MACKAY POTASH PROJECT DETAILED HYDROGEOLOGICAL ASSESSMENT (H3 LEVEL): ON-LAKE BRINE

PREPARED FOR AGRIMIN 2024

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Quality Statement

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Executive Summary

Introduction and Background

A Detailed Hydrogeological Assessment H3 Level Assessment (H3 Assessment) was undertaken for the on-lake development envelope (On-LDE) for the abstraction of brine from lakebed sediments for the Lake Mackay Sulphate of Potash (SOP) Project (the Proposal). The brine groundwater will be extracted from the lakebed sediments via a series of shallow trenches, within allocated brine mining units (BMUs), covering an area of approximately 1,973 km on the surface of Lake Mackay (within WA), to produce 9 Mt of SOP over the 20-year Life of Mine (LoM). Annual brine abstraction volumes are expected to range from 70 to 100 GL/a, depending on the required flow and potassium grade to meet the annual SOP mass targets.

A trench network will be constructed to access potassium bearing brine in the lakebed sediments, comprising a series of parallel west-east running infiltration trenches spaced 1 km apart. Brine will be transported via gravity flow, with lift pumps where needed. The final arrangement, depth and shape of the trenches has been optimised to minimise disturbance to the lake, while enabling the resource to be extracted. The trench network has been partitioned into 17 brine mining units (BMUs), with abstraction beginning in the southernmost BMUs, with additional BMUs constructed and brought online over a 17-year period to offset grade decline. Abstraction of brine from the central and eastern portions of the lake will not occur until approximately year 10 of operations.

The objective of this H3 Assessment was to fulfill the Environmental Scoping Document (ESD) requirements for the Proposal, specific to the extraction of brine within the On-LDE, summarising conceptual and numerical hydrogeological modelling results, and undertake environmental impact assessment (EIA) based on potential drawdown.

Hydrogeological Characteristics

Detailed hydrogeological investigations have been completed for the on-LDE and to a lesser extent the larger islands on the lake. The shallow lakebed sediments vary in composition from east to west, with the latter 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. 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.

The lacustrine or lakebed sediments sequence of Lake Mackay is characterised into three broad lithological units, including fine to coarse grained gypsum sand, which are thicker in the east, which grades downward into clayey and silty sand approximately 3 m below ground level (mbgl). Sandy and silty clay, containing discrete interbedded layers of evaporites (including granular/crystalline gypsum, halite, and calcite), and organics continues to around 150 mbgl and the density of the clays increases with depth. There is also a palaeochannel unit in the southern section of the lake, comprising sands and gravels, with minor silt and clay, which continues to more than 200 mbgl. The upper part of this unit contains discrete detrital iron, lignites and evaporite horizons. The lakebed sediments are unconformably underlain by what is interpreted to be a highly weathered pelitic bedrock.

The lakebed sediment groundwater has a shallow gradient, that generally follows the topography of the lake and flows from northwest to southeast. Depth to groundwater within the lakebed sediments are typically around 0.5 mbgl, with seasonal water level fluctuations that range from approximately 0.5 to 1 m. Immediate water level responses to large rainfall events are observed indicating a large portion of precipitation from larger rainfall events is recharging the brine aquifer.

Lake Mackay also comprises more than 270 islands within the On-LDE, which range from small unvegetated formations to large formations that host extensive and elevated sand dunes and are referred to as landform islands. The larger lake islands are composed of unconsolidated aeolian sand at surface and underlain by calcareous material and gypsiferous sand. Clay content increases with depth and typically marks the transition from island sediment to the lakebed sediments. Depth to groundwater on the landform islands is typically less than 5 mbgl. The island groundwater system is a vertically and laterally continuous aquifer, with a saline transition (mixing) zone. Above average rainfall events (>300 mm in one month) are likely to result in significant recharge of low salinity groundwater on the landform islands, saturating the vadose zone and increasing groundwater levels to within 0.6 m of the surface.

Groundwater sampling and monitoring indicates the lakebed sediments are characterised by circumneutral pH (mean of 6.6), with naturally elevated nitrate concentrations. While salinity (TDS) varies across the lake, it is typically greater than 200,000 mg/L, with a maximum of close to 340,000 mg/L, with the major ionic constituents comprising sodium and chloride, and potassium concentrations ranging from 3,000 mg/L to 3,350 mg/L. The landform islands host lower salinity groundwater, within the porous gypsiferous sands that overlay the clay dominant lakebed sediments (brine), likely associated with the infiltration of rainfall into the shallow, permeable aeolian sediment and where present, with calcrete outcrops. Salinities are typically below 60,000 mg/L, and below 10,000 mg/L in some instances, and vary according to seasonality, recharge, evapotranspiration and island lithology.

A vertical salinity density distribution likely occurs in the transition zone between the upper brackish water and the deeper brine, potentially resulting in less saline groundwater being confined to the island footprint. These pseudo-closed systems would temporarily host fresher and shallower groundwater, which is evident by the presence of gypsum crystals, which indicates a fluctuating water table.

Predictive Modelling Results

Groundwater modelling aligned with the Australian Groundwater Modelling Guidelines and was undertaken to simulate brine abstraction for the Proposal at up to 100 GL/annum for the production case. A groundwater flow and solute transport model was constructed using MODFLOW-SURFACT, conducted using the pre- and post-processor Groundwater Vistas. Hydraulic conductivity was distributed across model layers based on detailed analyses of the trench pumping tests at locations distributed relatively evenly across the lake. Four recharge zones were also used as estimated based on comprehensive studies.

Predicted groundwater drawdown, based on the numerical modelling, will vary spatially and temporally across the lake during operations, dependent on the schedule of abstraction from the BMUs over the LoM and the permeability of the lakebed sediments. The drawdown extent and average drawdown is more pronounced in the eastern portion of the lake due to the higher permeability of lakebed sediments. The deepest drawdown of up to approximately 3 m will occur at the trenches, while between trenches, generally ranges from 0.0 m to 1.5 m and up to 1.8 m in the east near the landform islands (with abstraction only beginning in this area at year 10).

Drawdown in the trenches typically increases over the initial two years of pumping, which is subsequently reduced, with staged abstraction within BMUs resulting in recovery and less drawdown. However, the average drawdown across the lake ranges from 0.4 to 0.8 m, which is comparable to seasonal variation in groundwater levels (0.5 to 1.0 m). This corresponds to a reduction in the average saturated aquifer thickness of the brine, which is generally less than 10% over the LoM.

The maximum drawdown of the brine in the lakebed sediments beneath the landform islands is expected to range from 1.4 m on the island fringes with an average of 0.35 m, with most of the islands subject to a drawdown of less than 0.25 m (at year 20). Based on the modelling, with buffers implemented that limit trench construction near the islands, drawdown is predicted to be minimal at the margins of the islands and negligible beneath the islands and will typically be within the range of natural seasonal variation. Recovery of groundwater levels to within 95% of baseline conditions then occurs over a period of two to five years once pumping ceases. Under natural conditions, the percentage of rainfall on the islands resulting in recharge is also likely to be higher, due to the more permeable dune sands, limiting drawdown of low salinity groundwater overlying the brine. The landform islands may therefore be considered semi-closed systems, with predicted drawdown impacts minimal.

Environmental Impact Assessment and Monitoring

The proposed trench network and brine abstraction from the On-LDE is not anticipated to impact groundwater users or potentially sensitive environmental receptors, with negligible to minimal risk. There are no other registered groundwater users in the vicinity of the lake, and no cumulative environmental impacts identified, given the remote nature of the development. The brine also provides unsuitable habitat for groundwater dependent ecosystems.

The impact assessment indicated there is no risk to claypans on the margins of the lake and islands, which are likely hydraulically distinct, while riparian vegetation is not groundwater dependent and not anticipated to be affected by drawdown. The largest landform islands on the lake support groundwater dependent vegetation (*Allocasuarina decaisneana*) and stygofauna (copepods), the records of which are typically located more than 1 km from the island margins. These potentially sensitive receptors are associated with low salinity or fresher groundwater that is overlying the brine in the lakebed sediments. However, as the landform islands are likely areas of high recharge and are considered semi-closed groundwater systems, predicted drawdown impacts are expected to be minimal. Buffers of 500 m from the trench network to the landform islands will also be implemented to prevent potential impacts. Due to recharge from rainfall, and differences in density of the low salinity and brine groundwater, saline intrusion into the upper transition zone is not expected.

The lake supports the highest ecological values during rare, major inundation events, during which surface waters are highly productive, due to emergent aquatic biota, attracting waterbirds for foraging and breeding. Several new aquatic aquatic invertebrate taxa and migratory listed waterbird species are known from the lake, although they are widely distributed. There are no significant impacts anticipated from the abstraction of brine for the Proposal on the hydrological regime of the lake in major floods. Predicted drawdown varies across the lake over the LoM, however, water balance modelling indicates a negligible change to the duration, maximum extent, depth, and frequency of surface water, during these events. In addition, large rainfall events will effectively reset groundwater levels to within baseline levels, and the lake's hydrological processes and ecological values are anticipated to be maintained during operations for the Proposal.

Quarterly monitoring of groundwater levels (daily logging data) and sampling of existing monitoring bores for chemical analysis both on the lake and the landform islands will be undertaken during pre-construction. Additional monitoring bores will also be installed on the lake in the vicinity of the landform islands and within the riparian zone of these islands, to monitor drawdown extent and collect long term data, aligning with the Inland Waters Environmental Management Plan (IWEMP). While no significant impacts are expected on potentially sensitive receptors on landform islands, monitoring against triggers and thresholds will provide an early warning to detect a reduction in groundwater levels outside of predicted modelled drawdown on the lake and islands. This will enable management actions to be implemented by Agrimin as required, which are detailed in the IWEMP.

