact can be minimised and implement threshold level response actions as soon as practicable, for example: – Review climatic and rainfall conditions. – Revise existing conceptual groundwater and hydrological models as required. – Modify brine abstraction rates, forecasting and strategy. – Modify BMU staging strategy. – Adjust design and layout of linear trench network and associated bunding. – Appropriate management and mitigation identified from the options assessment study. • Submit Investigation report to DWER with remediation actions proposed within 28 days of incident report. • In the event that analysis of surface water indicates the threshold criterion is exceeded, implement adaptive management of BMUs to limit abstraction and drawdown to sensitive areas of the lake, where possible.	1. Remote sensing of surface water depth and inundation extent in Lake Mackay, in accordance with AEMP (**Appendix A**). 2. Monitor in accordance with AEMP (**Appendix A**).	1. According to schedule in AEMP (**Appendix A**).	• Monitoring data. • AEMP reporting (**Appendix A**). • Incident reports. • Annual Environmental Reporting.

Table 4-2: Inland waters objective-based management provisions.

EPA Factor and Objective	Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.				
IWEMP Purpose	*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*				
Key Impacts and Risks	Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.				
Indicators	Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.				
Objective-based Management Provisions					
Management Target	**Management Actions**	**Monitoring**	**Timing**	**Responsible**	**Reporting**
Inland Waters					
MO1: No project-related adverse impacts to aquatic biota due to habitat loss, fragmentation or modification, from project-related disturbance.[1]					
1. Disturbance in the On-lake Development Envelope (On-LDE) is not to exceed: development of trenches, extraction of up to 100 GL/a of brine, and solar evaporation and harvesting ponds for potash salts, including ground disturbance of approximately 15,000 ha with the 217,261 ha On-LDE. 2. Buffer zones applied to landform islands, large and intermediate islands, small islands and WA and NT exclusion zones on Lake Mackay. 3. No unauthorised clearing within lake island buffer zones.	• Implement strict disturbance mitigation that avoids land disturbance as a priority, and clearly demarcate and monitor disturbance boundaries. • Delineate disturbance boundary areas by qualified surveyors in the field and confirmed cleared areas via survey after disturbance. • Coordinates for disturbance extents will be provided to the Construction Contractor. • Inductions of all site personnel to include information on the importance of aquatic biota and associated habitat, management targets, measures and expectations. • All Ground Disturbance Permits issued within each financial year will be recorded and reported to internal personnel on an annual basis. • Detailed hydrological modelling of surface water flows, simulation 1:100-year events to determine impacts. • Staged development of trenches via BMUs to allow for adaptive management of the engineering design. • Engineering design and implementation (1 km spacing, install crossovers) of suitable drainage control features. These features will convey flow past On-LDE infrastructure and return flow to its natural path and area of inundation. • Undertake detailed hydrological modelling of surface water flows, simulation 1:100-year events to determine impacts. • Progressively rehabilitate areas as appropriate. • Trench network and associated bunding will be breached as BMUs are progressively closed over LoM to allow natural flow paths to return to the lake. • Evaporation pond embankment will be breached at closure to allow periodic pulsed flows and natural dissipation of salt piles to the lake over time. • Develop a Ground Disturbance Permit (GDP) System and Procedure. • Develop an Incident Reporting Procedure. • Comply with: – CEMP – MCP.	1. Monitoring of disturbance register for compliance to approvals. 2. Analysis of disturbance undertaken via annual aerial imagery survey to assess whether any unauthorised disturbance has occurred. 3. Internal incident reporting and investigation process. 4. Routine monitoring of sediment quality, salt crust and aquatic biota, utilising rewetting trials, during dry conditions (**Appendix B**). 5. Monitoring of surface water extent and quality, sediment quality, salt crust and aquatic biota during major inundation events (**Appendix B**). 6. Monitor riparian vegetation health and soil salinity in accordance with FVEMP. 7. Comply with CEMP and MCP.	1. During construction, pre- disturbance and post- disturbance activities. 2. Annual aerial imagery capture and analysis to monitor disturbance extent. 3. As triggered. 4. Annual. 5. Opportunistic. 6. In accordance with FVEMP. 7. In accordance with CEMP and MCP.	• Construction. • Operations. • Environment Team.	• Annual Compliance Assessment Report (ACAR). • Internal incident reporting. • Annual Monitoring reports.
MO2: No project-related adverse impacts to aquatic biota due to changes in surface water flows and inundation during major flood events, from project development. ***Waterbird management targets and actions are addressed separately in the TFEMP***					
1. Verification of detailed hydrological modelling of surface water flows, including	• Undertake detailed hydrological modelling of surface water flows, simulation 1:100-year events to determine impacts.	1. Routine monitoring of sediment quality, salt crust and aquatic biota,	1. Annual. 2. Opportunistic (refer to **Appendix B**). 3. In accordance with TFEMP.	• Construction. • Operations.	• Annual Compliance Assessment Report (ACAR). • Internal incident reporting.

[1] *Riparian vegetation management targets and actions are addressed in a separate FVEMP.*

EPA Factor and Objective	Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.
IWEMP Purpose	*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*
Key Impacts and Risks	Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.
Indicators	Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.

Objective-based Management Provisions

Management Target	Management Actions	Monitoring	Timing	Responsible	Reporting
simulation 1:100-year rainfall events 2. No access permitted to inundated portions of Lake Mackay when more than 20 % of the lake is inundated. 3. Staged development of trenches via BMUs and engineering design (1 km spacing, install crossovers) to maintain natural hydrological processes.	• Installation of crossovers designed to maintain the hydrological regime, inundating the deepest parts of the basin to ensure favourable conditions for primary producers (such as algae and macrophytes) and aquatic invertebrates. • Undertake detailed long-term time series water balance modelling to determine baseline and operational scenarios and predicted climate change. • Staged development of trenches via implementation of BMUs. • Engineering design; 1 km distance between trenches, installation of crossovers to maintain hydrological processes. • At closure, breaching of southern feeder canal, trenches to infill naturally within ~10 years, aided by flooding. • Trench network and associated bunding will be strategically breached to allow natural flow paths to return to the lake. • Develop an Incident Reporting Procedure. • Comply with: • CEMP • MCP.	utilising rewetting trials, during dry conditions (**Appendix B**). 2. Monitoring of surface water extent and quality, sediment quality, salt crust and aquatic biota during major inundation events (**Appendix B**). 3. Monitoring of water birds in accordance with TFEMP. 4. Comply with CEMP and MCP.	4. In accordance with CEMP and MCP.	• Environment Team.	• Annual Monitoring reports.
MO3: No project-related adverse impacts to aquatic biota due to increased salinity in surface waters, from runoff from evaporation ponds and salt piles. ***Riparian vegetation management targets and actions are addressed in a separate FVEMP.***					
1. Staged development of evaporation ponds and salt piles is in place. 2. Evaporation pond embankment breached at closure.	• Staged development of evaporation ponds and salt piles. • Evaporation ponds have been designed for a 1% AEP flood event, with minimum embankment height of 1.5 m, providing sufficient freeboard to limit saline runoff into the lake during major rainfall events. • Evaporation pond embankment will be breached at closure to allow periodic pulsed flows and natural dissipation of salt to the lake over time. • Develop an Emergency Response Plan. • Develop an Incident Reporting Procedure. • Comply with: – CEMP – MCP.	1. Routine monitoring of sediment quality, salt crust and aquatic biota, utilising rewetting trials, during dry conditions (**Appendix B**). 2. Monitoring of surface water extent and quality, sediment quality, salt crust and aquatic biota during major inundation events (**Appendix B**). 3. Monitor riparian vegetation health and soil salinity in accordance with FVEMP. 4. Comply with CEMP and MCP.	1. Annual. 2. Opportunistic. 3. In accordance with FVEMP. 4. In accordance with CEMP and MCP.	• Construction. • Operations. • Environment Team.	• Annual Compliance Assessment Report (ACAR). • Annual Monitoring reports.
MO4: Minimise project-related adverse impacts to aquatic biota due to: • **changes to hydraulic connectivity and/or reduction in moisture content of lake sediment, from groundwater drawdown; or** • **changes in salinity and/or ionic composition of groundwater from lake bed sediment abstraction.** ***Riparian vegetation management targets and actions are addressed in a separate FVEMP*.**					
1. Groundwater abstraction not to exceed ground water licence limit. 2. Buffer zones to be implemented. 3. Groundwater monitoring procedure in place.	• Implement buffer zones around islands formations (up to 500 m). • Develop a Groundwater Monitoring Procedure (**Appendix A**).	1. Monitor groundwater in accordance with IWMP (**Appendix B**). 2. Routine monitoring of sediment quality, salt crust and aquatic biota, utilising rewetting trials, during dry conditions (**Appendix B**). 3. Monitoring of surface water extent and quality, sediment quality, salt crust and aquatic biota during major inundation events (**Appendix B**). 4. Monitor riparian vegetation health and soil salinity in accordance with FVEMP.	1. In accordance with IWMP (**Appendix B**). 2. Annual. 3. Opportunistic. 4. In accordance with FVEMP.	• Construction. • Operations. • Environment Team.	• Annual Compliance Assessment Report (ACAR). • Annual Monitoring reports.

EPA Factor and Objective	Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.
IWEMP Purpose	*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*
Key Impacts and Risks	Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.
Indicators	Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.

Objective-based Management Provisions

Management Target	Management Actions	Monitoring	Timing	Responsible	Reporting
MO5: Minimise project-related adverse impacts to aquatic biota due to potential disturbance and exposure of ASS during trench excavation. *Riparian vegetation management targets and actions are addressed in a separate FVEMP.					
1. Acid Sulphate Soils (ASS) Management Plan (ASSMP) and management of ASS in place.	• Development of ASS Management Plan (ASSMP) to enable identification and management of ASS. • ASS neutralising material kept on site to respond to acid generating materials encountered during construction. • Develop a Ground Disturbance Permit (GDP) System and Procedure. • Develop an Incident Reporting Procedure. • Comply with: – FVEMP – CEMP – ASSMP.	1. Monitor groundwater in accordance with IWMP (**Appendix B**). 2. Monitor riparian vegetation health and soil salinity in accordance with FVEMP. 3. Comply with FVEMP, CEMP and ASSMP.	1. In accordance with IWMP (**Appendix B**). 2. In accordance with FVEMP. 3. In accordance with FVEMP, CEMP and ASSMP.	• Construction. • Operations. • Environment Team.	• Annual Compliance Assessment Report (ACAR). • Annual Monitoring reports. • Internal incident reporting and investigation process.
MO6: No project-related adverse impacts to aquatic biota due to potential contamination of surface water and/or groundwater as a result of hydrocarbon and/or chemical spills, and landfill/wastewater treatment plant operations.					
1. Hazardous Substances Management Plan (HSMP) and Procedure implemented. 2. Spill response training for all personnel and contractors. 3. Spill response equipment provided for all site vehicles.	• Hydrocarbon and/or chemical leaks and spills (expected to be rare) will be managed using bunding techniques, leak detection mechanisms and spill kits to restrict impacts. • Fuel and chemicals to be stored in secure and bunded area in the Off-LDE and outside of the 1:100 year flood zone. • Spill response equipment available (including on all Haul Trucks). • Spill response training for all personnel and contractors. • Dedicated workshop and washdown facilities. • Maintain high standard of housekeeping around processing plant. • Bioremediation facility for the treatment of contaminated fill, soils, or sediment. • Management of sites as per the Contaminated Site Act 2003. • Develop a Hazardous Substances Management Plan (HSMP) and Procedure. • Develop a Refuelling Procedure of on-lake vehicles, plant and equipment. • Develop an Emergency Response Plan. • Develop a Spill Response Plan. • Develop a Controlled Waste Management Procedure. • Develop a Contaminated Sites Register. • Develop a Waste Management Procedure. • Develop an Incident Reporting Procedure. • Signage and bunding on all unstable landforms.Comply with CEMP.	1. Internal incident reporting and investigation process. 2. If required, sampling of soils to ensure all contaminated material has been removed and in situ soils sediment have been remediated. 3. If required, monitoring riparian vegetation in affected areas and adjacent areas. 4. Comply with CEMP.	1. As triggered. 2. As triggered. 3. As triggered. 4. In accordance with CEMP.	• Construction. • Operations. • Environment Team.	• Monitoring data. • Annual Compliance Assessment Report (ACAR). • Internal incident reporting and investigation process.
MO7: Minimise project-related adverse impacts to aquatic biota due to changes in hydraulic connectivity and groundwater quality from abstraction of up to 100 GL/a of brine groundwater for the project.					
1. Verification of detailed hydrological modelling of surface water flows, including simulation 1:100-year rainfall events. 2. Groundwater Monitoring Program in place.	• Conduct detailed hydrological modelling of surface water flows, simulation 1:100-year events to determine impacts. • Conduct groundwater investigations and modelling to investigate drawdown extent and change in surface flows to minimise impacts to SIDE aquifers and associated subterranean fauna habitat, and demonstrate residual impact are not greater than predicted. • Comply with Groundwater Monitoring Procedure (**Appendix B**). • Comply with CEMP.	1. Routine monitoring of groundwater levels and quality (**Appendix B**). 2. Comply with CEMP.	1. In accordance with IWMP (**Appendix B**). 2. In accordance with CEMP.	Construction. Operations. Environment Team.	Annual Compliance Assessment Report (ACAR). Annual Monitoring reports.

EPA Factor and Objective	Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.
IWEMP Purpose	*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*
Key Impacts and Risks	Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.
Indicators	Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.

Objective-based Management Provisions					
Management Target	**Management Actions**	**Monitoring**	**Timing**	**Responsible**	**Reporting**
3. Groundwater abstraction not to exceed ground water licence limit. 4. Groundwater monitoring procedure in place.					
MO8: Minimise project-related adverse impacts to aquatic biota from: • **windblown salt from evaporation ponds/salt piles; and** • **soil compaction of lake bed during development of trenches and heap and profile of salt piles.** ***Riparian vegetation management targets and actions are addressed in a separate FVEMP.***					
1. No project related incidents of vehicles being used outside of designated operational areas such as causeways or bunding, designated construction zones or approved disturbance areas. 2. Demarcation and monitoring of construction boundaries in place.	• Comply with CEMP. • Delineate construction boundary areas by qualified surveyors in the field. • Clearly demarcate and monitor construction boundaries. • Ensure light vehicles and machinery stay on causeways or bunding, within designated construction zones or within approved disturbance areas. • Inductions of all site personnel to include information on the importance of aquatic biota and associated habitat, management targets, measures and expectations.	1. Comply with CEMP. 2. Routine monitoring of sediment quality, salt crust and aquatic biota resting stages during dry conditions through rewetting trials, during dry conditions (**Appendix B**). 3. Visual observations of lake bed for unauthorised vehicular tracks and soil compaction. 4. Monitoring of surface water extent and quality, sediment quality, salt crust and aquatic biota during major inundation events (**Appendix B**). 5. Monitor riparian vegetation health and soil salinity in accordance with FVEMP.	1. In accordance with CEMP. 2. In accordance with **Appendix B** 3. In accordance with **Appendix A**. 4. Opportunistic. 5. In accordance with FVEMP.	• Construction. • Environment Team.	• Monitoring data. • Annual Compliance Assessment Report (ACAR). • Annual Monitoring reports.
MO9: No Project related adverse impacts to subterranean fauna on landform islands from the development of the on-LDE infrastructure (including brine abstraction) and from abstraction of groundwater from the SIDE.					
1. No project-related adverse impacts to prospective stygofauna fauna and/or habitat on the landform islands within the On-LDE from infrastructure development, including abstraction of brine. 2. No project-related impacts to subterranean fauna and/or prospective habitat due to groundwater drawdown from groundwater abstraction from the SIDE.	• Implementation of suitable buffer zones around the islands, comprising 500 m for landform islands, 250 m for large and intermediate islands and 100 m for small islands, negating the possibility of habitat excavation. • Progressive implementation of BMUs to limit the rate and magnitude of drawdown across the lake and islands. • Conduct groundwater investigations and modelling to investigate drawdown extent and change in surface flows to minimise impacts to lake, island and associated subterranean fauna habitat. • Adhere to Groundwater Abstraction Licence requirements for the SIDE and brine abstraction. • Comply with MCP.	1. Monitoring of disturbance register for compliance to approvals. 2. Analysis of disturbance undertaken via annual aerial imagery survey to assess whether any unauthorised disturbance has occurred. 3. Internal incident reporting and investigation process. 4. Routine monitoring of groundwater levels and quality (**Appendix B**).	1. During construction, pre-disturbance and post- disturbance activities. 2. Annual aerial imagery capture and analysis to monitor disturbance extent. 3. As triggered. 4. In accordance with IWMP (**Appendix A**).	• Construction. • Operations. • Environment Team.	• Annual Compliance Assessment Report (CAR). • Annual Monitoring reports.
MO10: No project-related adverse impacts to prospective subterranean fauna habitat on the islands and SIDE due to groundwater contamination from hydrocarbon spills.					
1. Hazardous Substances Management Plan (HSMP) and Procedure implemented. 2. Spill response training for all personnel and contractors. 3. Spill response equipment, bunding and leak detection mechanisms in place. 4. Bioremediation facility for the treatment of contaminated fill, soils, or sediment in place.	• Hydrocarbon and/or chemical leaks and spills (expected to be rare) will be managed using bunding techniques, leak detection mechanisms and spill kits to restrict impacts. • Avoidance of fuel/chemical storage and transfers outside of designated areas. • Spill response equipment available to prevent chemical / hydrocarbon spill from spreading within the On-LDE. • Spill response training for all personnel and contractors. • Dedicated workshop for maintenance. • Bioremediation facility for the treatment of contaminated fill, soils, or sediment.	1. Routine monitoring of groundwater levels and quality (**Appendix B**).	1. In accordance with IWMP (**Appendix B**).	• Construction. • Operations. • Environment Team.	• Annual Compliance Assessment Report (CAR). • Annual Monitoring reports.

EPA Factor and Objective	Inland Waters: To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected. Subterranean Fauna: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.
IWEMP Purpose	*To avoid adverse project-related impacts to aquatic biota and subterranean fauna including significant taxa and associated habitat.*
Key Impacts and Risks	Potential loss or degradation of aquatic and subterranean fauna habitat and the potential loss of diversity from the Proposal Area, as a result of implementation of the Proposal.
Indicators	Exceedance of groundwater levels, changes to groundwater or surface water quality, reduction in surface water extent, reduction in aquatic biota (aquatic invertebrates) and subterranean fauna communities or habitats.

Objective-based Management Provisions

Management Target	Management Actions	Monitoring	Timing	Responsible	Reporting
	• Management of sites as per the *Contaminated Site Act 2003*. • Develop a Hazardous Substances Management Plan (HSMP) and Procedure. • Develop a Refuelling Procedure of on-lake vehicles, plant and equipment. • Develop an Emergency and Spill Response Plans. • Develop a Contaminated Sites Register. • Develop an Incident Reporting Procedure. • Develop a Groundwater Monitoring Procedure (**Appendix B**) • Comply with CEMP.				
MO11: No project-related adverse impacts to prospective subterranean fauna habitat due to altered surface hydrology from project-related clearing and disturbance, resulting in changes to groundwater flows on the islands and SIDE.					
1. Clearing not to exceed 1,500 ha of flora and vegetation (the combined total of 200 ha of native vegetation within the 688 ha Off-LDE, and 300 ha of native vegetation within the 11,799 ha SIDE and 1,000 ha of native vegetation within the 33,928 ha NIDE). 2. Buffer zones applied to landform islands, large and intermediate islands, small islands and WA and NT exclusion zones on Lake Mackay. 3. No unauthorised clearing within lake island buffer zones. 4. Demarcation and monitoring of construction boundaries in place.	• Delineate disturbance boundary areas and confirmed disturbance areas. • Develop a Ground Disturbance Permit System and Procedure. • Rehabilitation of temporary cleared areas. • Comply with: – CEMP – MCP.	1. Post disturbance surveys. 2. Inspections of cleared and rehabilitated areas to detect presence of new weed species and to determine success of weed mitigation measures. 3. Internal incident reporting and investigation process. 4. Comply with CEMP and MCP.	1. Following completion of disturbance activities. 2. Annual in accordance with Weed Management Plan. 3. As triggered. 4. In accordance with CEMP and MCP.	• Construction. • Operations. • Environment Team.	• Annual Compliance Assessment Report (CAR). • Annual Monitoring reports.

5. Monitoring and Evaluation

A monitoring schedule has been developed with performance targets (**Table 5-1**), to assess the effectiveness of the management measures outlined in this IWEMP (**Section 4**). The performance targets have been aligned with the outcome-based objectives and associated environmental criteria, with associated measurement parameters, monitoring frequencies and responsibilities.

In addition, an Inland Waters Monitoring Program (IWMP) has been developed to align with the IWEMP and are presented in **Appendix A**. The survey design, frequency and components have been considered and informed by previous findings, and where possible aligned with the baseline survey (Stantec 2021a), for consistency and to allow for comparison over time.

The IWMP has been developed to achieve the following objectives:

- monitor the success of mitigation and management and detect potential impacts (**Section 3.3**) to aquatic and subterranean fauna and habitat;
- evaluate potential impacts against trigger, threshold, and target criteria (management provisions) (**Table 4-1** and **Table 4-2**);
- report exceedances against environmental criteria and implement corrective actions where required (**Section 6**); and
- assess the effectiveness of the environmental criteria to inform adaptive management and revision where required (**Section 8**).

Where environmental threshold criteria are exceeded, potential corrective actions have been identified for inland waters and subterranean fauna (**Table 4-1** and **Table 4-2**).

Table 5-1: Monitoring schedule for management targets for inland waters, including subterranean fauna.

Management Objectives	Monitoring Event	Monitoring Action	Frequency	Responsibility
Inland Waters				
No project-related adverse impacts to aquatic biota due to habitat loss, fragmentation or modification, from project-related disturbance.	• Aquatic ecology monitoring. • Riparian vegetation monitoring.	• Inspection of disturbance extents during disturbance activities to confirm no unauthorised disturbance or earthworks or approaching buffer zones. • Undertake monitoring of sediment quality, diatoms, resting stages and aquatic invertebrates (through rewetting trials) from Lake Mackay, during dry conditions, according to methods and approach outlined in **Appendix B**. • Undertake monitoring of surface water extent, depth and quality, sediment quality, benthic algae, diatoms and aquatic invertebrates from Lake Mackay during major flood events, according to methods and approach in **Appendix B.** • Undertake monitoring of riparian vegetation health in accordance with FVEMP.	• Daily during the construction period. • Annually. • Opportunistically. • In accordance with FVEMP.	• Agrimin. • Manager Environment. • Suitably qualified consultant. • Suitably qualified consultant.
No project-related adverse impacts to aquatic biota due to changes in surface water flows and inundation during major flood events, from project development.	• Aquatic ecology monitoring. • Waterbird monitoring.	• Undertake monitoring of sediment quality, diatoms, resting stages and aquatic invertebrates (through rewetting trials) from Lake Mackay, during dry conditions, according to methods and approach outlined in **Appendix B.** • Undertake monitoring of surface water quality, sediment quality, benthic algae, diatoms and aquatic invertebrates from Lake Mackay during major flood events, according to methods and approach in **Appendix B**. • Undertake monitoring of surface water extent and depth from Lake Mackay, utilising remote sensing techniques, according to methods and approach in **Appendix B**. • Undertake waterbird monitoring during periods of inundation in accordance with the TFEMP.	• Annually. • Opportunistically. • In accordance with IWMP (**Appendix B**) • In accordance with TFEMP.	• Agrimin. • Manager Environment. • Suitably qualified consultant. • Suitably qualified consultant.
No project-related adverse impacts to aquatic biota due to increased salinity in surface waters, from runoff from evaporation ponds and salt piles.	• Aquatic ecology monitoring. • Riparian vegetation monitoring.	• Undertake monitoring of salt crust thickness and sediment salinity in the vicinity of salt piles and evaporation ponds according to methods and approach outline in **Appendix B**. • Undertake monitoring of sediment quality, diatoms, resting stages and aquatic invertebrates (through rewetting trials) from Lake Mackay, during dry conditions, according to methods and approach outlined in **Appendix B**. • Undertake monitoring of surface water extent, depth and quality, sediment quality, benthic algae, diatoms and aquatic invertebrates from Lake Mackay during major flood events, according to methods and approach in **Appendix B**. • Undertake monitoring of riparian vegetation health in accordance with FVEMP.	• In accordance with IWMP (**Appendix B**). • Annually. • Opportunistically. • In accordance with FVEMP.	• Agrimin. • Manager Environment. • Suitably qualified consultant. • Suitably qualified consultant.
Minimise project-related adverse impacts to aquatic biota due to changes to hydraulic connectivity and/or reduction in moisture content of lake sediment, from groundwater drawdown.	• Groundwater monitoring. • Aquatic ecology monitoring. • Riparian vegetation monitoring.	• Undertake monitoring of groundwater levels according to methods and approach outlined in **Appendix B**. • Undertake monitoring of sediment quality (including soil moisture), diatoms, resting stages and aquatic invertebrates (through rewetting trials) from Lake Mackay, during dry conditions, according to methods and approach outlined in **Appendix B**. • Undertake monitoring of surface water extent, depth and quality, sediment quality, benthic algae, diatoms and aquatic invertebrates from Lake Mackay during major flood events, according to methods and approach in **Appendix B**. • Undertake monitoring of riparian vegetation health in accordance with FVEMP.	• In accordance with IWMP (**Appendix B**). • Annually. • Opportunistically. • In accordance with FVEMP.	• Agrimin. • Manager Environment. • Suitably qualified consultant. • Suitably qualified consultant.
Minimise project-related adverse impacts to aquatic biota due to changes in salinity and/or ionic composition of groundwater from lake bed sediment abstraction.	• Groundwater monitoring. • Aquatic ecology monitoring. • Riparian vegetation monitoring.	• Undertake monitoring of groundwater quality according to methods and approach outlined in **Appendix B**. • Undertake monitoring of sediment quality, diatoms, resting stages and aquatic invertebrates (through rewetting trials) from Lake Mackay, during dry conditions, according to methods and approach outlined in **Appendix B**. • Undertake monitoring of surface water extent, depth and quality, sediment quality, benthic algae, diatoms and aquatic invertebrates from Lake Mackay during major flood events, according to methods and approach in **Appendix B**. • Undertake monitoring of riparian vegetation health in accordance with FVEMP.	• In accordance with IWMP (**Appendix B**). • Annually. • Opportunistically. • In accordance with FVEMP.	• Agrimin. • Manager Environment. • Suitably qualified consultant. • Suitably qualified consultant.
Minimise project-related adverse impacts to aquatic biota due to potential disturbance and exposure of ASS during trench excavation.	• Groundwater monitoring. • Riparian vegetation monitoring.	• Undertake monitoring of groundwater quality according to methods and approach outlined in **Appendix B**. • Undertake monitoring of riparian vegetation health in accordance with FVEMP.	• In accordance with IWMP (**Appendix B**). • In accordance with FVEMP.	• Agrimin. • Manager Environment.
No project-related adverse impacts to aquatic biota due to potential contamination of surface water and/or groundwater as a result of hydrocarbon and/or chemical spills, and landfill/wastewater treatment plant operations.	• Soil sampling. • Riparian vegetation monitoring.	• Undertake soil sampling to ensure all contaminated material has been removed and in situ soils sediment have been remediated. • Undertake riparian vegetation monitoring in contamination-affected areas and adjacent areas.	• As triggered. • As triggered. • In accordance with CEMP.	• Agrimin. • Manager Environment. • Suitably qualified consultant.

Management Objectives	Monitoring Event	Monitoring Action	Frequency	Responsibility
		• Comply with monitoring requirements in CEMP.		
Minimise project-related adverse impacts to aquatic biota due to changes in hydraulic connectivity and groundwater quality from abstraction of up to 3.5 GL/a of groundwater for processing from borefield.	• Groundwater monitoring.	• Undertake monitoring of groundwater levels and quality according to methods and approach outlined in **Appendix B**.	• In accordance with IWMP (**Appendix B**).	• Agrimin. • Manager Environment.
Minimise project-related adverse impacts to aquatic biota due to fugitive dust emissions from windblown salt from evaporation ponds/salt piles.	• N/A	• Comply with monitoring requirements in CEMP.	• In accordance with CEMP.	• Agrimin. • Manager Environment.
Subterranean Fauna				
No project-related adverse impacts to prospective stygofauna and troglofauna habitat beneath landform islands within the On-LDE from infrastructure development.	• N/A	• Inspection of disturbance extents during disturbance activities to confirm no unauthorised disturbance or earthworks or approaching buffer zones.	• Daily during the construction period.	• Agrimin. • Manager Environment.
No project-related adverse impacts to subterranean fauna and/or prospective habitat due to groundwater drawdown from trench brine abstraction from the On-LDE and from abstraction from the SIDE.	• Groundwater monitoring.	• Undertake monitoring of groundwater quality according to methods and approach outlined in **Appendix B**.	• In accordance with IWMP (**Appendix B**).	• Agrimin. • Manager Environment.
No project-related adverse impacts to prospective subterranean fauna habitat beneath the islands and SIDE due to groundwater contamination from hydrocarbon spills.	• Groundwater monitoring.	• Undertake monitoring of groundwater quality according to methods and approach outlined in **Appendix B**.	• In accordance with IWMP (**Appendix B**).	• Agrimin. • Manager Environment.
No project-related adverse impacts to prospective subterranean fauna due to altered surface hydrology from project-related clearing and disturbance resulting in changes to groundwater flow paths on the islands and within the SIDE.	• Post disturbance surveys. • Inspections of cleared and rehabilitated areas.	• Post disturbance surveys. • Inspections of cleared and rehabilitated areas to detect presence of new weed species and to determine success of weed mitigation measures.	• Following completion of disturbance activities. • Annual.	• Agrimin. • Manager Environment.

6. Reporting Provisions

All the analysis and subsequent reporting provisions relating to the performance of this IWEMP will be submitted to the relevant regulatory authorities by the Manager Environment, as follows:

- DBCA: where plans relate to matters listed under the *Biodiversity Conservation Act* 2016 (BC Act)
- DWER: where plans relate to matters regulated under the *Environmental protection Act* 1986 (EP Act).
- DCCEEW: where plans relate to matters listed under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) or is a matter of national environmental significance (MNES).

Requirements for annual reporting, exceedance and incident reporting in accordance with this IWEMP are discussed in subsequent sections.

6.1. Annual Reporting

Agrimin will prepare an Annual Environmental Report (AER) for submission to the DWER and DBCA where applicable. An Annual Compliance Assessment Report (ACAR) for submission to the EPA. The format and contents of these reports will align with the conditions and requirements stipulated by the individual authorities and demonstrate compliance. Reporting specific to the management of inland waters and subterranean fauna will be summarised in the AER and ACAR to address the relevant conditions, with technical reports appended.

6.2. Exceedance Reporting

In the event that a management threshold level is exceeded, the DWER and DBCA will be notified as required within 7 days of identification of the exceedance in accordance with **Section 4** (**Table 4-1**).

6.3. Incident Reporting

All environmental incidents, regardless of the scale and nature of the incident, will be reported in accordance with the Event and Hazard Reporting Procedure to the Agrimin Manager Environment and, Heritage as soon as practicable. The following procedure will be adhered to:

- All environmental near misses and incidents will be recorded within an incident management system. Incidents will be recorded internally by the person/s who cause or identify the event, within 24 hours of the incident occurring.
- The area supervisor or Superintendent will determine the need for corrective actions and level of investigation required dependent on severity of the incident. Investigations will be conducted in accordance with the Investigation and Action Management Procedure and recorded within the incident re[porting system within two weeks of the incident occurring, or as instructed by the Registered Mine Manager. Where applicable, environmental incidents will be reported to the relevant regulatory authorities by the Manager Environment.
- In the event of a non-compliance, the cause of the non-compliance will be investigated and reported as an incident. Corrective actions will be developed and recorded, and outcomes monitored, as required. Non-compliance and incident reports will be closed out by the Manager Environment and/or the Registered Mine Manager.

7. Roles and Responsibilities

The key personnel involved in implementation of the IWEMP and their roles and responsibilities are listed in **Table 7-1**.

Table 7-1: Roles and Responsibilities for implementation of the IWEMP.

Key personnel	Responsibility
Agrimin	• Agrimin have the overall responsibility for implementation of the TFMP. • Audit and compliance. • Engagement with Traditional Owners.
Manager Environment (may delegate all or part responsibility to an appropriately qualified person)	• Obtain relevant approvals from regulatory agencies for disturbance as required. • Undertake monitoring for aquatic biota and subterranean fauna as detailed in **Section 5** of this Plan. • Monitor and report incidents. • Maintain land disturbance register to ensure compliance with approvals. • Implement and maintain the IWEMP, review its effectiveness and review the implementation as required. • Undertake training and inductions of personnel in accordance with the IWEMP. • Implement aquatic ecology monitoring programs as specified in **Appendix B** of this IWEMP. • Liaise with stakeholders and technical experts for advice and resolution of management aspects/objectives as required. • Engagement with Traditional Owners. • Report as required to regulating authorities.
All personnel (including contractors)	• Complete induction prior to commencement of work on site. • Toolbox meetings. • Training. • Comply with requirements in IWEMP. • Report any incidents through the Agrimin incident management system within 24 hours.
Third-party Contractor (specialist consultant)	• Specialist consultant to undertake monitoring according to aquatic ecology monitoring programs as specified in **Appendix B** of this IWEMP.

8. Adaptive Management and Review

It is recognised that there is a level of scientific uncertainty and current knowledge gaps relating to some aspects of the key factor of Inland Waters such as surface hydrology, hydrogeology, and subterranean fauna, in relation to potential impacts during the operation of the Proposal. Therefore, this IWEMP has been designed to be adaptive, and should be updated over the life of the Proposal. It is expected that additional information from aquatic ecology and subterranean fauna monitoring will be used to revise environmental criteria and response actions, as required.

Other changes that may prompt the revision of the IWEMP include:

- addressing items identified during incident investigations.
- audits or inspections; and
- additional information or data becomes available.

The IWEMP will be reviewed and revised every three years throughout the life of the Proposal, or as deemed necessary. Any revisions by Agrimin will be undertaken in consultation with DWER, DCCEEW and or DBCA (where appropriate). The review process will include:

- **Periodic review and evaluation of monitoring data or methodology** – to determine whether monitoring results indicate that management provisions and environmental objectives are suitable and management targets can be achieved.
- **Increased understanding of this factor and habitat requirements of biota** – additional information is received, which may be used to better inform environmental criteria, management or response actions.
- **Proposal changes (such as design and processing, or technical advances and innovation)** – consider the relevance and effectiveness of management provisions will be considered following any significant changes to the Proposal.

9. Stakeholder Consultation

Several key stakeholder groups have been identified for the Lake Mackay Potash Proposal. Whilst engagement continues, some of the key stakeholders with respect to the Proposal include:

- State Government agencies, including the EPA, DWER, DBCA, Department of Mines, Industry Regulation and Safety (DMIRS), Department of Planning, Lands and Heritage (DPLH), and the Department of Jobs, Tourism, Science and Innovation (DJTSI);
- The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW);
- Local Government agencies including the Shires of Shire of East Pilbara; Shire of Halls Creek; and Shire of Wyndham-East Kimberley;
- Native Title Bodies including: Central Desert Native Title Services; and Kimberley Land Council;
- Traditional Owners and Heritage representative groups, including the Tjamu Aboriginal Corporation and Kiwirrkurra People; Parna Ngururrpa Aboriginal Corporation and Ngururrpa People; and Tjurabalan Native Title Land Aboriginal Corporation; and
- Community representatives.

Agrimin maintains a Stakeholder Engagement Register that includes specific consultation with stakeholders and a detailed response to issues is provided. Stakeholder engagement will continue through the construction and operation of the Proposal and reported through revisions of Environmental Management Plans. Stakeholder consultation will continue to be monitored and reported following revision of the IWEMP as the document is finalised and implemented. A summary of stakeholder consultation specific to the IWEMP is summarised in **Table 9-1**.

Table 9-1: A summary of stakeholder consultation associated with the IWEMP.