Prior to construction of the trench network, baseline monitoring data may also be used to revise modelling and trigger and threshold criteria. In the unlikely event drawdown levels exceed thresholds, key mitigation measures include modification of the BMU schedule and increasing the buffer zones to landform islands to further reduce impacts. Brine abstraction from BMUs in the vicinity of the landform islands also begin at year 10 of operations, which allows for further groundwater monitoring and investigation. Recovery (to 95%) following cessation of operations, is predicted to occur over short period (two to five years) aided by intensive rainfall events, which are expected to increase in the frequency due to climate change.

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1. Introduction

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 abstraction 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 salts including sulphate of potash (SOP) that 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 Detailed Hydrogeological Assessment H3 Level Assessment (H3 Assessment) for the extraction of brine:

- **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, 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.
  - **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.

This H3 Assessment focusses on the On-LDE brine, with the brine groundwater extracted from the lakebed sediments via a series of shallow trenches, within allocated brine mining units (BMUs) (**Figure 1-2**). 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 (landforms) support low salinity of freshwater groundwater at higher elevations, which overlies the brine.

1.2. Assessment Objective and Scope

The objective of this H3 Assessment is to fulfill the Environmental Scoping Document (ESD) for the Proposal, of relevance to the extraction of brine within the On-LDE within the Proposal Area. The H3 Assessment for the brine will also form the basis of requirements for an application to the Department of Water and Environmental Regulation (DoW) for a Section 5C Licence to Take Groundwater, which will be submitted by Agrimin at a later date. This report is also in addition to the H3 Assessment of the water supply for the Proposal (SIDE borefield).

To address the objective for the extraction of brine, the H3 Assessment comprises the following scope:

- review and summarise the available hydrogeological information and previous studies;
- present conceptual and numerical hydrogeological modelling results; and
- undertake environmental impact assessment (EIA) associated with potential drawdown from the abstraction of brine within the On-LDE on any sensitive receptors.

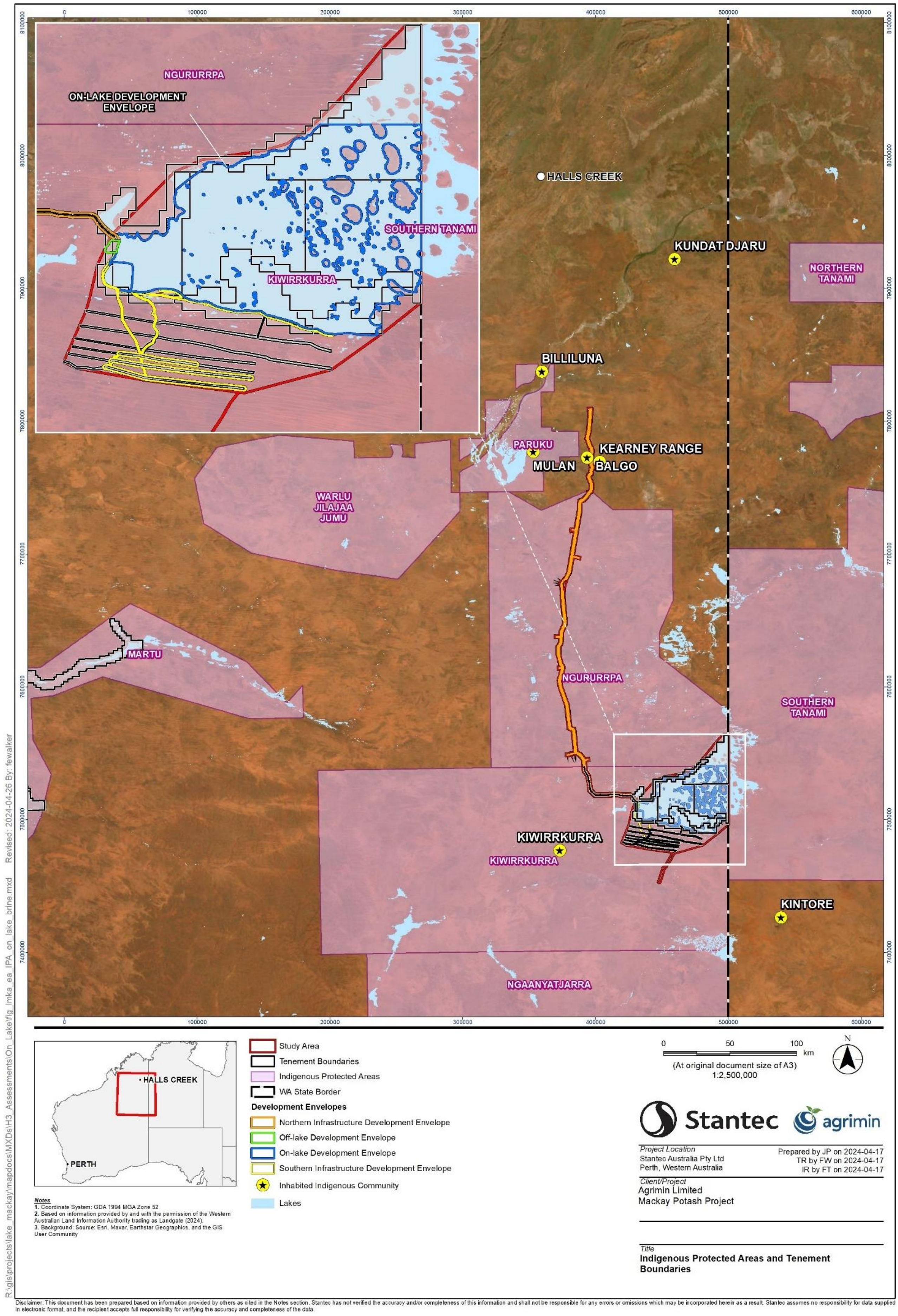

Figure 1-1: Proposal Development Envelopes (indicating the On-LDE), tenure, and IPA determinations.

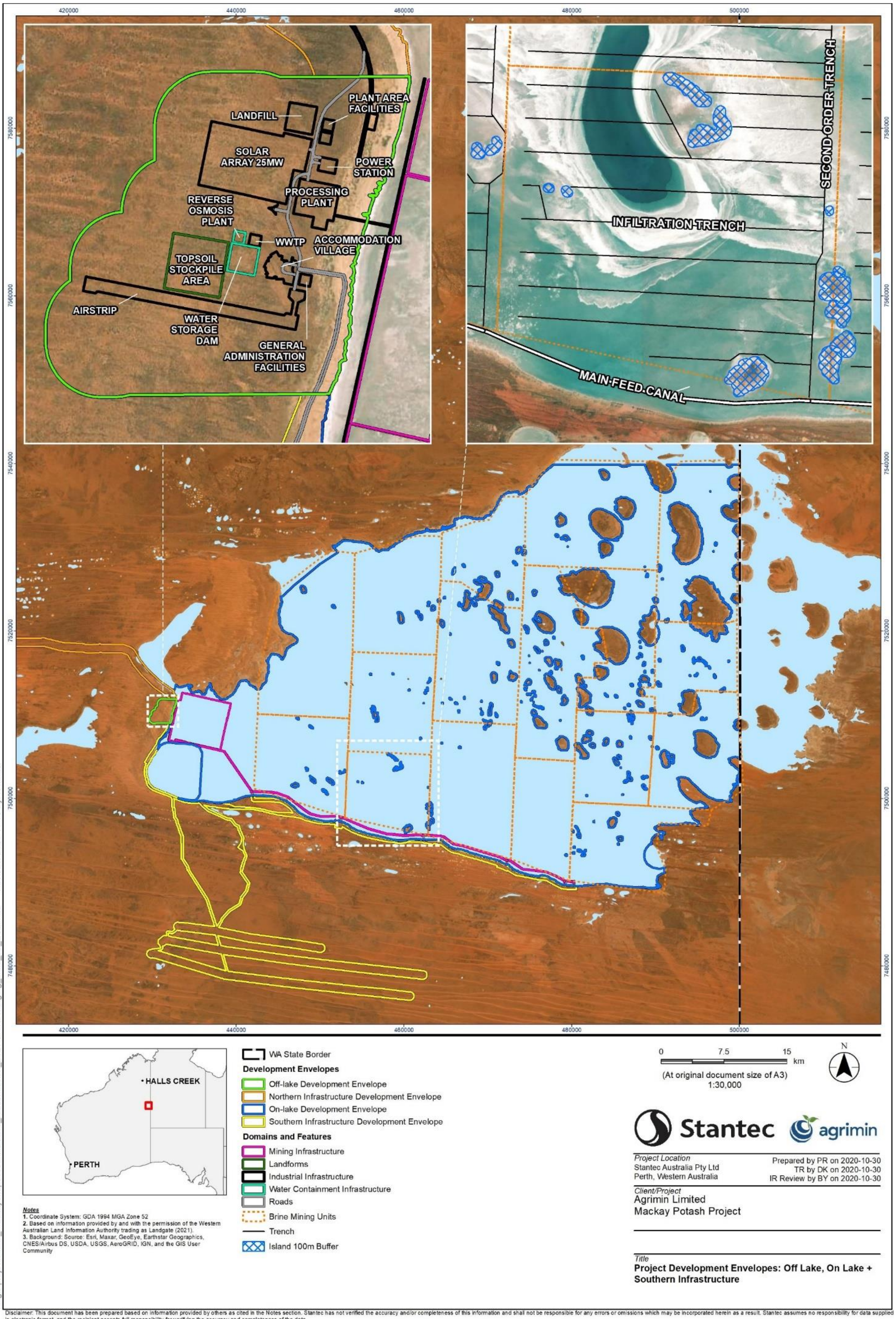

Figure 1-2: Proposal layout showing the On-LDE, brine mining units (BMUs) and indicative trench network.