Stakeholder	Date of Communication	Type of Consultation	Attendees	Summary of Communication	Outcome of Consultation
Between 2014-2017, consultations with relevant regulatory agencies, government departments and indigenous groups are summarised as follows: Regular meetings with representatives of the **Kiwirrkurra People** and **CDNTS** to discuss country, arrangements for an exploration agreement an negotiation protocol and discussions on heritage surveys Meetings with the **DMP** (now **DMIRS**) to discuss environmental assessments and management plans and discuss options given the limitations associated with applying the Mining Act to brine mineral resources. Subsequent discussions took place with the **DSD** and **Minister for State Development's office** regarding this issue. A meeting with the **DoW** to discuss implications to ground-water dependent ecosystems in relation to the Project. A meeting with **DPaW** to discuss arrangements for flora and vegetation, terrestrial fauna and subterranean fauna in relation to the Project.					
DoW	14/02/17	Meeting at DoW office to provide project briefing.	**Agrimin:** Tom Lyons **DoW:** Gary Humphreys, Josephine Searle, Lilly Magombedze, Natalie McAlpine	• Department of Water (DOW) recommends to check for Groundwater Dependent Ecosystems (GDE) south of Lake Mackay. • In regard to riparian vegetation, Agrimin must note any draw-down impacts from activities on the lake. • Agrimin must investigate whether there are GDEs associated with islands and whether the project's water abstraction will impact on the Kiwirrkurra community's bore water supply.	• Agrimin will check for GDEs. • Unlikely that project will impact the Kiwirrkurra community's bore but Agrimin will monitor for any draw-down effects. • Unlikely that riparian vegetation will be impacted by activities on the lake but Agrimin will monitor this.
DPAW	16/02/17	Meeting at DPAW office to provide project briefing.	**Agrimin:** Tom Lyons **DPAW:** Sandra Thomas, Murray Baker, Michelle Corbellini	• Flora & Vegetation – The Department of Parks & Wildlife (DPAW) understand the full environmental impacts of Project on and off footprint. Agrimin should focus on conservation of significant species. – Salt lakes are ecological islands. Note fringing vegetation, restricted species, new species, range extensions. – Correct ID of plant specimens (confirmed by WA Herbarium) to be properly vouchered. – Target genera and species of conservation significance, eg *Tecticornia* spp and samphires. – Transect surveys preferred over individual quadrats. – Gypsum islands have potential to host unique species – need thorough, targeted investigation. – Increase general survey area to capture more area outside of impact footprint. • Vertebrate Fauna – Migratory birds after significant rainfall need to be investigated and the potential for large bird numbers and associated aquatic invertebrates. – Target conservation significant species, especially Greater Bilby, Great Desert Skink and Brush-tailed Mulgara. – Map Bilby, Mulgara, Skink locations so that preferred living/foraging habitat is avoided as far as practicable. – Target endemic fauna, particularly reptiles. – Current fauna work needs to be more extensive, albeit Level 1 survey to date. • Subterranean Fauna – Need to understand calcrete locations which are related to subterranean fauna distributions. – Need to assess subterranean fauna off-footprint as well as within disturbance envelope.	• Future studies to incorporate advice from government agencies. • Future bore hole drilling to incorporate calcretes on- and off-footprint. • Agrimin will make use of existing bores as far as practicable for subterranean fauna assessments.
OEPA	21/02/17	Meeting at OEPA office to provide project briefing.	**Agrimin:** Tom Lyons **EPA:** Chris Stanley	• Ensure guidance document recommendations are incorporated into environmental assessments. • Provide technical environmental reports to the OEPA Technical Team for review and feedback. • Ensure early consultation on project with the Commonwealth Government.	• Provided technical reports on flora, vegetation and vertebrate fauna for review. • Initiated contact with the Commonwealth DoEE regarding project briefing.
DMP	17/04/17	Meeting at DMP office to provide project briefing.	**Agrimin:** Tom Lyons **DMP:** Demelza Dravnieks	• Impacts to surface water hydrology from trenching (bund wall influence on surface flows) should be assessed. • Use of piping constructed through bunds to direct surface flow over trenches. • Strategies should be considered to allow fauna to egress from trenches if required.	• Trench configuration constructed to minimise interference with surface water flow. • Piping strategy successful elsewhere under similar conditions. • Appropriate and practical egress measures to be considered for trenches.

Stakeholder	Date of Communication	Type of Consultation	Attendees	Summary of Communication	Outcome of Consultation
				• Groundwater drawdown, including depth and extent, and impacts to flora and subterranean fauna needs to be considered. • Closure planning.	• Further hydrological modelling is required to quantify drawdown impacts. • Closure planning to be addressed as part of project's development studies.
DoEE	21/12/17	Pre-referral meeting on teleconference.	**Agrimin:** Tom Lyons **DEE:** Matt Whitting, Mallory Owen	• The Commonwealth DoEE requires an understanding of the Project's hydrogeological modelling - need to adequately understand groundwater drawdown in relation to depth and lateral extent, and connectivity between shallow and deep aquifers (existence and rate of connectivity). • Hydrological modelling is also required regarding any increase in infiltration from the shallow aquifer, and corresponding reduction in surface water availability. This may include: • The impacts of drawdown relating to the proposed project life (period) and area of extraction (spatial). • The likelihood of depressurization of the overlying units occurring. • The approximate period of time to maximum impact extent and rate of recovery of the groundwater level in each aquifer • Determine uranium (U) and thorium (Th) concentrations in sediments/soils (assay results) in Project impact area as this has been an issue raised in relation to similar projects by Ministers. If U and Th concentrations are elevated then the ultimate test will be whether or not the action meets the test set out in Division 2.1 of the EPBC Regulations, particularly Regulation 2.02). • Investigate potential changed hydrology (water drawdown) impacts on the Dwarf Desert Spike-rush *Eleocharis papillosa* – DoEE search radius of 120km around Lake Mackay identified its occurrence to NE of the lake (Northern Territory). Also, any other plant spp which may be similarly impacted and potential impacts to fauna such as Bilby that may be dependent on these species. • If Project assigned as 'Controlled Action' then assessment can occur via an 'Accredited Process'.	• Preliminary groundwater and surface water modelling on-lake completed. Off-lake water modelling targeting potential impacts related to proposed borefield yet to commence. • Uranium and thorium concentrations in soils and sediments impacted by Project related activities to be assessed. • Re-visiting flora survey work to check for presence of *E. papillosa* and whether or not this species would have been visible, if present, during surveys. • Also, look for other similar flora spp which may be impacted by changed hydrology (lowering of water table) and consider related impacts to dependent fauna. • The DoEE's comments should currently be considered a guide at best in lieu of more detailed information becoming available.
OEPA (EPA Services Directorate, DWER)	3/05/18	Feedback regarding draft referral supporting documentation.	**Agrimin:** Tom Lyons **EPA:** Chris Stanley	• Advised that the overall referral document appears comprehensive, however, need to address the following: – Description for each activity in Key Characteristics table needs trimming to what is environmentally relevant and presented more concisely; – Development envelope needs to be reduced in size so that it is, at most, double the amount of disturbance; – Check that most recent EPA guidance is followed – see reference to 2004 (updated in 2016); – Potential impacts to potentially 5 new Tecticornia species needs to be more fully addressed; – Waste salt stockpiles – height and location may be an issue. – Greenhouse gas emissions – include truck haulage of product; – Remove or clarify reference to 'EPA scoping guideline'; – Remove reference to ASX code, and – MNES – complex with regard to what may be assessed under the EPBC Act.	• Agrimin will address each of the comments and amend the referral document, as appropriate. • Technical reports were not provided with the supporting document which may have facilitated an understanding of the issues commented on.
Tjamu Tjamu Aboriginal Corporation	14/05/18	Feedback regarding draft referral supporting documentation.	Belinda Bastow of Integrate Sustainability Pty Ltd	Clarify extent to which stakeholder engagement has taken place, eg provision of Stakeholder Register. Hydrology/Hydrogeology assessments of the Project area should be provided to address potential surface and groundwater impacts. Chemical characteristics of the salt lake surface and waste salts need to be addressed in more detail.	• Agrimin will address each of the comments and amend the referral document, as appropriate. • Technical reports were not provided with the supporting document which may have facilitated an understanding of the issues commented on.
DWER and EPA	6/03/19	EPA Aquatic and Terrestrial Ecology Discussion.	**Agrimin:** Tom Lyons **Stantec:** Sarah Osborne, Kate Stanbury Approvals, Fiona Taukulis, Paul Bolton, Alice Bott	Key topics discussed: – Haul Road corridor flora, vegetation and fauna survey. – Consolidation of previous survey work within the on-lake and off-lake development envelopes.	• Preliminary feedback provided on approaches for surveys.

Stakeholder	Date of Communication	Type of Consultation	Attendees	Summary of Communication	Outcome of Consultation
			EPA: Chris Stanley, Helena Mills, Claire Stevenson	– SRE surveys within the Haul Road corridor and in the vicinity of the lake. – Aquatic ecology survey during flooding (or rewetting trials as an alternative).	
EPA	20/08/20	Meeting at EPA Office to provide project presentation to EPA Board members.	**EPA Board**	• Agrimin's presentation was well received.	• No specific comments or issues were raised.
DWER and EPA	2/09/20	Meeting at EPA office to provide project update and major findings.	**Agrimin:** Tom Lyons **Stantec:** Sarah Osborne **EPA:** Liesl Rohl, Vanessa Robinson, Helena Mills, Claire Stevenson	• Stygofauna environmental assessments will be required and should be a priority given timeline issues with other projects in the State.	• EPA/TEB branch recommended to focus the attention of the ERD around: changes to surface water hydrology, sediments drying, impacts to Tecticornia (sediment loading / distribution / germination / change to large scale flooding events / indirect impacts on islands) and maintaining hydrological flows to maintain priority Tecticornia species and supporting vegetation communities.
DWER and EPA	30/09/20	Meeting at EPA office to provide project update and major findings.	**Agrimin:** Tom Lyons **Stantec:** Sarah Osborne, Paul Bolton **EPA:** Liesl Rohl, Vanessa Robinson, Helena Mills, Claire Stevenson	• Agrimin presented key findings of field surveys to DWER-EPA and TEB branch including Night Parrot and Great Desert Skink. Discussions around findings and next steps for further survey and impact assessment work for inclusion within the ERD was discussed.	• It was recommended to another discussion including DBCA around significant fauna species be undertaken. • EPA/TEB branch recommended to focus the attention of the ERD around: changes to surface water hydrology, sediments drying, impacts to *Tecticornia* (sediment loading / distribution / germination / change to large scale flooding events / indirect impacts on islands) and maintaining hydrological flows to maintain priority *Tecticornia* species and supporting vegetation communities.
Northern Territory Department of Environment, Parks and Water Security	30/04/21	Meeting with the Northern Territory Department of Environment, Parks and Water Security.	**Agrimin:** Mark Savich, Tom Lyons, Michael Hartley **Stantec:** Peter de San Miguel, Fiona Taukulis, Paul Bolton, Matthew Spence **DEPWS:** Paul Purdon, Lisa Bradley, Kylie Fitzpatrick, Maria Wauchope	• Agrimin/Stantec introduced the project and discussed the key issues that could relate to the NT side of the lake. Key issues being drawdown, which are considered negligible (similar to seasonal range). • Key discussion points include: – Key Mitigation Strategies – Hydrogeological Model Outcomes – Impact Predictions	N/A
NT EPA Board Meeting (Formal Agenda Item at Board Meeting)	1/06/21	Meeting.	**Agrimin:** Tom Lyons **Stantec:** Sarah Osborne **NT EPA Board:** meeting (formal agenda item at the meeting) including Paul Vogel	• Agrimin provided a detailed briefing note to inform the Northern Territory (NT) Environmental Protection Authority (EPA) of the Proposal by Agrimin to construct and operate the Lake Mackay Potash Project (the Proposal). • Agrimin detailed their consideration for WA EPA's mitigation hierarchy at each stage of the assessment process across all environmental factors, providing for the implementation of a number of proponent-led avoidance measures.	These were well received by the NT EPA Board.
DWER and EPA	11/10/21	Site Visit over two days (11 and 12 October 2021).	**Agrimin:** Mark Savich, Tom Lyons **Stantec:** Peter Tapsell, Fiona Taukulis, Paul Bolton **EPA:** Lee McIntosh, Jenny Pope, Troy Sinclair, Liesl Rohl, Cristina Angel	• Opportunity to show EPA/DWER the Proposal Area and discuss on site potential impacts and mitigation to flora and vegetation, waterbirds, SREs, Night Parrot, subterranean fauna and inland waters.	
DWER	9/11/21	Meeting.	**Agrimin:** Tom Lyons, Michael Hartley, Mark Savich **Stantec:** Matthew Spence, Peter Tapsell, Fiona Taukulis, Paul Bolton **EPA:** Liesl Rohl, Troy Sinclair	• Meeting to allow for Agrimin/Stantec to seek EPA guidance and advice, as well as clarification on a number of actions raised regarding the second draft of the Lake Mackay Potash Project's ERD (as per matters raised by Liesl Rohl, Manager EIA North, letter dated 29 October 2021).	

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Appendices

Appendix A Groundwater Monitoring Program

A.1 Background

The Lake Mackay Sulphate of Potash Proposal includes groundwater abstraction associated with the SIDE borefield and On-Lake Development, described in more detail below:

- **On-Lake Development (Brine)**: the On-lake Development Envelope (On-LDE) includes development of trenches, abstraction of up to 100 GL/a of brine, and solar evaporation and harvesting ponds for potash salts, including ground disturbance of approximately 15,000 ha with the 217,261 ha On-LDE. On-LDE brine, with hypersaline groundwater extracted from the lakebed sediments via a series of shallow trenches, within allocated brine mining units (BMUs). The trench network, once complete, will cover approximately 1,973 km on the surface of Lake Mackay, and on average will extend to 4.5 m in depth, required to produce 9 Mt of SOP over the 20-year Life of Mine (LoM). There has been comprehensive study of the brine for resource modelling and definition within the On-LDE, although there is limited hydrogeological investigation on the islands of Lake Mackay. The largest of these islands appear to support low salinity groundwater at higher elevations, which overlies the brine.
- **SIDE borefield**: which will be used to supply water to the process plant water pipeline and access tracks for abstracting up to 3.5 GL/a of processing water and off-lake access to Lake Mackay including clearing of approximately 300 ha of native vegetation within the 11,799 ha SIDE. The borefield is located approximately 15 km south of Lake Mackay and approximately 25 km southeast of the planned process plant. Based on the Agrimin's water exploration drilling completed in 2017, the borefield will target an extensive sedimentary aquifer with brackish to saline water quality. The borefield will comprise a linear configuration of 28 bores at 1 km intervals along the southern margin of the SIDE to supply processing requirements of 3.17 GL/annum. Hydrogeological investigations have been completed on the SIDE and immediately adjacent to the SIDE, referred to as the Southern Regional Area.

Detailed environmental impact assessment (EIA) was completed for the On-Lake Development and SIDE in the ERD document (Stantec 2022), supported by comprehensive hydrogeological assessments (H3 level) for both areas (Stantec 2024a; b), in relation to potentially sensitive environmental receptors. Other groundwater users are not of concern due to their distance from the Proposal Area, although there is an unregistered handpump located in the vicinity of the SIDE (**Figure A-1**).

There is no groundwater dependent vegetation or stygofauna in the predicted drawdown extent of the SIDE (at 20 years), however, there are records nearby (>1 km). On the landform islands of Lake Mackay, *Allocasuarina decaisneana*, a potential groundwater dependent flora species, is known from two of the landform islands of Lake Mackay (**Figure A-2**). Three stygofauna species, including the harpacticoid copepod *Schizopera* 'bradleyi' and cyclopoid copepods *Fierscyclops fiersi* and *Halicyclops kieferi*, are also known from the large and landform islands, with *Schizopera* 'bradleyi' a new and undescribed taxon (**Figure A-2**). *Allocasuarina decaisneana* and the stygal copepods are likely associated with low salinity or freshwater groundwater on the landform islands, which is maintained by recharge and overlies the brine in the lakebed sediments. While not predicted, drawdown from the Proposal has the potential to impact on groundwater dependent ecosystems (vegetation and stygofauna) and claypan ecosystems associated with the abstraction of groundwater from the SIDE borefield for the water supply and brine from the lake sediments.

The Proposal has implemented measures to avoid impacts to the potentially sensitive receptors outside of the predicted drawdown extent of the SIDE and to the low salinity or fresh groundwater associated with the landform islands. These measures will prevent or minimize direct and indirect impacts through implementation of the Inland Waters Environmental Management Plan (IWEMP). This Groundwater Monitoring Program has been prepared to evaluate the effectiveness of management provisions for the SIDE borefield and abstraction of brine on the lake, with measures developed to meet the objectives of the IWEMP.

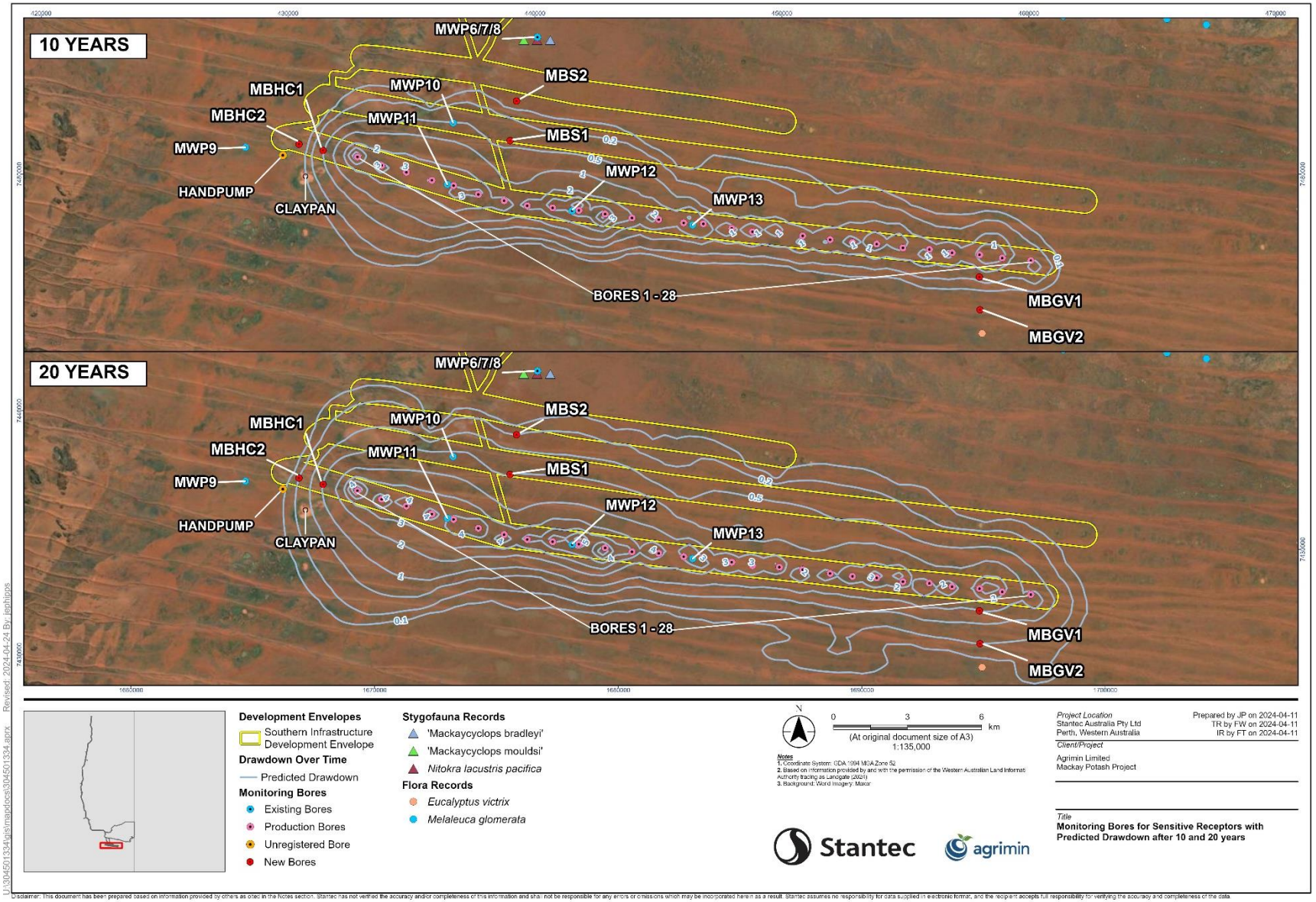

Figure A-1: Proposed monitoring bores, for potentially sensitive environmental receptors, compared to the maximum predicted drawdown at 10 and 20 years.