1.3. Land Use, Tenure and Licensing

The Proposal Area traverses two Indigenous Protected Areas (IPAs) comprising the Ngururrpa and Kiwirrkurra IPAs (**Figure 1-1**). Specific to the abstraction of potash (ore reserve) on Lake Mackay, the process plant and the SIDE borefield are located solely on the Kiwirrkurra IPA. The Kiwirrkurra IPA is managed by the Tjamu Tjamu Aboriginal Corporation and Agrimin have a Native Title Agreements (NTA) in place with the Tjamu Tjamu Peoples'. Commitments in the NTA focus on consultation and reasonable endeavours, to avoid adverse impacts to the environment or areas of cultural concern from the Proposal. In addition, Agrimin recognise the skills and experience of Indigenous Ranger groups and will provide opportunities for engagement in environmental surveys and monitoring where possible, as the Proposal develops.

Agrimin currently holds Exploration and Miscellaneous Licenses in Western Australia, obtained under the *Mining Act 1987*, which includes Lake Mackay (**Figure 1-3**). Agrimin's proposed SIDE borefield is also located on Miscellaneous License L80/00087, over which they hold Groundwater Licence 184176 within the Canning Kimberley Groundwater Area (**Figure 1-3**). This license allocation is for 6000 KL from the combined fracture rock central aquifer, which was used to carry out pump tests in 2017. The nearest allocations to the lake also include Groundwater Licence 209693 for Encounter Resources, which extends over several tenements that begin along the northern margin of the lake (**Figure 1-3**), and CGN Resources with Groundwater Licence 209597, located more than 20 km to the southwest of the lake.

1.4. Climate and Rainfall

The climate of the region is characterised as arid tropical, with low, variable rainfall that is often unpredictable and influenced by tropical cyclones off the Pilbara and Kimberley coasts (Kendrick 2001). The Proposal Area is typically subject to an arid tropical climate, characterised by cool mild winters and very hot summers. Daily temperatures in the summer months from November to February exceed 37°C and temperatures above 42°C are common. The winter season occurs from June to August with mean daily maximum and minimum temperatures of about 23°C and 10°C, respectively. Rainfall typically occurs within the summer months, associated with tropical storm activity, with minimal rainfall occurring during the cooler months (Beard 1990; Kendrick 2001).

The mean annual rainfall across the Lake Mackay catchment, based on the Bureau of Meteorology (BoM) for the period 1961 to 1990 is shown in **Figure 1-4**. The spatially averaged mean annual rainfall over the catchment area is approximately 319 mm, with the highest mean annual rainfall of 400 to 425 mm occurring to the northwest of Lake Mackay, reducing to less than 275 mm to the southwest. On the lake surface, the spatially averaged annual rainfall is approximately 300 mm.

The nearest BoM weather station to Lake Mackay, with reliable long-term and recent climatic data is Walungurru Airport (station number 015664), located approximately 135 km to the southeast, with data collected since 1998. Due to the size of the lake, data from Giles Wester Station (013017), approximately 275 km to the south, is also provided for comparison. In addition, Agrimin commissioned a weather station at Lake Mackay in 2015 (Pilot Pond); data is available for the Pilot Pond from December 2017 onwards.

The mean long-term annual rainfall (1998 to 2023) for Walungurru Airport is approximately 285 mm (Bureau of Meteorology 2024), with most rainfall occurring between December and March. Rainfall at both weather stations has generally been similar, while the Pilot Pond has recorded higher rainfall and lower evaporation. Comparison between the two regional weather stations and the Lake Mackay Pilot Pond weather station between January 2018 and December 2023 is presented in **Figure 1-5**. The average monthly rainfall and evaporation data from 1998 to 2023 from the two regional weather stations also indicates that rainfall and evaporation it typically higher at Giles (**Figure 1-6**).

1.5. Topography

Lake Mackay is the fourth largest salt lake in Australia and the largest in Western Australia, with an area of approximately 3,513 km^2, extending more than 100 km east-west and 80 km north-south. The lake lies within a topographic low and the playa and surrounds are subdued and flat. Lakebed elevations range from approximately 360 m AHD in the east to 364 m AHD in the west. This corresponds to the deepest parts of the basin, which occur in the southeast, while the western half of the lake is comparatively shallow. The eastern portion of the lake is also characterised by more than 270 islands varying in size from less than 100 ha to >2,000 ha. The largest of these, classified as landform islands, are more than 10 m in height above the lake surface (Stantec 2021a).

The lake margins are characterised by numerous claypans, salt pans and floodplains, and longitudinal sand dunes and swale systems that open locally onto sandplains (**Figure 1-7**). Claypans also occur on the landform islands of the lake. Some undulating plains and upland areas also occur in places. Among the dunes claypans and isolated residual sandstone hills may occur, as well as areas of ironstone gravels and some breakaways.

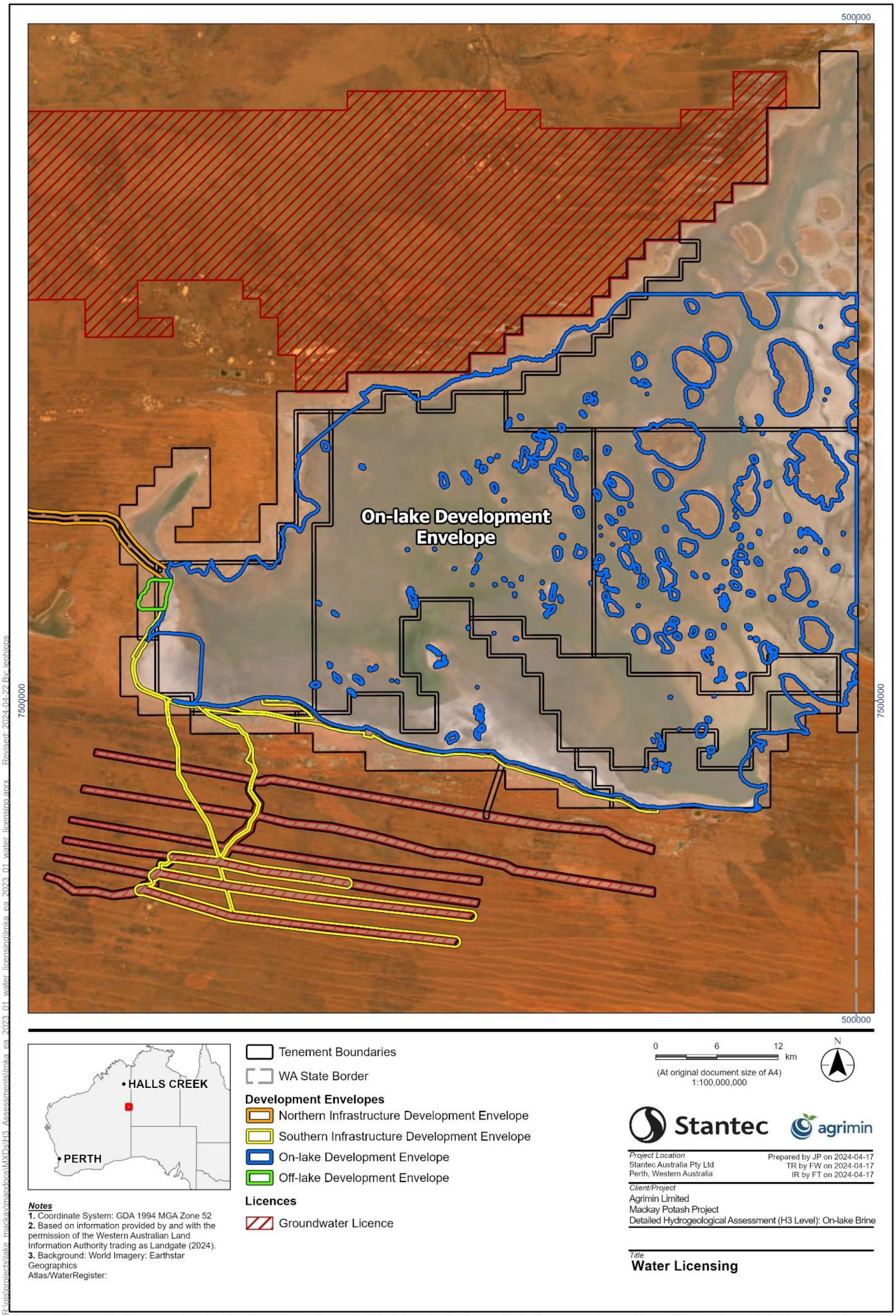

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Figure 1-3: Water licensing in the vicinity of Lake Mackay, indicating Agrimin's SIDE allocation.

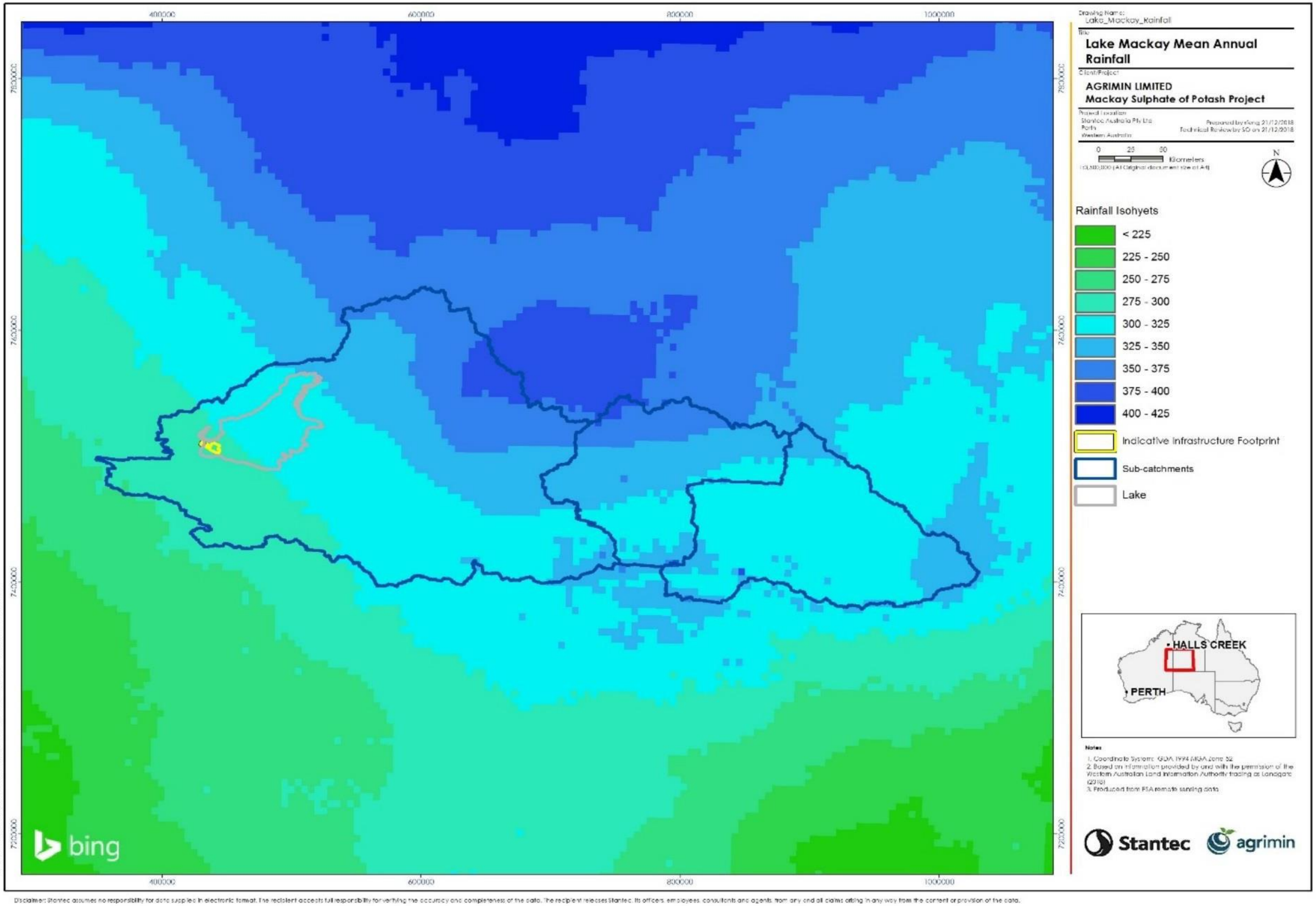

Figure 1-4: Catchment mean annual rainfall (BoM grid data 1961 to 1990).

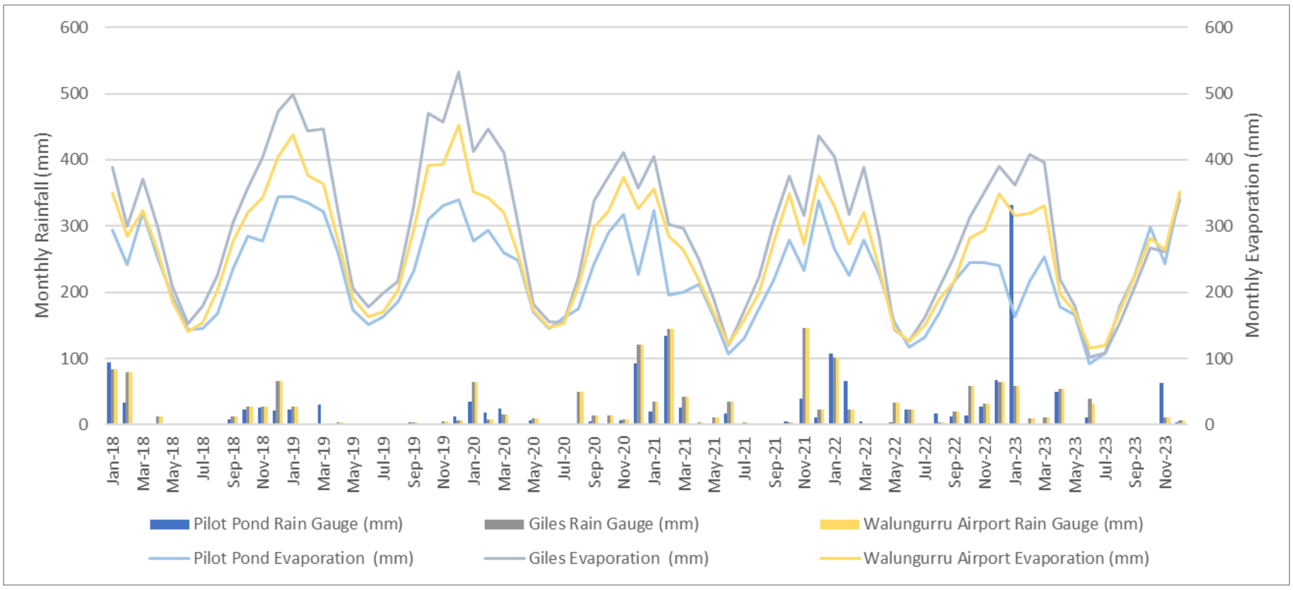

Figure 1-5: Monthly rainfall and evaporation at Pilot Pond (Lake Mackay), Walungurru Airport (BOM 2024 rainfall; SILO 2024 evaporation) and Giles Meteorological Observation (BOM 2024), January 2018 to December 2023.

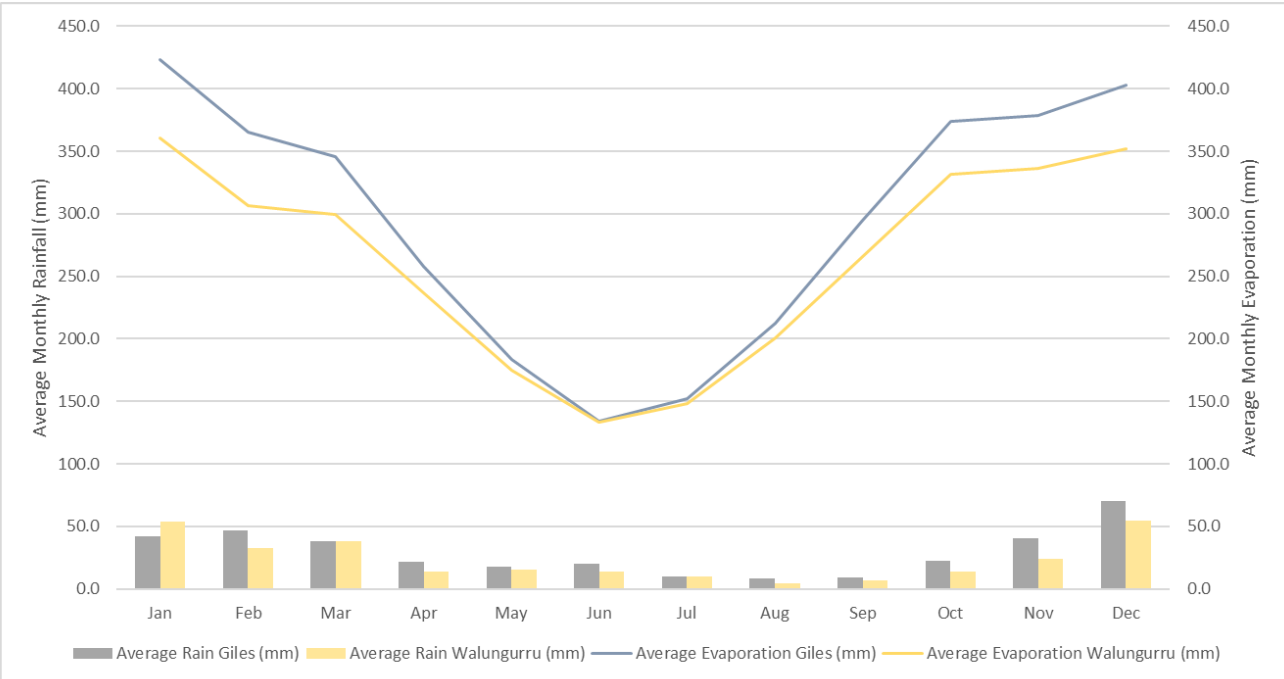

Figure 1-6: Average monthly rainfall and evaporation at Walungurru Airport and Giles Meteorological Weather Station, 1998 to 2023.