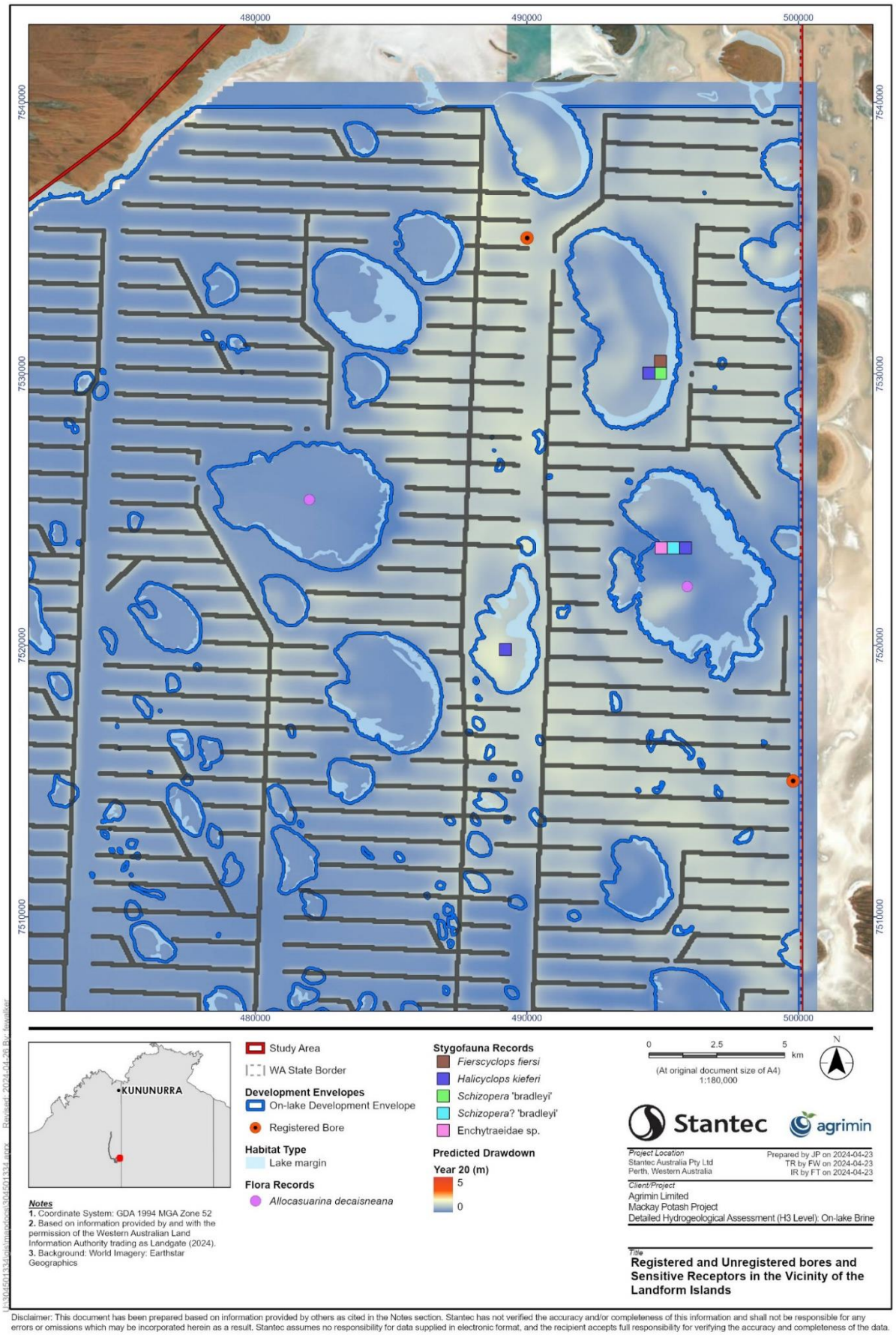

Figure A-2: Registered (Agrimin) bores, riparian zone habitat (mapped as lake margin), *Allocasuarina decaisneana* and stygal copepods and in the vicinity of the on-LDE, compared to the maximum predicted drawdown at 20 years.

A.2 Objectives and Duration of Monitoring

The objective of the Groundwater Monitoring Program (IWMP) is to monitor groundwater to maintain the environmental values of the Neogene aquifer, and Lake Mackay and the landform islands, which may be subject to drawdown or changes associated with the implementation of the Proposal. To address the objective the following will be undertaken:

- Monitor changes in groundwater levels and quality from bores associated the SIDE borefield, in relation to potential environmental factors or potential impacts from the Proposal;
- Monitor changes in groundwater levels and quality from bores associated with BMUs and landform islands on Lake Mackay, in relation to potential environmental factors or potential impacts from the Proposal;
- Evaluate the results of the monitoring against trigger and threshold criteria, and management measures outlined in the IWEMP, to demonstrate groundwater levels and quality are maintained during the life of the Proposal; and
- Provide opportunities for direct engagement of TO Ranger groups, allowing opportunities for knowledge sharing and connection to country.

The Groundwater Monitoring Program is required for the life of the Proposal (20 years), supported by an underlying adaptive management approach.

A.3 Traditional Owner Engagement

The Groundwater Monitoring Program presents an opportunity to engage with and work alongside TO Ranger groups from the Ngururrpa, Tjurabalan, and Kiwirrkurra IPAs. Opportunities to involve TO Rangers in in monitoring may include:

- Assisting with monitoring bore site selection; and
- Accompanying Agrimin staff on groundwater quality monitoring.

A.4 Monitoring

A.4.1 Overview and Timing

A summary of the proposed monitoring is presented in **Table A-1**, which also shows the relevant trigger and threshold criteria (outcome-based). The Groundwater Monitoring program will commence prior to land disturbance activities being undertaken for the Proposal (pre-construction) to provide adequate baseline monitoring data on groundwater (prior to potential impacts) to be collected for a two-year period.

It should also be noted that for indicators with outcome-based provisions, additional monitoring may be required where trigger and/or threshold criteria are exceeded, and response actions may require additional management measures to be implemented as part of investigations.

Table A-1: Groundwater Monitoring Program summary.

Responsibility	Area	Number of Monitoring Bores	Monitoring Parameters	Timing	Frequency	Outcome-based Management Objectives	Trigger Criteria	Threshold Criteria
Agrimin	• SIDE Borefield (water supply)	• 6 new bores to be installed in the shallow Neogene aquifer system for monitoring against triggers and thresholds • Additional monitoring will occur at production and existing monitoring bores for abstraction (6 and 28 bores, respectively), not linked to triggers and thresholds • Bores will target the Neogene shallow aquifer system	• Groundwater levels. • Groundwater quality (pH, salinity anions, cations and metals).	• Pre-construction Phase (baseline for 2 years).	• Groundwater levels measured daily (via remote bore loggers) and downloaded quarterly. • Groundwater quality sampled quarterly (except metals which are to be sampled biannually).	• N/A	• N/A (Baseline)	• N/A (Baseline)
		• 6 new bores to be installed in the shallow Neogene aquifer system for monitoring against triggers and thresholds • Additional monitoring will occur at production and existing monitoring bores for abstraction (6 and 28 bores, respectively), not linked to triggers and thresholds • Bores will target the Neogene shallow aquifer system	• Groundwater levels. • Groundwater quality (pH, salinity anions, cations and metals).	• Operational Phase		• **IW5:** No significant impact to the shallow aquifer (Neogene alluvial deposit) from the SIDE borefield, reducing availability of groundwater for other bore users, groundwater dependent vegetation and stygofauna habitat.	• Groundwater monitoring at bores: – MBS1, MBS2 (stygofauna habitat); OR – MBHC1, MBHC2 (other groundwater users); OR – MBGDV1, MBGDV2 (groundwater dependent vegetation); • detect drawdown levels that exceed 0.5m, 1.0m and 1.5m at 5, 10 and 20 years, respectively. AND • Subsequent investigation determines the change is related to groundwater abstraction.	• Drawdown exceeds 2m at: – MBS1, MBS2 (stygofauna habitat); OR – MBHC1, MBHC2 (other groundwater users); OR – MBGDV1, MBGDV2 (groundwater dependent vegetation). AND • Subsequent investigation determines the change is related to abstraction.
	• On-lake DE: BMUs (brine abstraction)	• 36 bores, up to 2 per BMU, for monitoring against triggers and thresholds • Bores will target the lakebed sediments in representative BMUs	• Groundwater levels. • Groundwater quality (pH, salinity anions, cations and metals).	• Pre-construction Phase (baseline for 2 years).	• Groundwater levels measured daily (via remote bore loggers) and downloaded quarterly. • Groundwater quality sampled quarterly (except metals which are to be sampled biannually).	• N/A	• N/A (Baseline)	• N/A (Baseline)
		• 36 bores, up to 2 per BMU • Bores will target the lakebed sediments in representative BMUs	• Groundwater levels. • Groundwater quality (pH, salinity anions, cations and metals).	• Operational Phase		• **IW3:** No significant impact to surface water levels during large inundation events from abstraction of the brine associated with the On-Lake Development.	• Drawdown exceeds 2 m at on-lake groundwater monitoring bores <u>AND</u> • Subsequent investigation determines the change is related to abstraction	• Drawdown exceeds 3 m at on-lake groundwater monitoring bores <u>AND</u> • Subsequent investigation determines the change is related to abstraction
	• On-Lake DE: Landform	• 18 bores, up to 4 associated with each large or landform island, for	• Groundwater levels. • Groundwater quality (pH, salinity anions, cations and metals).	• Pre-construction Phase	• Groundwater levels measured	• N/A	• N/A (Baseline)	• N/A (Baseline)

	Islands (brine abstraction)	monitoring against triggers and thresholds • Bores will target shallow brine or low salinity/fresh groundwater		(baseline for 2 years).	daily (via remote bore loggers) and downloaded quarterly. • Groundwater quality sampled quarterly (except metals which are to be sampled biannually).			
		• 18 bores, up to 4 associated with each large or landform island, for monitoring against triggers and thresholds • Bores will target shallow brine or low salinity/fresh groundwater	• Groundwater levels. • Groundwater quality (pH, salinity anions, cations and metals).	• Operational Phase		• **IW2:** No significant impact to low salinity or fresh groundwater from abstraction of the brine to groundwater dependent vegetation and stygofauna, relative to baseline conditions, on landform islands.	• Drawdown exceeds 2 m at new groundwater monitoring bores on lake and in riparian zone <u>AND</u> • Subsequent investigation determines the change is related to abstraction	• Drawdown exceeds 3 m at new groundwater monitoring bores on lake and in riparian zone <u>AND</u> • Subsequent investigation determines the change is related to abstraction

A.4.2 Logistical Considerations

Several logistical factors were taken into consideration for the design and safe implementation of the Groundwater Monitoring Program:

- The Proposal is located in a remote area of Western Australia and mobilisation to site from Perth currently takes a minimum of 1.5 days.
- Additional bores will be required to be installed for the purpose of this monitoring program, the locations of which may vary dependent on hydrogeological or environmental characteristics during drilling.
- Lake Mackay is a large salt lake, covering 3,500 km^2 and therefore a helicopter will be required to access the substantial distance between the geographically spread monitoring bores.

A.4.3 Monitoring Sites

Groundwater monitoring associated for the Proposal will be conducted from monitoring bores, including existing monitoring bores and those to be installed for the SIDE borefield and the On-Lake DE BMUs and landform islands. Proposed locations and numbers of monitoring bores are shown in **Figure A-3** to **Figure A-5** and presented in **Table A-2** to **Table A-4**. Bore installation and construction will need to be adaptively managed on site which may result in some variation in proposed location and bore construction details.

SIDE Borefield

Six new bores are to be installed in the shallow Neogene aquifer system for monitoring against triggers and thresholds (**Figure A-3; Table A-2**). Additional monitoring will occur at production and existing monitoring bores for abstraction (six and 28 bores, respectively), not linked to triggers and thresholds.

On-Lake DE BMUs and Landform Islands (brine abstraction)

A total of 36 bores, up to two per BMU, will be installed for monitoring against triggers and thresholds (**Figure A-4; Table A-3**). Bores will target the lakebed sediments in representative BMUs. A total of 18 bores, up to four bores associated with each large and landform island (**Figure A-5; Table A-4**), will be installed for monitoring against triggers and thresholds, with bores targeting the shallow brine or low salinity/fresh groundwater.

A.4.3.1 Additional Conceptual Groundwater Modelling

Additional monitoring bores, test production bores (for pump testing) and monitoring bores (including additional monitoring bores near potentially sensitive receptors) will be installed, to refine the existing models for the SIDE, the on-lake brine and landform islands (low or freshwater conditions) as required. These results may also be used to revise environmental criteria, or the Groundwater Monitoring Program through adaptive management (**Section A.6**).

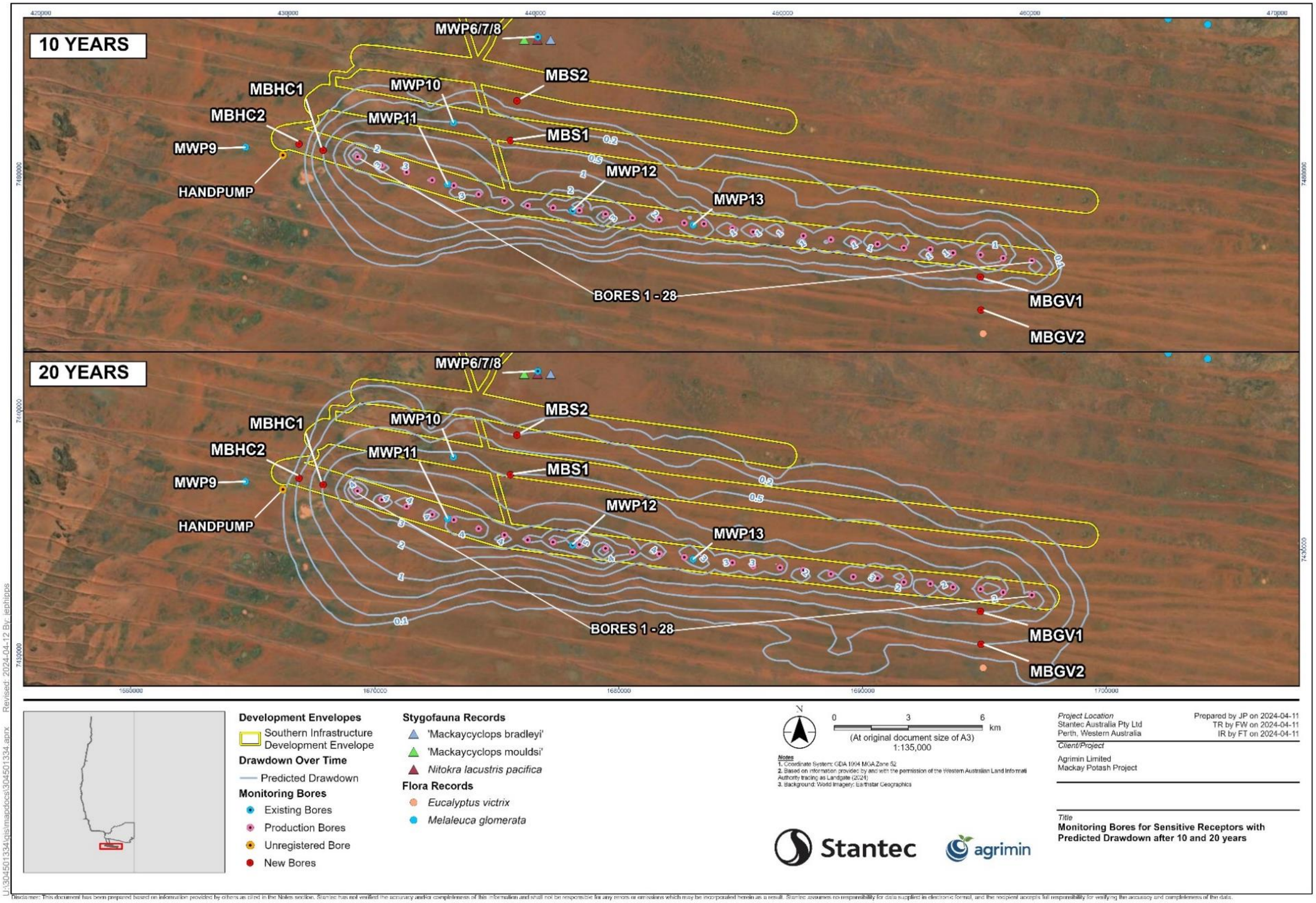

Figure A-3: Proposed monitoring bores associated with the SIDE borefield, in relation to potential sensitive environmental receptors, compared to the maximum predicted drawdown at 10 and 20 years.