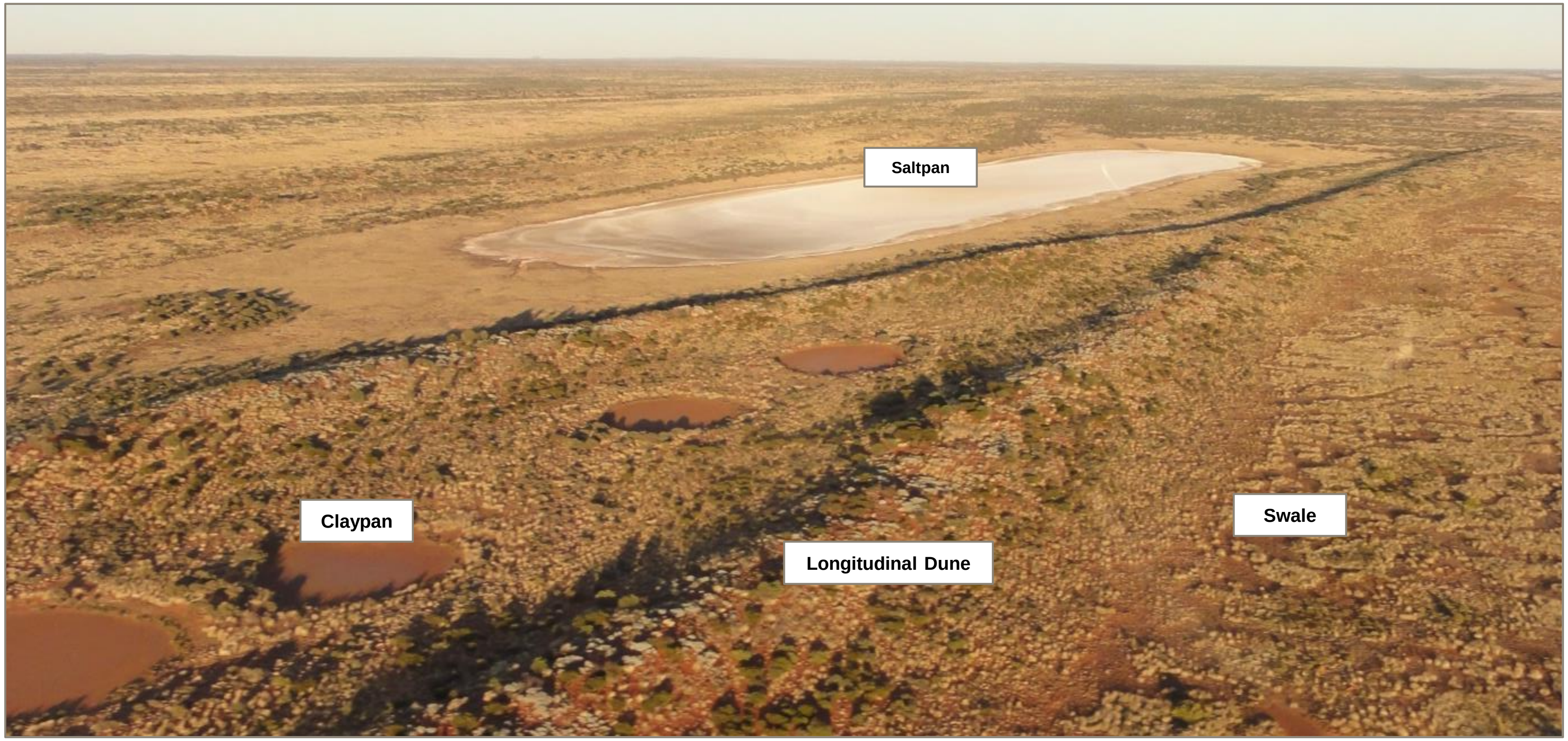

Figure 1-7: Intra-dune salt pan, claypans and longitudinal dunes and swales on the margins of Lake Mackay (Source: Agrimin 2018b).

1.6. Hydrology

Lake Mackay lies within the internally draining Mackay Basin. The lake is a closed system with no outflow or historic evidence of spilling into adjacent lakes (**Figure 1-8**). 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 periods of extreme rainfall. These features are localised and tend to be more common in the southeast portion of the lake. There are no major channels that appear to reach the lake. The lake is also surrounded by numerous claypans and smaller waterbodies; there are more than 200 of these waterbodies in the vicinity of Lake Mackay.

A comprehensive surface water assessment (Stantec 2020a) estimated that the total catchment area of Lake Mackay is approximately 87,000 km^2, of which only 20% is considered effective. The catchment stretches more than 550 km east of the lake into the MacDonnell Ranges and comprises two key sub-catchments (**Figure 1-9**). The east to west drainage line is uncoordinated along its length, comprising hundreds of small playas that superficially resemble a river flow path, although a dune system significantly impedes surface water movement. Flow paths meander longitudinally along the dunes, with surface water movement only likely to occur at topographic lows.

The lake is predominantly dry and is rarely subject to inundation. Rainfall events of approximately 30 mm typically occur several times throughout the year (Stantec 2020a), resulting in the formation of isolated, pooled surface water usually within the southern half of the lake. However, these shallow bodies of water (<0.1 m) are strongly influenced by prevailing winds, infiltration, and evaporation, rarely persisting on the lake for longer than a few days (Agrimin, pers. comm. 2020).

More widespread inundation occurs in response to large rainfall events, which are unreliable. While extended dry conditions can prevail, storms and cyclones that move inland from the northern coastline of WA have the potential to generate intensive rainfall, particularly during the wet season. Given the size of the catchment and surface area of the lake, peak inflows generally result from longer duration storms (three to four days of storm activity). During peak flows there are some areas of concentrated flow between islands and/or, where inflow from external runoff enters the lake. While typically negligible, flow velocities of up to 0.5 m/s may occur under peak conditions.

Based on a long-term dataset of available satellite imagery (dating back to the early 1980's) as part of the surface water assessment (Stantec 2020a), the lake mostly fills (along the visible perimeter) on average, once every 10 years, following rainfall events that exceed 250 mm. Under this scenario the depth throughout most of the lake is initially predicted to range from 0.5 m to 1.0 m, reaching a maximum of approximately 2 m in the southeastern extremity. While subject to major flooding however, the persistence of surface water is variable and dependent on preceding conditions, although typically the lake may remain inundated for several months.

Along the margins of the lake, there are small ephemeral streams and watercourses that drain the surrounding landscape and contribute surface water runoff onto the lake during periods of extreme rainfall. These features are localised and tend to be more common in the southeast portion of the lake. There are no major stream channels that appear to reach the lake. There are also numerous claypans and salt pans, with more than 200 of these waterbodies located within 10 km of the lake.

There is limited available literature on the peripheral claypans of Lake Mackay, with the larger landform islands also supporting claypans, due to their size. These waterbodies are most likely associated with near surface clay (Duguid 2005), having formed between sand dune swales (**Figure 1-7**). Many of the claypans are shallow and unvegetated (particularly on the islands), while others are deeper and well vegetated. Some of these waterbodies are also substantial in size (>0.1 km^2) and can be considered saltpans. The hydrology of each claypan is variable although they typically fill directly from rainfall, and/or localised surface runoff. Following large rainfall events there may also be some connectivity between the surface waters of claypans. Inundation of these waterbodies can last from days to months, and the aggregations of claypans forms important waterbird habitat (Duguid 2005).

The peripheral and island claypans are likely perched with no expected hydraulic connection to the regional groundwater water table, with a surface water regime driven by rainfall. This is shown in **Figure 1-10**, representing water level fluctuations over the course of the wet and dry seasons, for a claypan located along the southern margin of Lake Mackay. However, the longevity and persistence of any surface water in the claypans may be influenced by localised discharge from the surrounding sand dunes. Infiltration is negligible, demonstrated by the persistence of surface water several weeks following a rainfall event. The discharge of water from the claypans is primarily by evaporation.

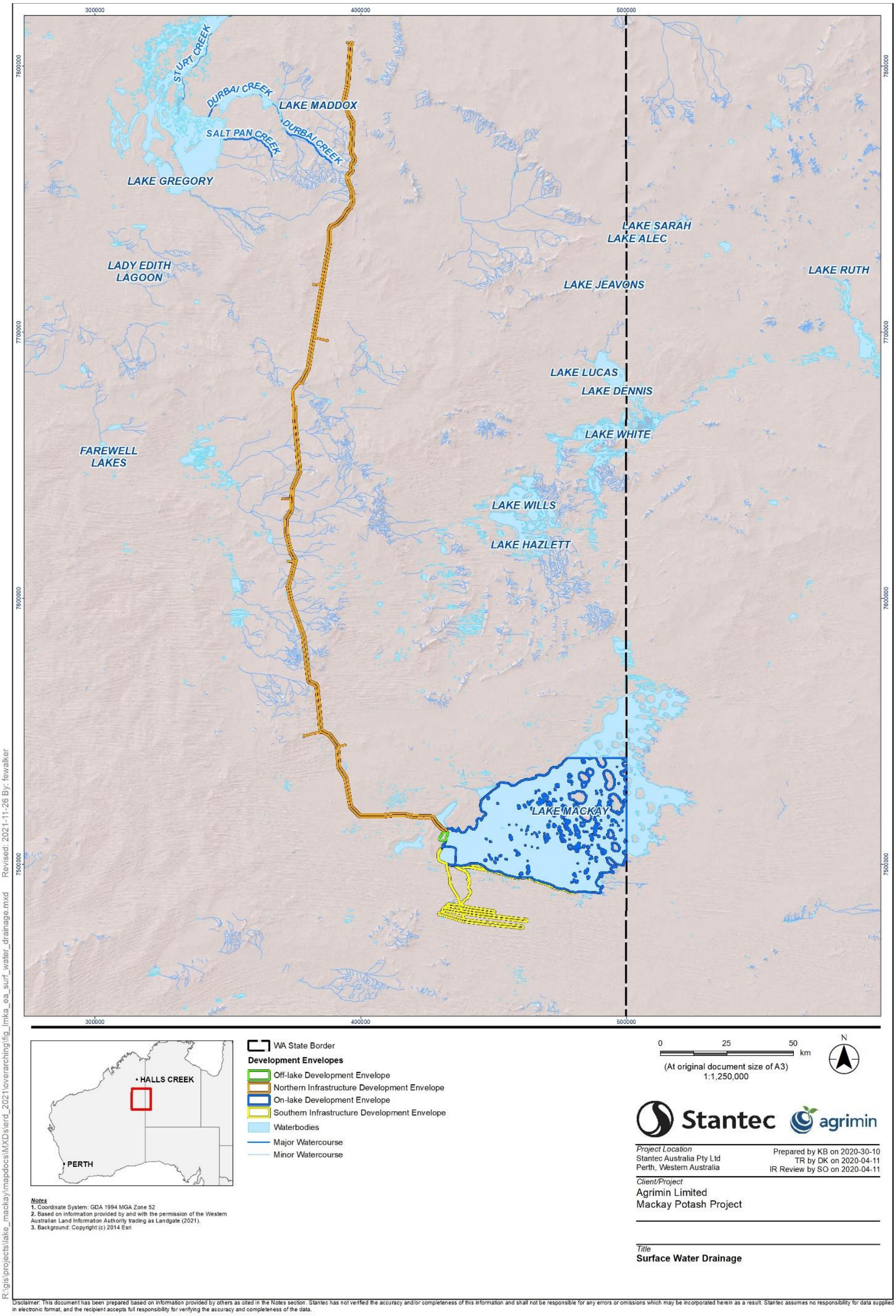

Figure 1-8: Regional watercourses and waterbodies in relation to the Proposal Area.

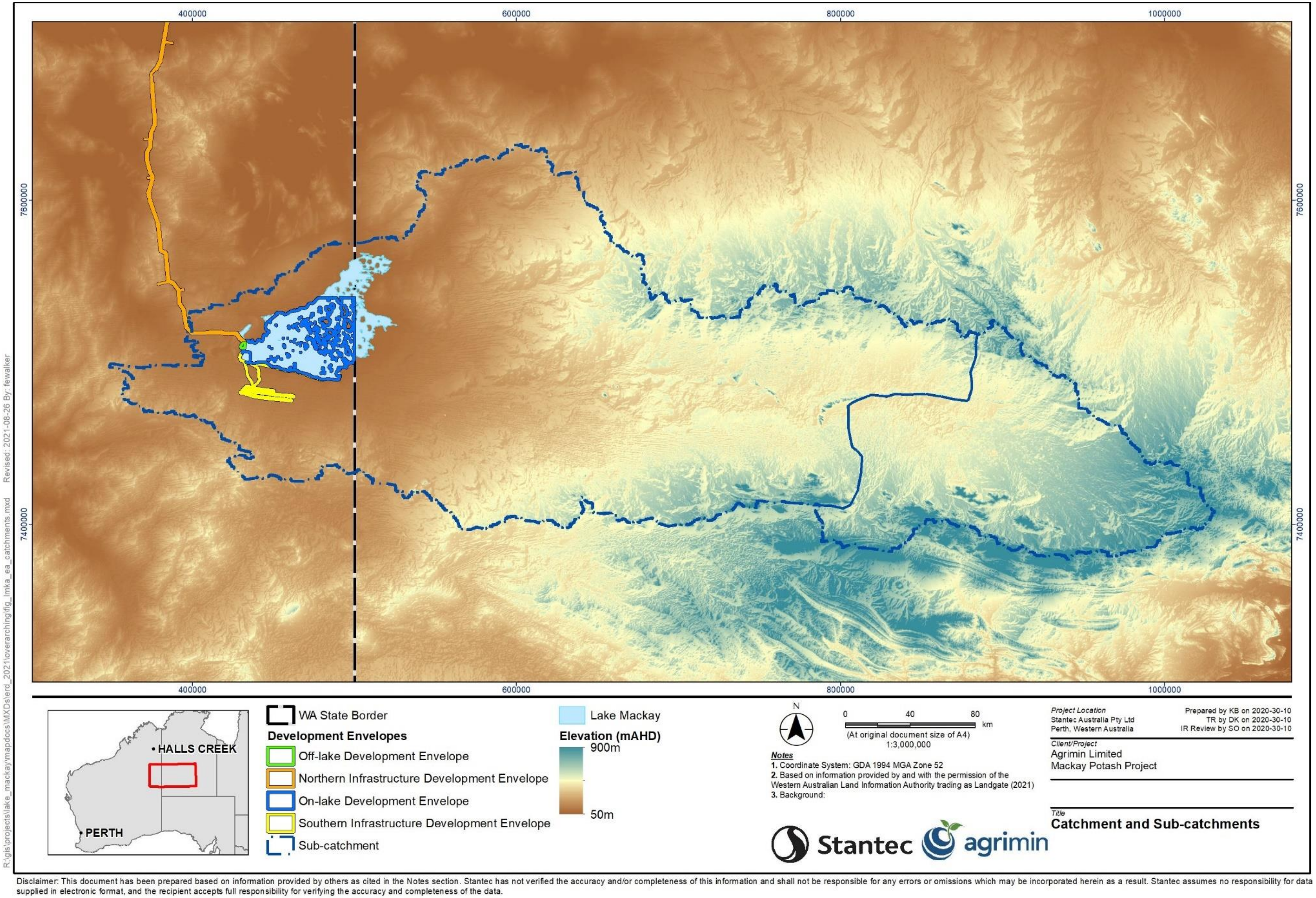

Figure 1-9: Lake Mackay sub-catchments in relation to the Proposal Area (Source: Stantec 2020a).

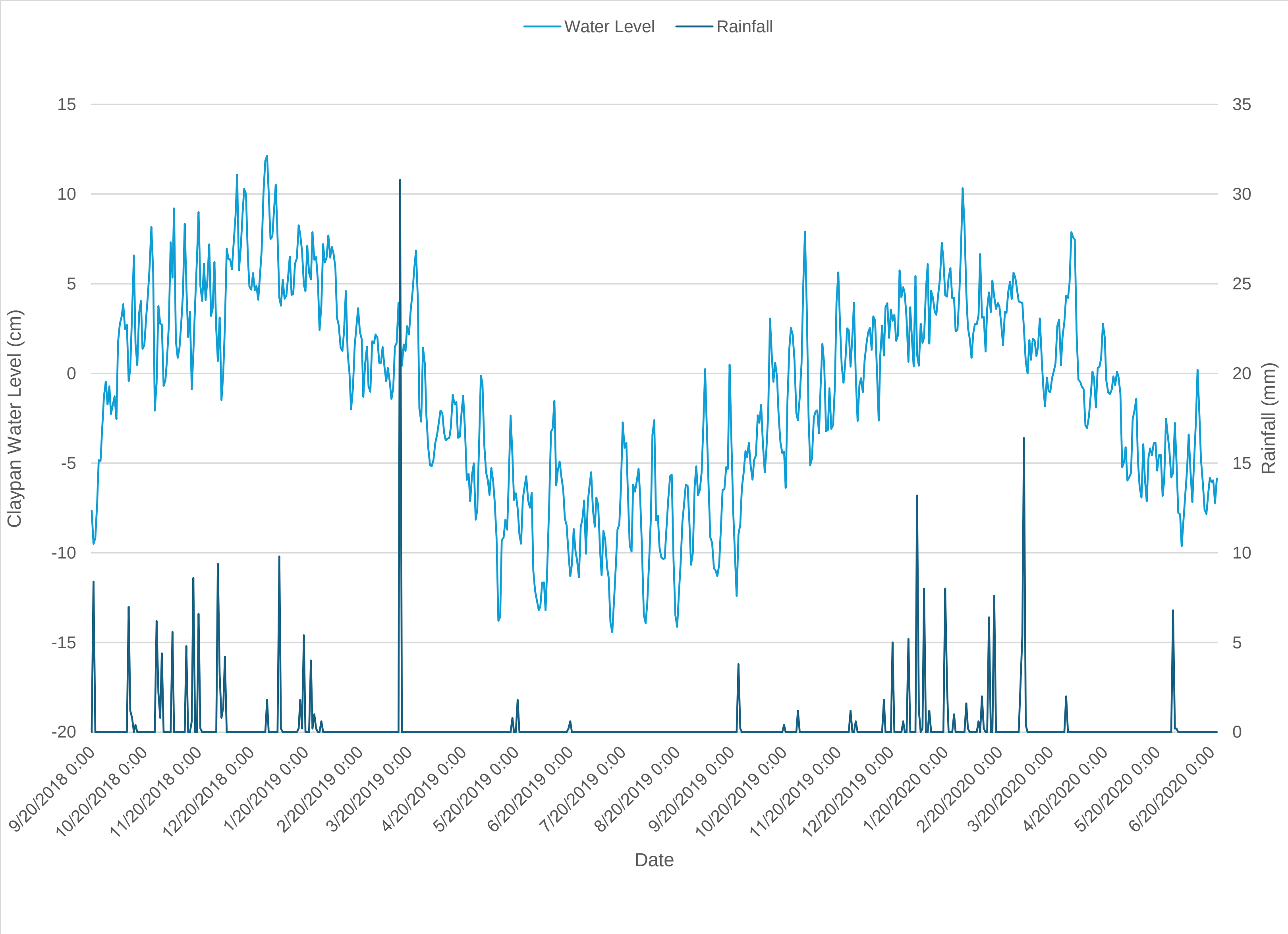

Figure 1-10: Changing water levels of the southern margin claypan (on Lake Mackay), in response to rainfall, based on Agrimin logger data recorded from 2018 to 2020.

2. Groundwater Use

2.1. Proposal Groundwater Use and Source

The occurrence and accumulation of brine in the sediments of Lake Mackay is due to evapoconcentration over time, as evaporation rates exceed rainfall. Groundwater levels are generally shallow (<0.5m) across the lake and have a very shallow gradient from west to east. A schematic block model of the lake's hydrogeological conceptualization is presented in **Figure 2-1**.

Mine planning simulations were undertaken in order to gain an insight into an extraction trench layout that will be required to achieve the flow and potassium concentrations to meet annual SOP equivalent mass targets during mining. The extraction target is 540 ktpa of SOP pumped into the pre-concentration ponds. Annual brine abstraction volumes range from 70 to 100 GL/a and will vary depending on the required flow and potassium grade to meet the annual SOP mass targets.