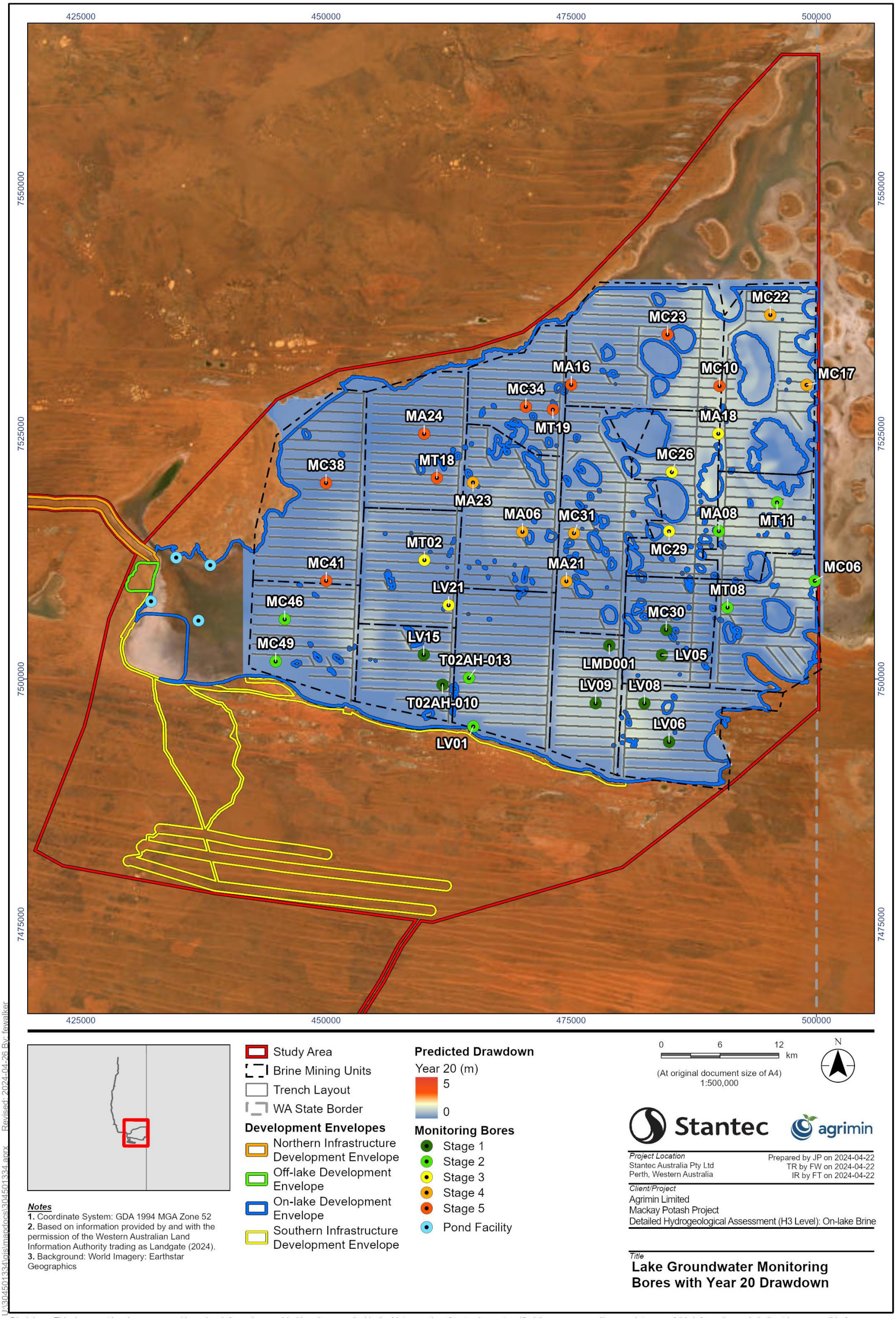

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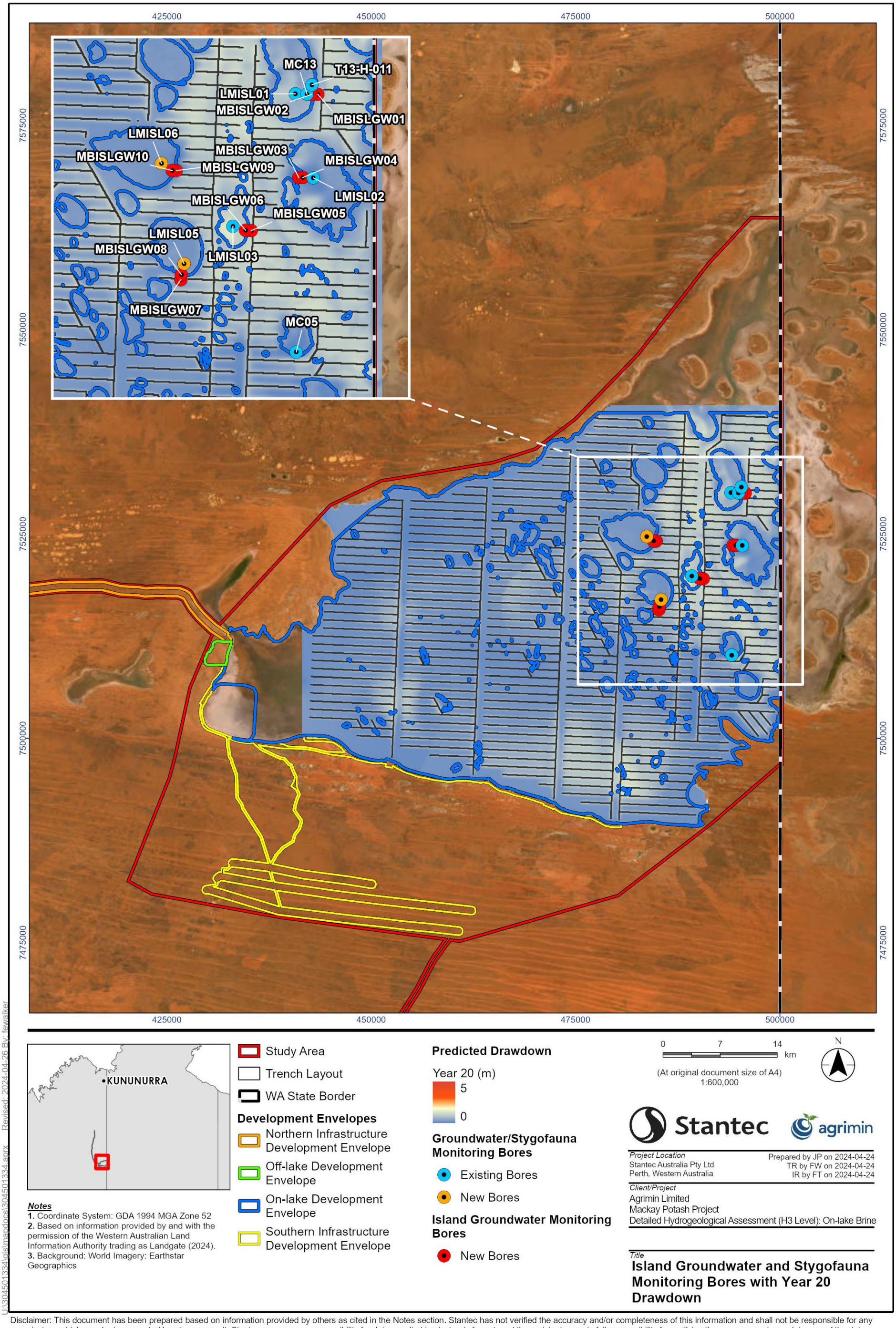
Figure A-4: Proposed location of groundwater monitoring bores associated with BMUs for the groundwater monitoring program.



Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Figure A-5: Proposed location of groundwater monitoring bores associated with large and landform islands for the groundwater monitoring program.

Table A-2: Locations of proposed bores associated with the SIDE borefield for the Groundwater Monitoring Program (GDA94 Z52).

Name	Status	Type	Easting	Northing
MBHC1	To be drilled	Monitoring Bore (triggers and thresholds)	431413.8922	7480956.321
MBHC2	To be drilled	Monitoring Bore (triggers and thresholds)	430439.6045	7481211.449
MBS1	To be drilled	Monitoring Bore (triggers and thresholds)	438988.2021	7481354.899
MBS2	To be drilled	Monitoring Bore (triggers and thresholds)	439249.9864	7482958.704
MBGV1	To be drilled	Monitoring Bore (triggers and thresholds)	457995.9074	7475834.564
MBGV2	To be drilled	Monitoring Bore (triggers and thresholds)	458022.0134	7474503.053
Bore 1	To be drilled	Production Bore	7480697	432809.7
Bore 2	To be drilled	Production Bore	7480350	433788.6
Bore 3	To be drilled	Production Bore	7480074	434787.6
Bore 4	To be drilled	Production Bore	7479750	435823.2
Bore 5	To be drilled	Production Bore	7479534	436701.5
Bore 6	To be drilled	Production Bore	7479176	437703.6
Bore 7	To be drilled	Production Bore	7478920	438746.5
Bore 8	To be drilled	Production Bore	7478718	439685.2
Bore 9	To be drilled	Production Bore	7478632	440712.1
Bore 10	To be drilled	Production Bore	7478531	441774.8
Bore 11	To be drilled	Production Bore	7478381	442836.9
Bore 12	To be drilled	Production Bore	7478223	443925.2
Bore 13	To be drilled	Production Bore	7478160	445010.3
Bore 14	To be drilled	Production Bore	7478024	446021.2
Bore 15	To be drilled	Production Bore	7477987	446816.4
Bore 16	To be drilled	Production Bore	7477803	447968.6
Bore 17	To be drilled	Production Bore	7477665	448807.7
Bore 18	To be drilled	Production Bore	7477599	449894.5
Bore 19	To be drilled	Production Bore	7477498	450838.4
Bore 20	To be drilled	Production Bore	7477345	451950.2
Bore 21	To be drilled	Production Bore	7477229	452855.2
Bore 22	To be drilled	Production Bore	7477166	453836.4
Bore 23	To be drilled	Production Bore	7477015	454899.5
Bore 24	To be drilled	Production Bore	7476949	455972
Bore 25	To be drilled	Production Bore	7476812	456892
Bore 26	To be drilled	Production Bore	7476732	458000.6
Bore 27	To be drilled	Production Bore	7476600	458919.8
Bore 28	To be drilled	Production Bore	7476492	460079.8
MWP6	Existing	Monitoring Bore (abstraction)	7480956	431413.9
MWP7/8	Existing	Monitoring Bore (abstraction)	7481211	430439.6
MWP9	Existing	Monitoring Bore (abstraction)	7481355	438988.2
MWP10	Existing	Monitoring Bore (abstraction)	7482959	439250

Name	Status	Type	Easting	Northing
MWP11	Existing	Monitoring Bore (abstraction)	7475835	457995.9
MWP12	Existing	Monitoring Bore (abstraction)	7474503	458022
MWP13	Existing	Monitoring Bore (abstraction)	446377	7477943

Table A-3: Locations of proposed bores associated with On-Lake DE (BMUs) for the Groundwater Monitoring Program (GDA94 Z52).

Name	BMU Stage	Easting	Northing
LMD001	Stage 1	478872	7503410
LV05	Stage 1	484247	7502448
LV06	Stage 1	484973	7493598
LV08	Stage 1	482461	7497519
LV09	Stage 1	477481	7497528
LV15	Stage 1	459948	7502471
MC30	Stage 1	484684	7505003
T02AH-010	Stage 1	461865	7499406
LV01	Stage 2	465013	7495164
MA08	Stage 2	490050	7515074
MC06	Stage 2	499845	7510004
MC46	Stage 2	445769	7506084
MC49	Stage 2	444860	7501803
MT08	Stage 2	490935	7507279
MT11	Stage 2	495992	7517998
T02AH-013	Stage 2	464572	7500113
LV21	Stage 3	462491	7507523
MA18	Stage 3	489998	7525007
MC26	Stage 3	485261	7521087
MC29	Stage 3	484971	7515062
MT02	Stage 3	460022	7512116
MA06	Stage 4	470022	7515008
MA21	Stage 4	474508	7509959
MA23	Stage 4	464982	7520024
MC17	Stage 4	499006	7529977
MC22	Stage 4	495295	7537123
MC31	Stage 4	475276	7514859
MA16	Stage 5	475005	7529997
MA24	Stage 5	460000	7524999
MC10	Stage 5	490123	7529868
MC23	Stage 5	484818	7535109
MC34	Stage 5	470370	7527745
MC38	Stage 5	449994	7519984

Name	BMU Stage	Easting	Northing
MC41	Stage 5	450016	7510007
MT18	Stage 5	461294	7520500
MT19	Stage 5	473122	7527460

Table A-4: Locations of proposed bores associated with On-Lake DE (landform islands) for the Groundwater Monitoring Program (GDA94 Z52).

Name	Type	Easting	Northing
MBISLGW01	To be drilled	495752.1567	7530013.149
MBISLGW02	To be drilled	495244.8692	7530002.179
MBISLGW03	To be drilled	494281.1617	7523607.439
MBISLGW04	To be drilled	494592.6321	7523609.189
MBISLGW05	To be drilled	490621.2955	7519520.366
MBISLGW06	To be drilled	490189.3531	7519544.464
MBISLGW07	To be drilled	485191.5697	7515732.425
MBISLGW08	To be drilled	485241.0689	7516121.053
MBISLGW09	To be drilled	484850.2314	7524140.816
MBISLGW10	To be drilled	484536.6309	7524145.777
LMISL05	To be drilled	485449.6332	7516970.673
LMISL06	To be drilled	483708.5364	7524689.682
LMISL01	Existing	494005	7530054
LMISL02	Existing	495393	7523588
LMISL03	Existing	489207	7519847
MC05	Existing	494087	7510174
MC13	Existing	494917	7530028
T13-H-011	Existing	495287	7530747

A.4.4 Field and Laboratory Methods

Groundwater levels will be measured daily via automated water level sensors installed at all bores, with data downloaded quarterly from the on-lake monitoring areas (landform islands and BMUs) and monthly from off-lake monitoring areas (SIDE-Borefield).

Groundwater quality will be collected quarterly from monitoring bores associated with the landform islands, BMUs and SIDE Borefield. The proposed suite of water quality parameters to be measured are outlined in **Table A-4**. Water samples collected for laboratory analyses, will be carried out according to the supplier instructions and using the bottles provided. The samples will be analysed for basic parameters and nutrients, anions and cations, and dissolved metals. All water samples will be stored and kept cool following collection and transported to a NATA-accredited laboratory for analysis, with the accompanying chain of custody documentation.

Table A-5: Groundwater quality parameters to be analysed from monitoring bores.

Basic and Nutrients	Anions and Cations	Dissolved Metals and Trace Elements	
pH	Sulphate (SO_4)	Aluminium (Al)	Iron (Fe)
Electrical Conductivity (EC)	Chloride (Cl)	Arsenic (As)	Lead (Pb)
Total Dissolved Solids (TDS)	Calcium (Ca)	Barium (B)	Manganese (Mn)
Nitrite + Nitrate (NO_x)	Magnesium (Mg)	Beryllium (Be)	Mercury (Hg)
Total Kjeldahl Nitrogen (TKN)	Sodium (Na)	Cadmium (Cd)	Nickel (Ni)
Total Nitrogen (TN)	Potassium (K)	Chromium (Cr)	Selenium (Se)
Total Phosphorus (TP)	Carbonate (CO_3)	Cobalt (Co)	Uranium (U)
	Bicarbonate (HCO_3)	Copper (Cu)	Vanadium (V)
			Zinc (Zn)

A.4.5 Personnel and Licensing Requirements

The Groundwater Monitoring Program will be undertaken by suitably qualified internal Agrimin staff. There are no biological licence requirements associated with the monitoring of groundwater levels or quality. However, additional monitoring requirements for groundwater levels and quality will be required as part of the licence issued under Section 5C of the *Rights in Water and Irrigation Act 1914* for both the SIDE borefield and brine abstraction on the lake.

A.4.6 Data and Statistical Analyses

The groundwater level and water quality data will be collated, to enable interrogation and detection of spatial and temporal trends, and for comparison against available environmental criteria outlined in the management provisions of the IWEMP. For groundwater levels, data will be compared to available predicted modelling results. For water quality, data will also be compared to available guidance such as ANZG (2018). Where required for assessment against trigger and threshold criteria, suitable statistical techniques will be employed for analyses, such as analysis of variance (ANOVA), to test for significant differences ($p<0.05$) in the data over time.

A.5 Reporting

A standalone technical report will be submitted to Agrimin at the conclusion of each monitoring period, presenting the key findings of the Groundwater Monitoring Program. The report will include assessment against relevant management provisions, including outcome- and objective-based criteria, and specifically trigger and threshold criteria presented in **Table 4-1** of the IWEMP. In the event that trigger or threshold criteria are exceeded, these will be reported in accordance with **Section 7.2** of the IWEMP and contingency actions implemented where required. The technical report will be summarised within or appended to the Annual Environmental Report (AER) to be submitted to the DWER, and EPA, respectively, aligning with **Section 7.1** of the IWEMP.

A.6 Adaptive Management and Review

Results obtained from this Groundwater Monitoring Program may inform adaptive management measures for the IWEMP. The review of data and information gathered during monitoring may inform management and mitigation measures such as:

- On-Lake Development:

  - Pre-construction Phase: Investigation into the construction and location of bores on-lake and larger islands (considering hydrogeology and hydraulic connectivity), to ensure data capture aligns with numerical model predictions; and
  - Operational Phase: Investigation into the potential to develop groundwater level and salinity triggers and thresholds from baseline monitoring data on island, for the low salinity groundwater on the larger islands (currently 2 points); initial, biannual review of interim trigger and threshold criteria based on revised groundwater modelling, using baseline monitoring data collected prior to construction, to support an adaptive management framework, and revise criteria if required (detailed in the IWEMP); and subsequent, 3-yearly revision or validation of the groundwater model using monitoring data collected during operation, to build model prediction confidence, noting abstraction in the vicinity of the landform islands will not occur until year 10 of operations.

- SIDE borefield:
  - Pre-construction Phase: Collation and analysis of baseline monitoring data (anticipated to be collected over a minimum of a two-year period) to revise the existing model and revise trigger and threshold criteria (if required).
  - Operational Phase: Initial, biannual review of trigger and threshold criteria based on revised groundwater modelling, using baseline monitoring data collected prior to construction, to support an adaptive management framework, and revise criteria if required (detailed in the IWEMP); and subsequent, 3-yearly revision or validation of the groundwater model using monitoring data collected during operation of the borefield will be undertaken to build model prediction confidence.
- Reviewing the BMU development and modifying the abstraction schedule.
- Review the abstraction schedules or modify pumping rates from the SIDE borefield or the brine trench network.
- Revise triggers and thresholds as required utilisng additional monitoring data collected over time.

A review of this Groundwater Monitoring Program will be undertaken after two years and then every five years, in response to adaptive management, as new technology becomes available, or as required by to achieve the environmental outcomes associated with the IWEMP. Any revisions of the Groundwater Monitoring Program will be submitted to the relevant State (DWER, DBCA) for approval, or in accordance with relevant regulatory conditions or requirements.

A.7 References

ANZG. (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. .

Stantec. (2022). Mackay Sulphate of Potash Project - Environmental Review Document. Unpublished report prepared for Agrimin Ltd.

Stantec. (2024a). Mackay Potash Project Detailed Hydrogeological Assessment (H3 Level): On-Lake Brine. Internal report prepared for Agrimin Ltd, Perth, Western Australia.

Stantec. (2024b). Mackay Potash Project Detailed Hydrogeological Assessment (H3 Level): SIDE Borefield. Internal report prepared for Agrimin Ltd, Perth, Western Australia.

Appendix B Aquatic Ecology Monitoring Program

B.1 Background

Lake Mackay is the fourth largest salt lake in Australia and the largest in WA, coving an area of approximately 3,500 km^2. It is a predominantly dry, highly episodic saline lake, that is subject to a boom phase during flooding, in line with all inland wetlands in the arid zone of WA. The eastern portion of the lake is characterised by more than 270 islands varying in size from less than 100 ha to >2,000 ha. The lake is a closed system with no outflow or historic evidence of spilling into adjacent lakes. Small localised ephemeral creeks and watercourses occur along the margins of the lake that and potentially contribute surface water runoff to the lake during periods of extreme rainfall. The lake is also surrounded by numerous smaller peripheral wetlands (claypans), irregularly spaced between the longitudinal dunes. These claypans are perched surface water features isolated from groundwater due to the low permeability of their substrate.

The ecological values of the lake are considered highest during the largest inundation events (equivalent to 1:20 or 1:50 year events), due to reduced salinities, with the south-eastern portion of the lake important in providing deeper, stable conditions for aquatic biota and waterbirds. During the smaller inundation events increased productivity is associated with areas of the lake that hold water for longest, corresponding to small areas associated with the north-western arm and central southern area of the lake adjacent to a small island. Lower salinities at the beginning of the hydroperiod provide a cue for aquatic biota to emerge, providing a food source for higher order consumers including waterbirds (boom phase). During these initial stages, water quality conditions are relatively homogenous, with salinities increasing as water levels recede, before drying completely (bust phase). During the inundated period, aquatic biota (algae and aquatic invertebrates) matures and reproduces, replenishing the egg bank, contributing to the recovery of the lake and peripheral wetlands during the next flood event.

Several lake-based studies during dry and inundated conditions have been undertaken to characterise the aquatic ecology of Lake Mackay and the peripheral wetlands, to inform the assessment of the Proposal (Invertebrate Solutions 2017b; 2018; Stantec 2021a). A total of 42 benthic and planktonic algal taxa, and 25 diatom taxa, comprising common, ubiquitous and cosmopolitan genera and species, have been recorded across the lake and the peripheral wetlands. In comparison, a total of 53 aquatic invertebrate taxa are known from Lake Mackay and the peripheral wetlands, with the latter recording a higher diversity.

The aquatic invertebrate community of the lake is dominated by halophilic branchiopods and copepods, including *Parartemia laticaudata* (brine shrimp) and *Meridiecyclops platypus* (cyclopoid copepod). The peripheral wetlands support a higher proportion of opportunistic (insect) taxa, *Branchinella* as the dominant anostracan and a higher diversity of diplostracans. Two new aquatic invertebrate taxa (the ostracods *Reticypris* `BOS1371` and *Billcypris* n.sp. `BOS1509`) are known exclusively from the lake and occur throughout the playa. In contrast, the peripheral wetlands are known to host eight new aquatic invertebrate species, including two spinicaudatan and six ostracod taxa. During periods of high productivity, aquatic invertebrate communities provide an important food source for higher order consumers, such as migratory waterbirds which inhabit Lake Mackay and the peripheral wetlands during large inundation events.

There have been six SRE surveys undertaken at Lake Mackay for the Proposal (Invertebrate Solutions 2017a; b; Stantec 2021b). Survey methods for SRE salt lake specialist invertebrate fauna focused predominately on the deployment of wet pitfall traps. Potential SRE salt lake specialist invertebrate species recorded during the surveys comprised three wolf spider taxa (*Hogna* 'FP-11090', *Tetralycosa* sp., *Venator* `sp. (VWF1177)`) and four Tiger Beetle taxa (*Australicapitona* 'LM1', *Pseudotetracha* 'blackburni complex', *Pseudotetracha* 'cf helmsi', *Rivacindela* 'LM1'). These species were recorded from the salt lake playa and/or lake margin habitats.

The Proposal has implemented measures to avoid impacts to the aquatic ecology of Lake Mackay, where possible and avoid residual direct impacts and minimise any indirect impacts, through the implementation of the Inland Waters Environmental Management Plan (IWEMP). The Aquatic Ecology Monitoring Program (AEMP) will measure the effectiveness of management measures and whether the objectives of the IWEMP are met.

B.2 Objective and Duration of Monitoring

The objective of the Aquatic Ecology Monitoring Program is to monitor and measure the success of management provisions (outcome- and objective-based) outlined in the IWEMP. To address this objective the following will be undertaken:

- Monitor changes in the abiotic environment (surface water quality, sediment quality and surface salt crust) of Lake Mackay during dry and suitably inundated conditions over time, in relation to environmental factors or potential impacts from the Proposal;
- Monitor changes in the biotic environment (algae and aquatic invertebrates) of Lake Mackay during dry and suitably inundated conditions over time, in relation to environmental factors or potential impacts from the Proposal;
- Investigate the extent and occurrence of surface water on Lake Mackay and the timing and duration of inundation events over time, in relation to environmental factors or potential impacts from the Proposal;
- Assess the direct and indirect effects of climate change on the aquatic environment of Lake Mackay, where possible;
- Evaluate the results of monitoring against trigger and threshold criteria, and management measures outlined in the IWEMP, to demonstrate the aquatic environment of Lake Mackay is not adversely impacted during the life of the Proposal; and
- Provide opportunities for the engagement of TO Ranger groups, allowing opportunities for knowledge sharing and connection to country.

The Aquatic Ecology Monitoring Program is required for the life of the Proposal (approximately 20 years), with relevant sampling intervals proposed, supported by an underlying adaptive management approach.

B.3 Traditional Owner Engagement

The Aquatic Ecology Monitoring Program presents an opportunity to engage with and work alongside TO Ranger groups from the Ngururrpa and Kiwirrkurra IPAs. During the baseline surveys for the Proposal, TO Rangers provided integral local knowledge of the area. Opportunities to involve TO Rangers in in monitoring may include:

- consultation on survey design and discussion regarding site selection within impact and reference areas; and
- accompanying appropriate qualified scientists on aquatic ecology monitoring surveys.

B.4 Monitoring

B.4.1 Overview and Timing

A summary of the proposed monitoring is presented in **Table B-1**, which also shows the relevant trigger and threshold criteria (outcome-based) management provisions. Survey design (**Section B.4.3**) follows a before-after-control-impact (BACI) design. The BACI design is considered optimal to isolate potential effects of the Proposal on the aquatic ecology of Lake Mackay, from effects which may be attributed to natural variability. Prior to land disturbance activities being undertaken for the Proposal, adequate baseline monitoring data on aquatic ecology (prior to potential impacts), will be collected for a two-year period.

The Aquatic Ecology Monitoring Program will be undertaken by specialist consultants and supported by TO Ranger groups, as agreed. Dry sampling of the lake and claypans will be undertaken annually during the dry season (April to October) and will also include rewetting trials to provide additional data and information on the biological communities of Lake Mackay during intermittent periods. Opportunistic sampling during flooded conditions will also be undertaken following suitable inundation events.

Following a review of satellite imagery, inundation extent and duration of inundation extents as per the water balance modelling memorandum {Stantec, 2021 #9227}, suitable inundation events are likely to occur on average every three to five years. This equates to flooding of more than 50% of the surface area of the lake, which has occurred 26 times since 2000, and typically for an average of at least two weeks. However, major flood events, which result in complete inundation of the lake area for several months, such as those that occurred in 2000 and 2001 are rare, with the lake tending to dry rapidly unless subsequent top-up rainfall occurs. Flexibility is required on the timing of opportunistic flood sampling and is dependent on the duration of the inundation event, to allow aquatic biota to emerge and mature for sampling and identification of mature aquatic invertebrate specimens (typically a two-to-three-week period).

It should also be noted that for indicators with outcome-based provisions, additional monitoring may be required where trigger and/or threshold criteria are exceeded, and response actions require additional survey work as part of investigations. In this instance, targeted monitoring will need to be developed for this purpose.

The monitoring design and methods used align with industry best practice and relevant legislation and regulatory guidelines, including:

- Environmental Factor Guideline – Inland Waters (EPA 2018);
- Goldfields Environmental Management Workshop: DWER's Approach to Assessment of Mine Dewatering Discharge to Salt Lakes and Claypan Environments (DWER 2018); and
- Assessing and Managing Water Quality in Temporary Waters (Smith *et al.* 2020).

In addition to aquatic ecology, this monitoring program provisions for the assessment of SRE salt lake specialist invertebrate fauna to align with Management Objective (MO5) in the TFEMP which includes "no project-related adverse impacts to SRE salt lake specialist invertebrate fauna as a result of changes in hydrology". In developing this monitoring program for salt lake specialists, the following items were taken into consideration:

- Salt lake specialists recorded during the baseline surveys were predominately recorded via the use of wet pitfall traps.
- The use of wet pitfall traps is no longer endorsed as a survey method by the Wildlife Animal Ethics Committee (WAEC) from September 2023.
- The use of wet pitfall traps as part of a monitoring program would progressively remove individuals from a population that is being monitored and influence the results of the monitoring program.

As a result, wet pitfall trapping is unlikely to be a viable option for a monitoring program and alternative methods of monitoring SRE salt lake specialist invertebrates were developed based on the following:

- Tiger beetles: short lifespan of weeks to months with abundance that is likely to fluctuate with in response to inundation cycles and associated food resources. Abundance is unlikely to be consistent across baseline conditions
- Wolf spiders: longer lifespan of 2-3 years (DCCEEW 2019) and are therefore likely to have a more stable population. Abundance is likely to be relatively consistent across baseline conditions.

Based on the biology of the two groups, Tiger Beetles were not considered a viable species for a monitoring program, however the biology of the Wolf Spider provided the opportunity for this group to be indicators of ecosystem health (for all SRE salt lake invertebrate species) and provide the opportunity to detect potential impacts of the Proposal over time.

Table B-1: Aquatic Ecology Monitoring Program summary.

Personnel	Timing	System	Number of Monitoring Sites	Monitoring Parameters	Outcome-based Management Provisions	Trigger Criteria*	Threshold Criteria*
Qualified Consultants	Dry Lake Conditions						
	• Annually during the dry season (April to October)	• Lake Mackay	• Up to 24 impact sites • Up to 7 reference sites	• Water quality (where sufficient surface water is available) • Sediment quality • Salt crust thickness	• No significant increase in contaminants within surface waters of Lake Mackay during a major inundation event, relative to baseline conditions.	• Water quality monitoring of Lake Mackay during a major inundation event demonstrates statistically significant exceedances of potential contaminants (such as salinity, suspended solids, and metals) compared to baseline (and suitable reference sites) and applicable guideline values, attributed to the Project.	• Water quality monitoring of Lake Mackay during two consecutive major inundation events demonstrates statistically significant exceedances of potential contaminants (such as salinity, suspended solids, and metals) compared to baseline (and suitable reference sites) and applicable guideline values, attributed to the Project.
	• Annually during the dry season (April to October)	• Lake Mackay	• Up to 24 impact sites • Up to 7 reference sites	• Diatoms • Resting stages • Rewetting trials • Benthic algae • Diatoms • Aquatic invertebrates	• No significant decline in aquatic invertebrate communities of Lake Mackay due to project-related activities.	• A statistically significant change in aquatic invertebrate community composition during a monitoring survey of a major inundation event, compared to baseline (and suitable reference sites), attributed to the Project. • A loss of one or more aquatic invertebrate species of scientific interest during a monitoring survey of a major inundation event, compared to baseline (and suitable reference sites), attributed to the Project.	• A statistically significant change in aquatic invertebrate community composition during monitoring surveys of two consecutive major inundation events, compared to baseline, attributed to the Project. • Persistent loss of one or more aquatic invertebrate species of scientific interest during monitoring surveys of two major inundation events, compared to baseline, attributed to the Project.
	Inundated Conditions						
	• Opportunistic, during suitable inundation events (likely every 3 to 5 years)	• Lake Mackay • Peripheral Wetlands	• Up to 24 impact sites • Up to 7 reference sites • Up to 7 peripheral wetland sites	• Surface water quality • Sediment quality • Salt crust thickness	• No significant increase in contaminants within surface waters of Lake Mackay during a major inundation event, relative to baseline conditions.	• Water quality monitoring of Lake Mackay during a major inundation event demonstrates statistically significant exceedances of potential contaminants (such as salinity, suspended solids, and metals) compared to baseline (and suitable reference sites) and applicable guideline values, attributed to the Project.	• Water quality monitoring of Lake Mackay during two consecutive major inundation events demonstrates statistically significant exceedances of potential contaminants (such as salinity, suspended solids, and metals) compared to baseline (and suitable reference sites) and applicable guideline values, attributed to the Project.
	• Opportunistic, during suitable inundation events (likely every 3 to 5 years)	• Lake Mackay • Peripheral Wetlands	• Up to 24 impact sites • Up to 7 reference sites • Up to 7 peripheral wetland sites	• Benthic and planktonic algae • Diatoms • Aquatic macrophytes • Aquatic invertebrates (micro- and macroinvertebrates) • Resting stages	• No significant decline in aquatic invertebrate communities of Lake Mackay due to project-related activities.	• A statistically significant change in aquatic invertebrate community composition during a monitoring survey of a major inundation event, compared to baseline (and suitable reference sites), attributed to the Project. • A loss of one or more aquatic invertebrate species of scientific interest during a monitoring survey of a major inundation event, compared to baseline (and suitable reference sites), attributed to the Project.	• A statistically significant change in aquatic invertebrate community composition during monitoring surveys of two consecutive major inundation events, compared to baseline, attributed to the Project. • Persistent loss of one or more aquatic invertebrate species of scientific interest during monitoring surveys of two major inundation events, compared to baseline, attributed to the Project.
	Remote Sensing						
	• Annually	• Lake Mackay	• N/A	• Extent and occurrence of surface water • Timing and duration of inundation events	• No significant decrease in the surface water extent and duration, in the deepest parts of the Lake Mackay basin as a result of project-related activities.	• Analysis and mapping of satellite imagery during a major inundation event demonstrates a statistically significant decrease in the extent and duration of surface water in the deepest parts of Lake Mackay, compared to historic trends, attributed to the Project.	• Analysis and mapping of satellite imagery during consecutive major inundation events demonstrates a statistically significant decrease in the extent and duration of surface water in the deepest parts of Lake Mackay, compared to historic trends, attributed to the Project.

* Threshold and contingency actions are presented in the IWEMP.

Table B-2: SRE salt lake invertebrate Monitoring Program summary.

Personnel	Timing	System	Number of Monitoring Sites	Monitoring Parameters	Objective-based Management Provisions	Trigger Criteria	Threshold Criteria	Trigger Exceedance Corrective Actions	Threshold Exceedance Corrective Actions
Qualified Consultants	Dry Lake Conditions								
	• Annually during the dry season (April to October)	• Lake Mackay	• Four impact sites and two reference sites with the locations aligning with those of the aquatic monitoring survey.	• Monitoring set transects established at each monitoring site during each annual survey. Through counting the number of burrows present during each monitoring event it will be possible to determine if there are changes in abundance over time.	• Management Objective (MO5) in the TFEMP which includes "no project-related adverse impacts to SRE salt lake specialist invertebrate fauna as a result of changes in hydrology".	• A statistically significant decline in abundance of wolf spider burrows recorded during a single monitoring event, compared to baseline (and suitable reference sites), attributed to the Project.	• A statistically significant decline in abundance of wolf spider burrows recorded over 2 consecutive monitoring events, compared to baseline (and suitable reference sites), attributed to the Project.	• Report internally as an incident in accordance with internal procedures. • Investigate the cause of decline in abundance of wolf spider burrows e.g. groundwater drawdown, sedimentation, salt accumulation or environmental variables. • If decline in abundance of wolf spider burrows is attributed to project-related activities, undertake a review of management actions and procedures to determine if impact can be minimised. Implement corrective actions with consideration of the following: • Determine whether the observed at the impact sites are comparable to the observations at the reference sites. • Cross-reference SRE salt lake invertebrate monitoring results with the most recent environmental monitoring data (i.e. surface water, groundwater monitoring meteorological, etc.) to determine potential causes. • Assess groundwater levels in the IWEMP against triggers and thresholds to ensure drawdown is not extending beyond predictions. • Ground truth the results of the disturbance (eg. uncontrolled discharge) to determine extent, potential causes and if	• Report incidence of significant decline in vegetation health to DWER and DBCA in 7 days. • Compare the outcomes of SRE salt lake invertebrate monitoring program against predicted hydrological modelling of surface and groundwater. Investigate cause of potential impacts and review trench network design and configuration, and if required, modify abstraction schedule. • Assess groundwater levels in the IWEMP against triggers and thresholds to ensure drawdown is not extending beyond predicted and is not affecting areas of the lake differently. • Ground truth the results of the disturbance (eg. uncontrolled discharge) and potential impacts to SRE salt lake invertebrate fauna habitat to determine potential causes and if additional actions are required to prevent reoccurrence and whether remediation is required. • Where the threshold exceedance was caused by operation or decommissioning activities: – Review management measures in the IWEMP and implement an adaptive management response. – Review SRE salt lake invertebrate monitoring program parameters to determine if management actions

								additional actions are required to prevent reoccurrence. Implement appropriate remediation measures, as required. • Review SRE salt lake invertebrate monitoring program and increase the number of monitoring sites (impact and reference) if required.	are effective and where necessary, implement changes to the monitoring program. – Implement adaptive management actions for applicable cause of the decline. Depending on the findings of investigation into potential causes, corrective actions may include: – Changes in inundation regime: verify hydrological modelling of surface water flows, including simulation 1:100-year events and investigate potential impacts that vary from predicted and if required, review and modify trench network design and configuration appropriately. • Groundwater abstraction and/or Sedimentation: verify predicted hydrological modelling of groundwater and whether different areas of the lake are affected differently by groundwater drawdown. Review trench network design and configuration, and if required, refine/modify abstraction from the affected areas of the lake. • Once corrective actions have been completed, review the frequency of monitoring events for SRE salt lake invertebrate monitoring program to verify that actions are effective.

B.4.2 Logistical Considerations

Several logistical factors were taken into consideration for the design and safe implementation of the Aquatic Ecology Monitoring Program:

- The Proposal is located in a remote area of Western Australia and mobilisation to site from Perth currently takes a minimum of 1.5 days.
- Lake Mackay is a large salt lake, covering 3,500 km^2 and therefore a helicopter will be required to access the substantial distance between the geographically spread survey sites.
- Potential access limitations to the periphery of the lake during inundated conditions.
- Transportation and storage of preservative (100% ethanol) on site during field surveys for the preservation of aquatic invertebrate samples.

B.4.3 Monitoring Sites

B.4.3.1 Aquatic Ecology

Proposed monitoring sites are provided in **Figure B-2** and **Table B-3** for monitoring surveys conducted during dry lake and inundated conditions, and where possible, will include established baseline sites to align with riparian vegetation monitoring detailed in the FVEMP. Additional sites to the baseline are also proposed to assess potential impacts associated with the evaporation ponds, salt piles and trench network on the lake, with sites also located in proximity to the islands, and new regional reference sites and peripheral wetlands included for comparison (**Figure B-2**). This approach will assist with detecting potential changes in aquatic ecology on the lake, which may be associated with the Proposal.