2.2. Proposed Trench Network Construction

A trench network will be constructed to access potassium bearing brine in the lakebed sediments. The trench network will comprise a series of parallel west-east running infiltration trenches that are spaced 1 km apart. Brine will seep into infiltration trenches and flow into north-south running second order trenches, transporting brine to the south of the lake by gravity flow. A 52 km long main feed canal will be constructed parallel to the southern shoreline to transfer brine to evaporation ponds in the south-western portion of the lake. Lift pumps will transfer brine from the north-south second order trenches into the main feed canal. This will allow the brine draw from various parts of the lake to be controlled.

The final arrangement, depth and shape of the trenches has been optimised to minimise disturbance to the lake, while enabling the resource to be extracted. Infiltration trenches will typically be 4 m deep with second order trenches varying in depth from 4 m to 5 m to facilitate gravity flow. The main feed canal will vary in depth from 3 m to 4 m and be up to 14 m wide.

The trench network has been partitioned into 17 brine mining units (BMUs), which represent areas on the lake with similar physico-chemical characteristics (**Figure 2-2**). Initially the southernmost BMUs will be developed with additional BMUs constructed and brought online over a 17-year period to offset grade decline. Abstraction of brine from the central and eastern portions of the lake will not occur until approximately year 10 of operations (**Figure 2-2**).

Brine extraction parameters have been estimated from data derived from 22 trial trenches excavated during resource estimation field trials conducted between 2017 and 2019. The trench network is designed to deliver brine to the ponds at an average rate of 2,500 L/s. Approximately 1,973 km of trenches will ultimately be required to be constructed to produce 9 Mt of SOP over the 20-year LoM (**Figure 2-2**).

2.3. Existing Groundwater Users

There are no known existing groundwater users on or near Lake Mackay. There are three registered groundwater bores on Lake Mackay, MA02, MA09 and MA13, which are associated with Agrimin's on-LDE and related to groundwater monitoring only. The closest confirmed groundwater users, the community of Kiwirrkurra with six bores located approximately 40 to 80 km south and southwest of Lake Mackay and 10 Gibson Desert North bores (82Lh) located approximately 60 to 100 km northwest. An unregistered hand pump is located approximately 20 km southwest of Lake Mackay (Southern Regional Area, near monitoring bore MWP09). These registered and unregistered bores are shown in **Figure 2-3.**

Two monitoring bores (MC05 and MC13) were also installed on the islands (LMISL01-05) of Lake Mackay in 2015 (**Figure 2-3**). These bores were drilled through the islands and into the lakebed sediments and are representative of island and lakebed sediment brine water levels and groundwater chemistry. Another five were installed in 2019 (LMISL01, LMISL02, LMISL03, LMISL09, LMISL10) and were a series of bores specifically designed to drill only the island stratigraphy to measure water levels and groundwater chemistry from the transition zone above the brine (**Figure 2-3**). Several additional monitoring bores are planned to be drilled on the largest landform islands to better understand the hydraulic connectivity between the transition zone and the brine.

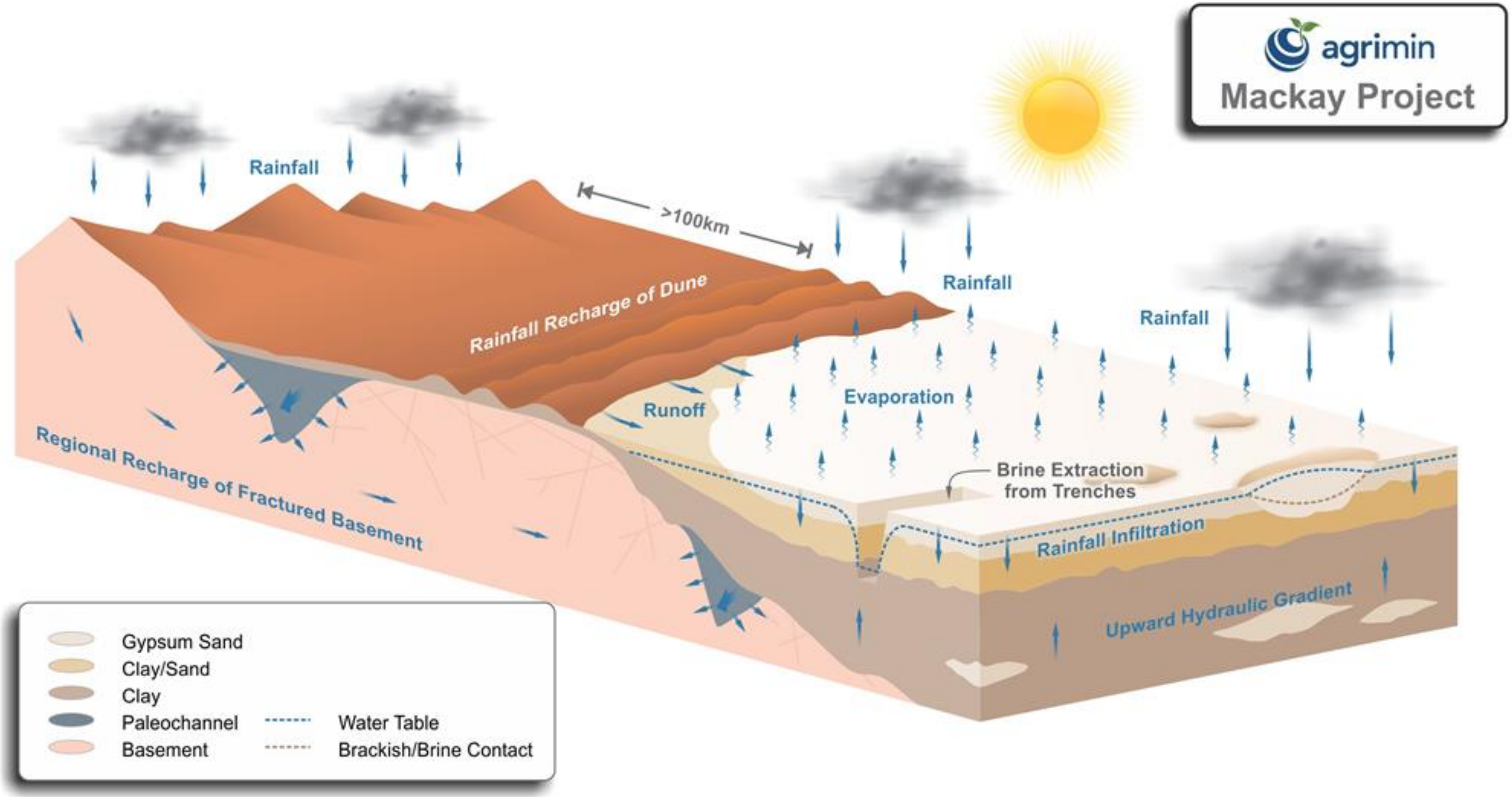

Figure 2-1: **Conceptual hydrologeological model of Lake Mackay.**

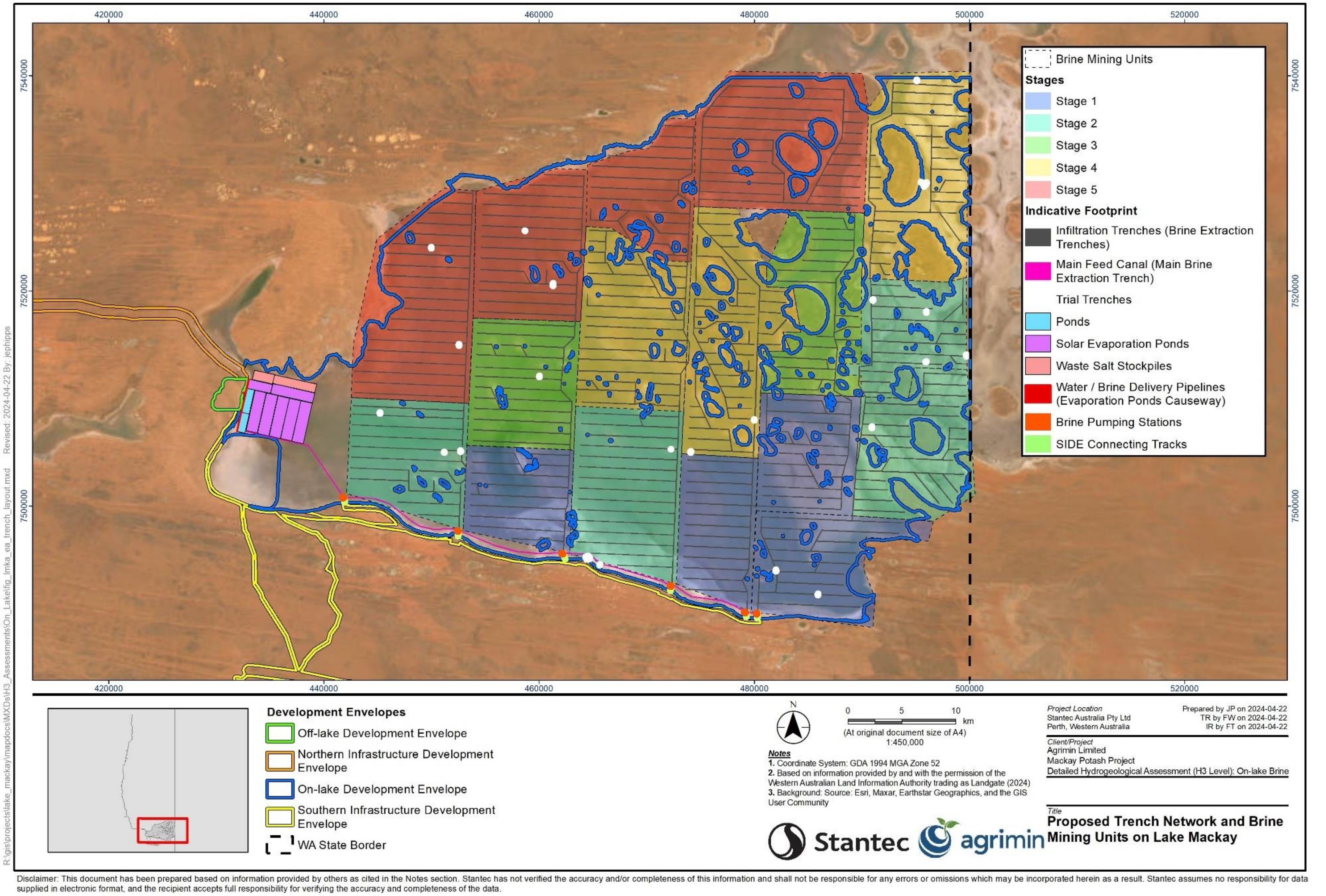

Figure 2-2: **Proposal layout showing the trench network and indicative schedule of BMU implementation on Lake Mackay.**