The number and location of the sites will correspond to the development and area of impact, and will also depend on conditions and access, and therefore may need to be refined over time. Dry lake monitoring surveys will include monitoring sites on Lake Mackay, whereas inundation monitoring surveys will include monitoring sites on Lake Mackay and peripheral wetlands. Monitoring surveys should include impact and reference sites.

B.4.3.2 SRE salt lake invertebrate monitoring

The SRE salt lake invertebrate monitoring component of this program will involve surveying up to four impact sites and two reference sites with the locations aligning with those of the aquatic monitoring survey. These sites will be selected based on in field investigations of which sites support suitable numbers of Wolf Spiders for monitoring.

B.4.4 Field and Laboratory Methods

A summary of the ecological components and methods to be employed during annual monitoring during dry lake conditions and opportunistic monitoring during inundated conditions is provided in **Table B-4**, respectively. During monitoring surveys, the sampling of water and sediment quality will be consistent with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).

B.4.4.1 Dry Lake Conditions

B.4.4.2 Aquatic Ecology

At each site sampling will comprise habitat characterisation and salt crust measurement, with sediment also collected for chemical analysis and the assessment of diatoms and resting stages (**Table B-4**). Additional sediment samples will also be collected at each site, comprising two replicates, for use in laboratory-based rewetting trials. In the laboratory, sediment should be dried and placed in to 20 L containers and inundated with water to simulate inundated conditions. The containers should be artificially aerated, and nutrients added to promote biological productivity. The rewetting trials should run for approximately 10 to 12 weeks to allow time for the maturity of aquatic macrophyte and invertebrate taxa, with biota collected from the tanks at several stages.

B.4.4.3 SRE salt lake invertebrate monitoring

The SRE salt lake invertebrate monitoring methods for Wolf Spiders will involve the detection of active burrows within the salt lake surface. Burrows can be readily detected and their activity can be determined by silk around the burrow entrance (**Figure B-2**). The survey approach will involve the walking of set transects established at each monitoring site during each annual survey. Through counting the number of burrows during each monitoring event it will be possible to determine if there are changes in abundance over time.

Transects will be orientated from the riparian zone and extend onto the lake playa. Refinements to the survey design may be required based on the findings of the baseline surveys. The length and width of the monitoring transect will be refined based on the number of burrows detected during the baseline survey, but indicatively may be up to 100 m in length and up to 10 m in width. The length and width of the transect may be refined depending on the prevalence of burrows in relation to the distance from the lake edge.

Figure B-1: Salt Lake Wolf Spider (left) and Wolf Spider at active burrow with silk.

B.4.4.4 Inundated Conditions

Opportunistic monitoring during inundated conditions will comprise habitat characterisation, salt crust measurement, with sediment also collected for chemical analysis and the assessment of diatoms and resting stages (**Table B-4**). Water samples will also be collected for chemical analysis and the assessment of phytoplankton and aquatic invertebrates (including micro- and macroinvertebrates). Benthic algal mats and aquatic macrophytes should also be collected from each site, where present.

SRE salt lake invertebrate monitoring for Wolf Spiders not be possible during inundation events as the burrows will be underwater.

Table B-3: Locations of proposed sampling sites for the Aquatic Ecology Monitoring Program (GDA94 51J).

System	Site	Classification	Northing	Easting
Lake Mackay	LMD1*	Impact	7499760	435518
Lake Mackay	LMD2*	Impact	7509897	456898
Lake Mackay	LMD3*	Impact	7492001	472583
Lake Mackay	LMD4*	Impact	7505098	481093
Lake Mackay	LMD5*	Impact	7508765	469633
Lake Mackay	LMD6*	Impact	7517959	493518
Lake Mackay	LMD7*	Impact	7510629	432623
Lake Mackay	LMD11*	Impact	7538276	476169
Lake Mackay	LMD12*	Impact	7522116	476729
Lake Mackay	LMD13*	Impact	7522014	459304
Lake Mackay	LMD17*	Impact	7497785	452472
Lake Mackay	LMD19*	Impact	7508806	494714
Lake Mackay	LMD20*	Impact	7498074	476909
Lake Mackay	LMF1*	Impact	7494567	485496
Lake Mackay	LMF3*	Impact	7490709	490260
Lake Mackay	LMF5*	Impact	7499972	493894
Lake Mackay	LMF7*	Impact	7528806	483561
Lake Mackay	LMF9*	Impact	7513888	470592
Lake Mackay	LMF12*	Impact	7515842	485356
Lake Mackay	I1	Impact	7511716	436101
Lake Mackay	I2	Impact	7505346	439147
Lake Mackay	I3	Impact	7509637	447233
Lake Mackay	I4	Impact	7521181	448076
Lake Mackay	I5	Impact	7502250	469799
Lake Mackay	LMD14*	Control	7520335	434505
Lake Mackay	R1	Control	7503150	429506
Lake Mackay	R2	Control	7546543	484265
Lake Mackay	R3	Control	7543546	493569
Lake Mackay	R4	Control	7555181	493137
Lake Mackay	R5	Control	7561560	496854
Lake Mackay	R6	Control	7546042	499235
Peripheral Wetland	PWD1*	Control	7506592	417350
Peripheral Wetland	PWD2*	Control	7494202	453573
Peripheral Wetland	PWD3*	Control	7494592	492932
Peripheral Wetland	PWD4*	Control	7486138	483437
Peripheral Wetland	PWD6*	Control	7536719	465941
Peripheral Wetland	PWD7*	Control	7530499	437727
Peripheral Wetland	PWF9*	Control	7490756	464401

** indicates site established during the baseline aquatic ecology study (Stantec 2021a).*

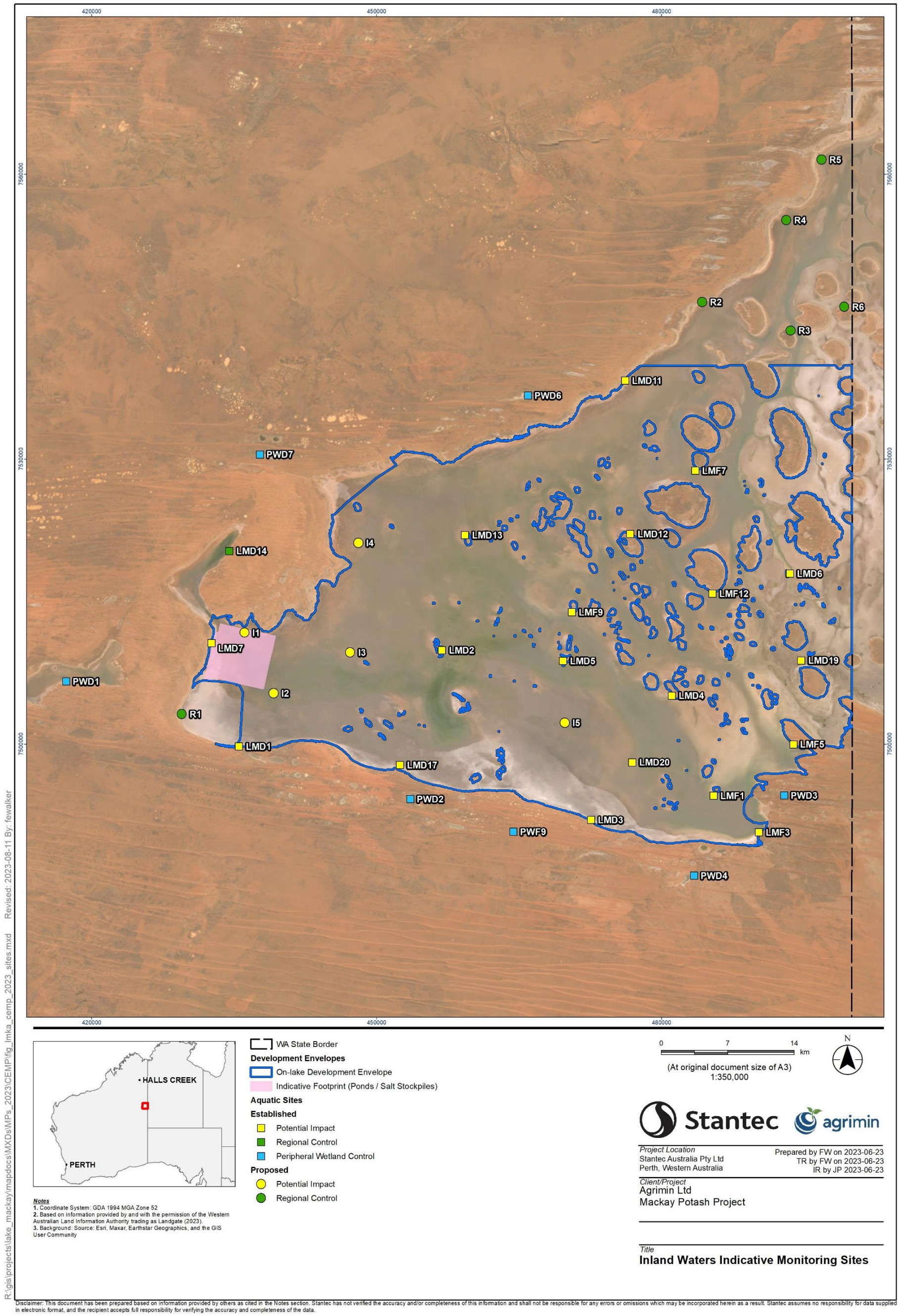


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Figure B-2: Proposed location of sampling sites on Lake Mackay and peripheral wetlands for the aquatic ecology monitoring program.

Table B-4: Summary of proposed components and sampling methods for the aquatic ecology monitoring program, during dry and inundated conditions.

Component		Sampling Methods	Dry Conditions	Inundated Conditions
Field Survey	Habitat Characterisation	• Qualitative observations of habitat types and substrate composition should be recorded in conjunction with abiotic and biotic sampling, using standardised worksheets, supported by photo-monitoring.	✓	✓
	Water Quality	• During inundated conditions, and where sufficient surface water is present in dry conditions, water quality should be measured in-situ using a portable, hand-held water quality field meter, including electrical conductivity (µs/cm), dissolved oxygen (% and mg/L), temperature (°C) and pH. The water quality field meter will be calibrated according to appropriate standards prior to the field survey. • Water samples should also be collected for laboratory analyses, using pre-washed (0.1% nitric acid) bottles. These will be analysed for pH, electrical conductivity, total suspended solids, total dissolved solids, major ions, nutrients and dissolved metals (**Table B-5**), with parameters aligning with previous baseline surveys to provide robust comparisons over time. • Water samples should be stored on ice following collection. • Water samples should accompany the field survey team on their return to Perth for subsequent transport to a NATA accredited laboratory, with accompanying chain of custody documentation.		✓
	Sediment Quality	• Sediment samples should be collected at all sites during dry and inundated conditions, from the lake playa using nitrile gloves to reduce incidental contamination. These will be analysed for pH, electrical conductivity, total soluble salts, major ions, nutrients and dissolved metals (• **Table B-6**), with parameters aligning with previous baseline surveys to provide robust comparisons over time. • Sediment samples should be stored in an esky with ice following collection. • Sediment samples should accompany the field survey team on their return to Perth for subsequent transport to a NATA accredited laboratory, with accompanying chain of custody documentation.	✓	✓
	Salt Crust	• The presence of a salt crust (speckled or intact) should be recorded at each site, including a measurement of thickness, supported by photo-monitoring.	✓	✓
	Benthic & Planktonic Algae	• During inundated conditions planktonic algae should be collected at all sites by towing a 25 µm mesh net through the water column, and where observed, benthic algal mats will be opportunistically collected, where present. Samples should be placed in 70 mL vials and kept cool for preservation of form and structure. • In the laboratory, sub-samples of algal samples, representative of each site, should be fresh mounted on glass microscopy slides and examined under a compound microscope at 40 x magnification. • The abundance of algal taxa will be recorded per cell, colony or filament, dependent on morphological form, with identification to genus level, where possible.		✓
	Diatoms	• During dry and inundated conditions diatoms should be sampled at each site by collecting surface sediment (approximately 1 cm deep) using a 70 mL vial, to assess diatom community structure. • Sediment samples should be kept cool to preserve diatom structure. • In the laboratory, samples should be treated in 70% nitric acid to remove organic material and permanent slides prepared according to John (1983). • A maximum of 100 diatoms should be counted at each site to provide a representation of community structure, and the abundance and diversity of taxa recorded.	✓	✓
	Aquatic Macrophytes	• Aquatic macrophytes should be recorded and collected at all sites, where present, during inundated conditions. • Specimens should be examined under a dissecting microscope in the laboratory and identified to genus level using morphological and reproductive features.		✓
	Aquatic Invertebrates	• During inundated conditions aquatic invertebrates (microinvertebrates and macroinvertebrates) should be sampled. • Microinvertebrates should be sampled using a 53 µm plankton net swept over a standardised (30 m) longitudinal reach. • Macroinvertebrates should be sampled during inundated conditions, using a 250 µm D-frame dip net using a kick/sweep motion over a standardised (30 m) longitudinal reach, targeting the open water column, benthic substrate, debris, logs/branches and aquatic macrophytes. • Each sample should be concentrated and preserved in 70% ethanol. • The samples should be sorted, identified and enumerated to lowest possible level (typically genus or species, depending on level of maturity and sex), under a dissecting microscope in the laboratory. Submission of some submission of some microcrustacean groups to specialist sub-consultants for species-level identification should be undertaken, as required.		✓
	Resting Stages	• The dormant propagules of algae and aquatic invertebrates should be collected during dry and inundated conditions by scraping the surface sediment across a square quadrat measuring 30 x 30 cm and 1 to 2 cm deep, with the resultant sediment sample placed into calico bags. • Sediment samples should be oven dried and passed through 500 µm and 106 µm brass sieves, with the retained material examined using a dissecting microscope. The resting stages of algae, macrophytes and aquatic invertebrates should be identified to genus level, where possible. • During dry conditions an additional sediment sample should be at each site, to be artificially flooded in tanks for the purpose of rewetting trials conducted in the laboratory.	✓	✓
	Wolf Spiders	• During dry conditions, set transects will be walked at four impact sites and at two reference sites. The transects will run from the riparian zone onto the playa. The number and location of Wolf Spider burrows were be recorded along each transect. Monitoring will not be possible during inundation events as the burrows will be under water.	✓	
Rewetting Trials	Benthic Algae	• Where present benthic algal mats should be sampled from rewetting trial containers. • Sub-samples should be fresh mounted on glass microscopy slides and examined under a compound microscope at 40 x magnification. • The abundance of algal taxa (using a broad ranking system) will be recorded per cell, colony or filament, dependent on morphological form, with identification to genus level, where possible.	✓	
	Diatoms	• Sediment samples should be collected from the rewetting trial containers for the processing of diatoms.	✓	

		• Samples should be treated in 70% nitric acid to remove organic material and permanent slides prepared according to John (1983). • A maximum of 100 diatoms should be counted at each site to provide a representation of community structure, and the abundance and diversity of taxa recorded.		
	Aquatic Macrophytes	• Where present, aquatic macrophytes should collected from rewetting trail containers. • Specimens should be examined under a dissecting microscope and identified to genus level using morphological and reproductive features.	✓	
	Aquatic Invertebrates	• Aquatic invertebrates (micro and macroinvertebrates) should be sampled from rewetting trail containers using a 50 m mesh net to collect micro- and macroinvertebrates, with the resultant sample preserved in 100% undenatured ethanol. • The samples should be sorted, identified and enumerated to lowest possible level (typically genus or species, depending on level of maturity and sex), under a dissecting microscope in the laboratory. Submission of some submission of some microcrustacean groups to specialist sub-consultants for species-level identification should be undertaken, as required.	✓	
Remote Sensing		• Analysis of extent and occurrence of surface water utilsing the Water Observations from Space (WOfS) database of Geoscience Australia. • Investigation of the timing and duration of inundation events using satellite imagery from the Landsat and Sentinel satellites, analysed using the Open Data Cube (ODC) and imagery products from Digital Earth Australia (DEA).		

Table B-5: Surface water analytical suite for the aquatic ecology monitoring program.

Basic Parameters	Anions and Cations	Dissolved Metals and Trace Elements	
pH	Chloride (Cl)	Aluminium (Al)	Iron (Fe)
Electrical Conductivity (EC)	Sulphate (SO_4)	Arsenic (As)	Lead (Pb)
Total Dissolved Solids (TDS)	Carbonate (CO_3)	Barium (Ba)	Manganese (Mn)
Total Suspended Solids (TSS)	Bicarbonate (HCO_3)	Beryllium (Be)	Mercury (Hg)
Total Nitrogen (TN)	Sodium (Na)	Cadmium (Cd)	Nickel (Ni)
Total Kjeldhal Nitrogen (TKN)	Magnesium (Mg)	Chromium (Cr)	Selenium (Se)
Nitrite + Nitrate (NO_2 + NO_3)	Calcium (Ca)	Cobalt (Co)	Uranium (U)
Total Phosphorous (TP)	Potassium (K)	Copper (Cu)	Vanadium (V)
			Zinc (Zn)

Table B-6: Sediment analytical suite for the aquatic ecology monitoring program.

Basic Parameters	Anions and Cations	Metals and Trace Elements	
pH	Chloride (Cl)	Aluminium (Al)	Iron (Fe)
Moisture Content (MC)	Sulphate (SO_4)	Arsenic (As)	Lead (Pb)
Total Soluble Salts (TSS)	Carbonate (CO_3)	Barium (Ba)	Manganese (Mn)
Total Nitrogen (TN)	Bicarbonate (HCO_3)	Beryllium (Be)	Mercury (Hg)
Total Kjeldhal Nitrogen (TKN)	Sodium (Na)	Cadmium (Cd)	Nickel (Ni)
Nitrite + Nitrate (NO_2 + NO_3)	Magnesium (Mg)	Chromium (Co)	Selenium (Se)
Total Phosphorus (TP)	Calcium (Ca)	Cobalt (Co)	Uranium (U)
Total Organic Carbon (TOC)	Potassium (K)	Copper (Cu)	Vanadium (V)
			Zinc (Zn)

B.4.5 Personnel and Licencing Requirements

The Aquatic Ecology Monitoring Program will be undertaken by suitably qualified specialist consultants trained in the methods described in **Section B.4.4**. Current licence requirements comprise a DBCA Fauna taking (scientific or other purposes) licence to take or disturb native fauna, which will be obtained prior to commencement of monitoring.

B.4.6 Data and Statistical Analyses

B.4.6.1 Field Surveys

All available and relevant abiotic and biotic data will be collated from the field survey, rewetting trials and laboratory analysis and summarised into tables and figures. Water and sediment quality data will be compared against ANZG (2018) default guideline values (DGVs). Species lists will be compiled to provide an accurate record of biota identified from Lake Mackay and peripheral wetlands. Any taxa of potential conservation significance recorded and identified during rewetting trials or during inundated conditions will also be highlighted and mapped.

Abiotic and biotic data will be statistically analysed (univariate and/or multivariate procedures) to investigate trends in relation to spatial and temporal changes that may be related to Proposal activities, in comparison to baseline conditions. Overtime site specific guideline values for water and sediment quality may be developed utilising baseline and reference site data, in accordance with methods described in ANZG (2018). In addition, baseline data may also be utilised to form the basis of salinity tolerance limits that can be developed for aquatic invertebrate species.

B.4.6.2 Remote Sensing

The Water Observations from Space (WOfS) database of Geoscience Australia could be utilised to visually analyse the extent and occurrence of surface water at Lake Mackay. The timing and duration of inundation events of the lake will be investigated, using archived satellite imagery data such as the Landsat and Sentinel satellites, this could be done using the Open Data Cube (ODC) and imagery products made available by Digital Earth Australia (DEA).

B.5 Reporting

A standalone technical report will be submitted to Agrimin at the conclusion of each monitoring period, presenting the results and key findings of the Aquatic Ecology Monitoring Program. Associated data will be submitted concurrently, as per the Agrimin Data Standards. The technical report will include assessment against relevant management provisions, including outcome- and objective-based criteria, and specifically trigger and threshold criteria presented in Table 4-1 of the IWEMP, as required. In the event that trigger or threshold criteria are exceeded, these will be reported in accordance with Section 6.2 of the IWEMP and contingency actions will be provided for consideration. The technical report will be summarised within or appended to the Annual Environmental Report (AER) and the Annual Compliance Assessment Report (ACAR), to be submitted to the DWER, DCCEEW, and EPA, respectively, aligning with Section 6.1 of the IWEMP.

B.5.1 Reporting Considerations

There are several considerations associated with this Aquatic Ecology Monitoring Program, which will be considered when interrogating the data recorded and for interpretation and reporting:

- Comparison to baseline data and to different stages of the hydroperiod, with observed differences related to hydrogeochemical and environmental conditions over time.
- Comparison of impact and reference sites, considering the above, and the staging of abstraction of brine across BMUs on the lake.
- Laboratory-based rewetting trials simulate flooding and document the emergence of aquatic biota, however, these trials cannot completely replicate natural inundated conditions. Consideration will be given to the limitations of rewetting trials (lower aquatic biota diversity and abundance, including a lack of opportunistic colonisers such as insects) when reporting and analysing data associated with this AEMP.
- Differences in the composition of aquatic biota will vary substantially over the course of the hydroperiod and flood events, which may mean it is difficult to discern environmental differences from changes that may be related to the Proposal.
- Management of large complex data sets over time and appropriate data analyses and comparisons to adequately address the objectives of the IWMP.
- Addressing management provisions and objectives using the data collected from a range of sampling components and across a large, highly variable lake system, providing comparison within the survey and over time.

B.6 Adaptive Management and Review

Results obtained from this Aquatic Ecology Monitoring Program may inform adaptive management measures for the IWEMP. The review of data and information gathered during monitoring may increase understanding of the aquatic environment of Lake Mackay in a regional context. This may inform management and mitigation measures such as:

- Reviewing the BMU development and modifying the abstraction schedule.
- Reviewing abstraction schedule or reducing pumping from bores in the SIDE borefield.
- Reviewing and modifying the staged development of evaporation ponds and salt piles.
- Revise hydrological modelling of surface water flows.
- Revising triggers and thresholds to make them more appropriate overtime.

A review of this Aquatic Ecology Monitoring Program will be undertaken every five years, in response to adaptive management, as new technology becomes available, or as required to achieve the environmental outcomes associated with the IWEMP. Any revisions of the Aquatic Ecology Monitoring Program will be submitted to the relevant State (DWER, DBCA) and Commonwealth Government (DCCEEW) for approval, or in accordance with relevant regulatory conditions or requirements.

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Appendix C Stygofauna Monitoring Program

C.1 Background

Lake Mackay is the fourth largest salt lake in Australia and the largest in WA, coving an area of approximately 3,500 km^2. The eastern portion of the lake is characterised by more than 270 islands varying in size from less than 100 ha to >2,000 ha. Several studies on the subterranean fauna (stygofauna and troglofauna) have been undertaken of the landform islands on the lake (Stantec 2021b). These studies have identified three stygofauna species, comprising the harpacticoid copepod *Schizopera* 'bradleyi' and cyclopoid copepods *Fierscyclops fiersi* and *Halicyclops kieferi*, and an Enchytraeidae sp. While Enchytraeids (oligochaetes) are found in a wide range of habitats ranging from freshwater to marine, *Schizopera* 'bradleyi' is a new and undescribed taxon, and to date has only been found from two of the largest landform islands. A single individual of the potential endemic troglofauna Projapygidae-OES3 was also recorded from the unsaturated zone of one of these landform islands, although there is limited information on this species (Stantec 2021a).

The copepod stygofauna were generally recorded from the largest landform islands, comprising surficial sands, associated with some finer calcareous or gypsiferous material, and low salinity groundwater overlying the brine in elevated areas (Agrimin 2024). Although impacts to stygofauna are not expected to result from the Proposal, the Stygofauna Monitoring Program will be implemented to ensure low salinity or freshwater habitats associated with the landform islands will not be impacted.

C.2 Objective and Duration of Monitoring

The objective of the Stygofauna Monitoring Program is to ensure the stygofauna communities associated with the landform islands of Lake Mackay are maintained and to monitor and measure the success of management provisions outlined in the IWEMP. To address the objective the following will be undertaken:

- Monitor changes in groundwater levels and quality and stygofauna communities associated with the landform islands of Lake Mackay, in relation to environmental factors or potential impacts from the Proposal;
- Evaluate the results of monitoring against management measures outlined in the IWEMP, to demonstrate stygofauna habitat and stygal copepod communities are not adversely impacted during the life of the Proposal; and
- Provide opportunities for the engagement of TO Ranger groups, allowing opportunities for knowledge sharing and connection to country.

The Stygofauna Monitoring Program is required for the life of mining (20 years), or until hydrogeological modelling demonstrates there are no impacts to stygofauna or their habitat on landform islands. Monitoring duration and frequency should be revised as required, supported by an underlying adaptive management approach.

C.3 Traditional Owner Engagement

The Stygofauna Monitoring Program presents an opportunity to engage with and work alongside TO Ranger groups from the Ngururrpa and Kiwirrkurra IPAs. During the baseline surveys for the Proposal, TO Rangers provided integral local knowledge of the area. Opportunities to involve TO Rangers in in monitoring may include:

- Consultation on survey design and discussion regarding site selection; and
- Accompanying appropriate qualified scientists on stygofauna monitoring surveys.

C.4 Monitoring

C.4.1 Overview and Timing

A summary of the proposed monitoring is presented in **Table C-1**, which also shows the relevant objective-based management provisions. Survey design (**Section C.4.3**) follows a before-after-control-impact (BACI) design. The BACI design is considered optimal to isolate potential effects of the Proposal on the stygofauna communities associated with the large and landform islands of Lake Mackay, from effects which may be attributed to natural variability. Prior to land disturbance activities being undertaken for the Proposal, adequate baseline monitoring data on stygofauna and groundwater (prior to potential impacts), will be collected for a two-year period.

The Stygofauna Monitoring Program will be undertaken biannually during the dry (April to October) and wet (November to March) season, by specialist consultants and supported by TO Ranger groups, as agreed. The monitoring design and methods used align with industry best practice and relevant legislation and regulatory guidelines, including:

- Environmental Factor Guideline – Subterranean Fauna (EPA 2016a);
- Technical Guidance – Subterranean fauna surveys for environmental impact assessment (EPA 2016c); and
- Technical Guidance – Sampling Methods for Subterranean Fauna Survey (EPA 2016b).

Table C-1: Stygofauna Monitoring Program summary.

Personnel	Timing	System	Number of Monitoring Bores	Monitoring Parameters	Objective-based Management Provision
Qualified Consultants	• Biannually; during the wet (November to March) and dry season (April to October)	• Lake Mackay – six large and landform islands located in the north-eastern portion of the lake	• 7	• Groundwater levels and quality • Stygofauna	• No project-related adverse impacts to prospective stygofauna fauna and/or habitat on the landform islands within the On-LDE from infrastructure development, including abstraction of brine.

C.4.2Logistical Considerations

Several logistical factors were taken into consideration for the design and safe implementation of the Subterranean Fauna Monitoring Program:

- The Proposal is located in a remote area of Western Australia and mobilisation to site from Perth currently takes a minimum of 1.5 days.
- Significant distance exists between the larger islands and a helicopter will be required to access the substantial distance between monitoring bores.
- Sampling of stygofauna can be heterogeneous and is variable dependent on seasonal conditions and preceding environmental factors such as rainfall.
- Transportation and storage of preservative (100% ethanol) on site during field surveys for the preservation of stygofauna samples.

C.4.3Monitoring Bores

The Stygofauna Monitoring Program will include a total of eight monitoring bores, comprising six existing bores (LMISL01, LMISL02, LMISL03, MC05, MC13 and T13-H-011) and two bores proposed to be drilled (LMSL05 and 06), located across six large and landform islands for the monitoring of stygofauna (**Figure C-1** and **Table C-1**). Proposed monitoring bore locations have been aligned with known stygofauna records from large and landform islands of Lake Mackay identified during baseline studies.

Table C-1: Locations of proposed monitoring bores for the Stygofauna Monitoring Program (GDA94 Z52).

Bore Name	Type	Easting	Northing
LMISL01	Existing	494005	7530054
LMISL02	Existing	495393	7523588
LMISL03	Existing	489207	7519847
LMISL05*	To be drilled	485450	7516971
LMISL06*	To be drilled	483709	7524690
MC05	Existing	494087	7510174
MC13	Existing	494917	7530028
T13-H-011	Existing	495287	7530747

* Exact locations of proposed bores to be flexible.

C.4.4Field and Laboratory Methods

A summary of field and laboratory methods to be employed during biannual stygofauna monitoring surveys is provided in **Table C-2**. Sampling for stygofauna will comprise net haul sampling, utilising two weighted haul nets with mesh sizes of 150 µm and 50 µm. Groundwater quality will also be measured *in-situ*, for the analysis of basic water quality parameters.

Table C-2: Summary of proposed components and sampling methods for the stygofauna monitoring program.

Component	Sampling and Laboratory Methods
Groundwater	• Groundwater quality should be measured *in-situ* using a portable, hand-held water quality field meter, including pH, electrical conductivity (µs/cm), total dissolved solids (mg/L), dissolved oxygen (% and mg/L), temperature (°C) and reduction-oxidation potential (mV). The water quality field meter will be calibrated according to appropriate standards prior to the field survey. • Standing water levels should be measured as metres below ground level (mbgl) using a Solinst water level meter. The end of hole depth (EoH) is to be calculated from the number of rotations of the stygofauna sampling winch reel (a known distance), which was required to retrieve the stygofauna nets. • Data recorded from the field should be collated and maintained in an excel spreadsheet allowing for comparison of conditions over time for reporting purposes.
Stygofauna	• Stygofauna will be sampled using haul nets during both dry and wet season sampling for the Stygofauna Monitoring Program, which is widely considered the most efficient method to retrieve stygofauna from bores (Allford *et al.* 2008). • Sampling is to be consistent with the procedures outlined in the Environmental Protection Authority (EPA) Technical Guidance Sampling Methods for Subterranean Fauna Survey (EPA 2016b). • Sampling should utilise two weighted haul nets with mesh sizes of 150 µm and 50 µm, with the 150 µm net to be lowered first to the base of the bore and raised slowly to retrieve the sample. This process is to be repeated three times alternating with three hauls using the 50 µm mesh net. Samples should be combined and concentrated and preserved in 100% ethanol and stored on ice. • Samples should be sorted, identified and enumerated to lowest possible level (typically species, depending on level of maturity and sex), under a stereomicroscope in the laboratory. Species determination should verified using genetic analysis, as required. Submission of some microcrustacean groups (copepods and ostracods) to specialist sub-consultants for species-level identification should be undertaken, as required. • Stygal records verified in the laboratory should be collated and maintained in an excel spreadsheet allowing for comparison of community composition over time and in comparison to water quality parameters, for reporting purposes.

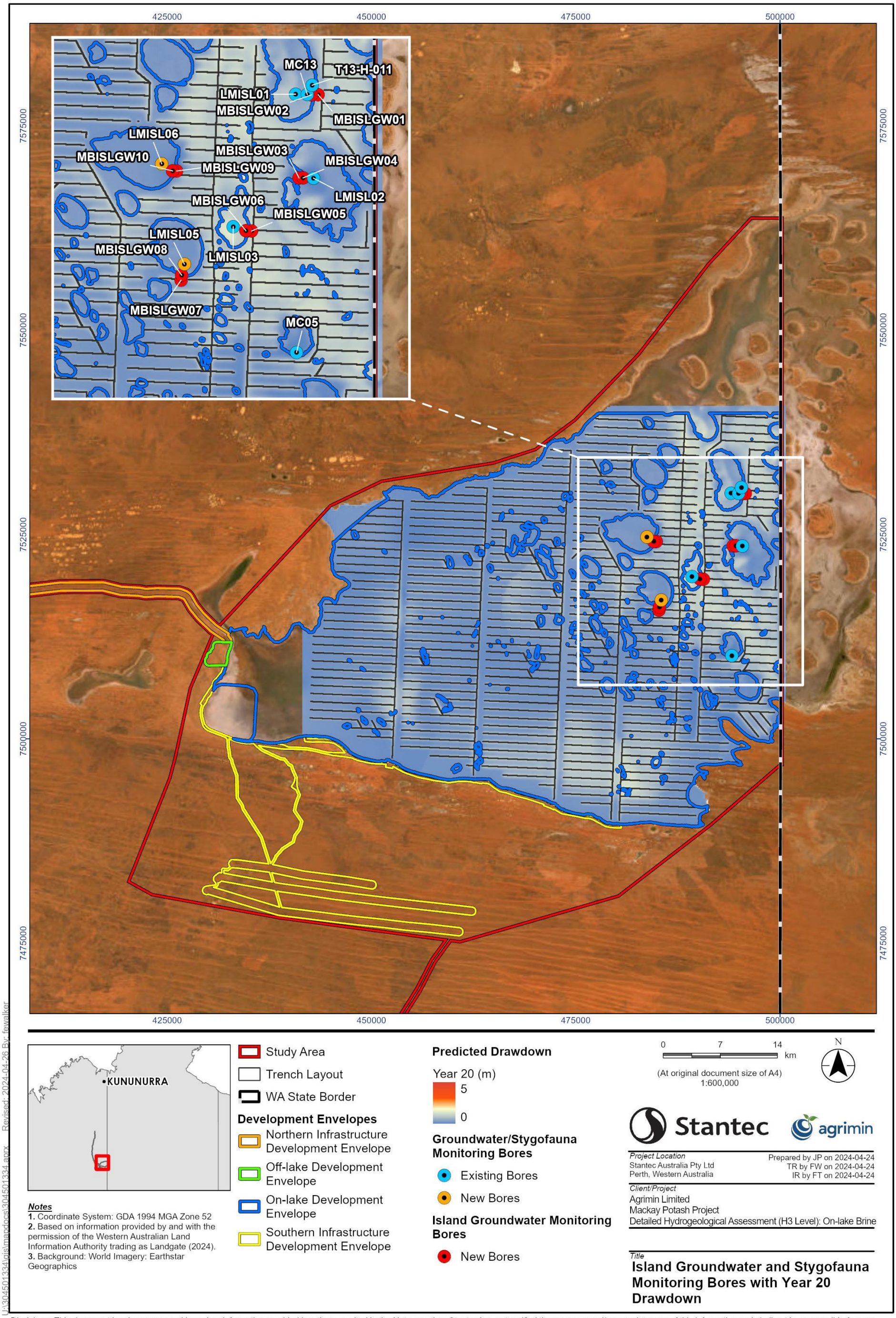

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Figure C-1: Proposed location of monitoring bores on larger islands of Lake Mackay for the stygofauna monitoring program.

C.4.5Personnel and Licencing Requirements

The Stygofauna Monitoring Program will be undertaken by suitably qualified specialist consultants trained in the methods described in **Section C.4.4**. Current licence requirements comprise a DBCA Fauna taking (scientific or other purposes) licence to take or disturb native fauna, which will be obtained prior to commencement of monitoring.

C.4.6Data and Statistical Analyses

Stygofauna species lists will be compiled to provide an accurate record of stygofauna identified from Lake Mackay. Any taxa of potential conservation significance recorded and identified will also be highlighted and mapped. Basic statistics such as minimum, mean, and maximum species richness and abundance can be calculated per bore for comparison. Abiotic (groundwater) and biotic (species richness and abundance) data may be statistically analysed (using appropriate univariate and/or multivariate procedures) to investigate trends in relation to spatial and temporal changes that may be related to Proposal activities, in comparison to baseline conditions. As data accumulates over time species richness and survey effort may also be investigated using an appropriate statistical software package, such as EstimateS. The species richness data provide a statistical evaluation of the proportion of the stygofauna assemblage detected.

C.5 Reporting

A standalone technical report will be submitted to Agrimin at the conclusion of each monitoring period, presenting the results and key findings of the Stygofauna Monitoring Program. Associated data will be submitted concurrently, as per the Agrimin Data Standards. The technical report will include assessment against relevant management provisions, including objective-based criteria presented in Table 4-2 of the IWEMP, as required. The technical report will be summarised within or appended to the Annual Environmental Report (AER) and the Annual Compliance Assessment Report (ACAR), to be submitted to the DWER, DCCEEW, and EPA, respectively, aligning with Section 6.1 of the IWEMP.

C.5.1Reporting Considerations

There are several considerations associated with this Stygofauna Monitoring Program, which will be considered when interrogating the data recorded and for interpretation and reporting:

- Management of large complex data sets over time and appropriate data analyses and comparisons to adequately address the objectives of the IWMP.

C.6 Adaptive Management and Review

Results obtained from this Stygofauna Monitoring Program may inform adaptive management measures for the IWEMP. The review of data and information gathered during monitoring may increase understanding of the stygofauna of Lake Mackay landform islands in a regional context. This may inform management and mitigation measures such as:

- Reviewing the BMU development and modifying the abstraction schedule.

Revising triggers and thresholds to make them more appropriate overtime. A review of this Stygofauna Monitoring Program will be undertaken every five years, in response to adaptive management, as new technology becomes available, or as required to achieve the environmental outcomes associated with the IWEMP. Any revisions of the Aquatic Ecology Monitoring Program will be submitted to the relevant State (DWER, DBCA) and Commonwealth Government (DCCEEW) for approval, or in accordance with relevant regulatory conditions or requirements.

C.7 References

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Ground Floor, 226 Adelaide Terrace, Perth, 6000
Australia: +61 8 6222 7000 | www.stantec.com