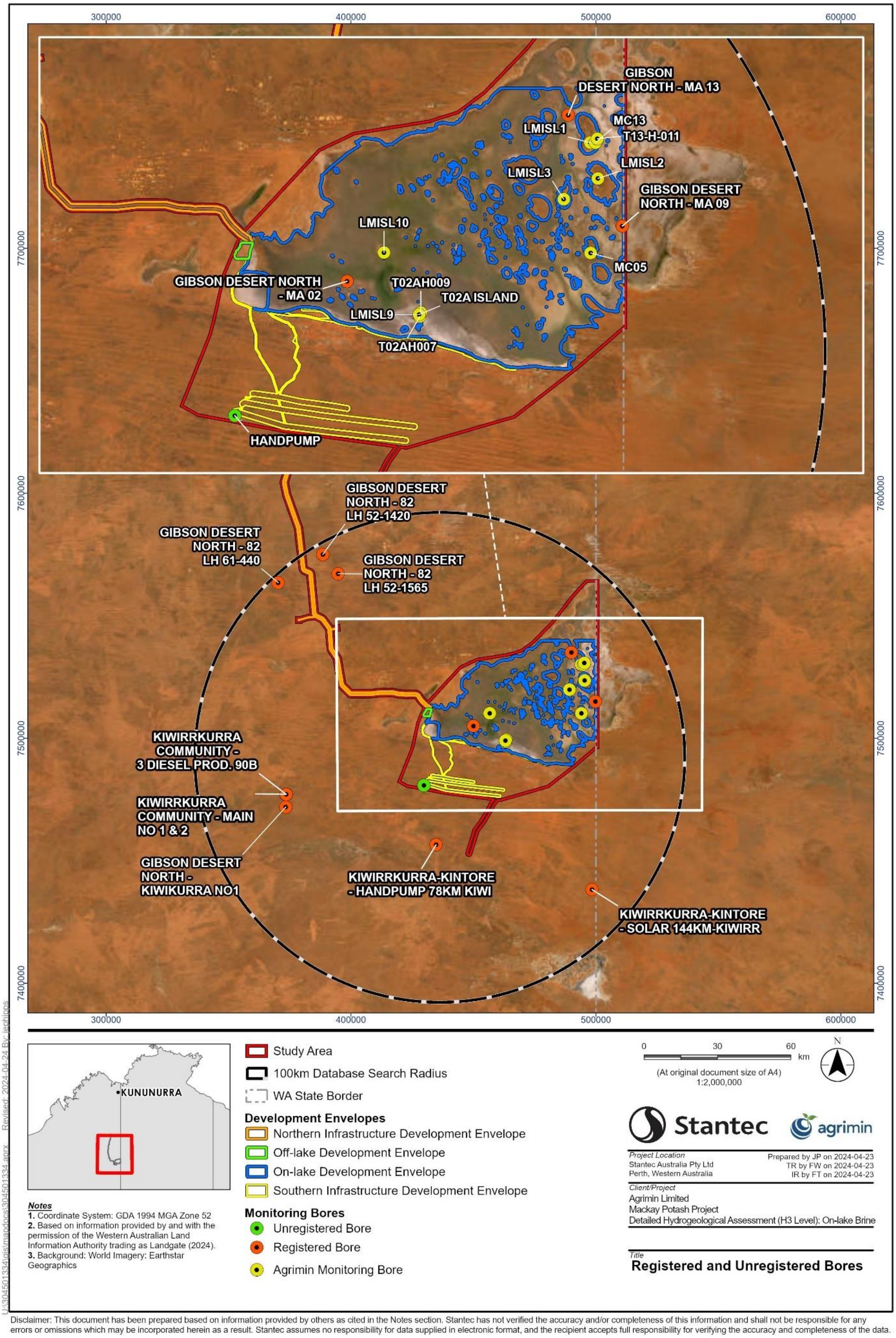

Figure 2-3: Registered and unregistered bores in the vicinity of the Proposal Area (showing on-LDE and island monitoring bores).

2.4. Groundwater Dependent Ecosystems

The Groundwater Dependent Ecosystems Atlas (GDEs Atlas) indicates that 21,442 ha of the Proposal Area has the potential to contain GDEs (**Table 2-1, Figure 2-4**Table 2-1: Potential GDEs mapped within the Proposal Area, with the on-LDE highlighted in grey (Source: BoM 2021).), equivalent to approximately 8% of the Proposal Area (BoM 2021). However, these GDEs have been mapped using remote sensing and have not been verified by ground-truthing. Additional vegetation mapping has been undertaken as part of baseline studies for the Proposal, with a summary of the relevant GDE records, from flora and subterranean fauna surveys, provided in the subsequent sections,

Table 2-1: Potential GDEs mapped within the Proposal Area, with the on-LDE highlighted in grey (Source: BoM 2021).

Development Envelope	Extent (ha) within the Proposal area	
	High Potential GDE (Succulent steppe with scrub; teatree over saltflats)	Low Potential GDE (Hummock grasslands, shrub steppe; mixed shrubs over soft spinifex)
On-LDE	1,256^	0
Off-LDE	661	0
SIDE	2,302	0
NIDE	3,564	13,659
Proposal Area Total	**7,782**	**13,659**

2.4.1. Flora and Vegetation

Numerous flora and vegetation studies have been completed of the Proposal Area (Stantec 2021a), including the lake margins and islands, which adhere to regulatory technical guidance (Environmental Protection Authority, 2016a). Of the 50 vegetation types that have been recorded across the Proposal Area, 11 occur within the On-LDE, represented by the lake islands as the playa is bare of vegetation. No vegetation types represent a Threatened Ecological Community, Priority Ecological Community, or GDE.

The vegetation generally represents comparable landforms in the Mackay subregion of the Great Sandy Desert and Tanami bioregions and consists of *Triodia* hummock grasslands, with some low height open woodlands comprising eucalypts and *Acacia* species and low height open samphires around saline flats and depressions. Chenopod shrublands, dominated by *Tecticornia*, *Frankenia* and *Eragrostis* occur on the margins of Lake Mackay and its islands, typically between the playa and hummock grassland communities (Stantec 2021a).

While there were no GDEs recorded from the Proposal Area, four flora species were identified as having the potential to use groundwater; *Allocasuarina decaisneana*, *Eucalyptus victrix*, *Melaleuca glomerata* and *Corymbia candida*. Of these, *Eucalyptus victrix*, *Melaleuca glomerata* and *Corymbia candida* are considered vadophytes (plants that depend solely on moisture held within the soil profile) and are not groundwater dependent (Stantec 2021b). However, *Allocasuarina decaisneana* (Desert Oak) has the potential to utilise groundwater, although its reliance is unknown and there is limited literature available. This species is however, known to develop deep root systems of up to 10 m, and the tree appears to change form once groundwater is reached (Atlas of Living Australia 2023). There are two records of *Allocasuarina decaisneana* on the landform islands (Stantec 2021a), within one supporting vegetation type (Ad(Eg)TpTb) (Stantec 2021b).

There have been 96 riparian flora taxa from 25 families recorded from Lake Mackay, the islands, and peripheral wetlands, with no GDEs recorded. Vegetation within the riparian zone is dominated by *Tecticornia*, which is diverse (17 taxa) and widespread. However, this genus has relatively shallow root systems, which grow no deeper than 30 cm in the soil profile (Botanica Consulting 2018). It is also unlikely *Tecticornia* access saline groundwater (which is outside their tolerance limits), which occurs at depths at least 0.5 m from the playa surface and typically between 3 m to 10 m in terrestrial habitats of the lake margins and islands (Stantec 2021b). Instead, they most likely access water in the capillary fringe of the vadose zone, which is recharged by rainfall.

2.4.2. Subterranean Fauna

Several studies on the subterranean fauna (stygofauna and troglofauna) have been undertaken of the On-LDE and large landform islands on the lake (Stantec 2021c), which adhere to regulatory technical guidance (Environmental Protection Authority 2016b; 2016c). No subterranean fauna occurs in the brine of the lakebed sediments, as the habitat is not prospective, due to the high salinities and limited interconnected voids (Stantec 2021b).

However, studies of the islands on Lake Mackay have identified three stygofauna species, including the harpacticoid copepod *Schizopera* 'bradleyi' and cyclopoid copepods *Fierscyclops fiersi* and *Halicyclops kieferi*, and an Enchytraeidae sp. While the latter is 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 2021c).

The copepod stygofauna were generally recorded from the largest landform islands, comprising surficial sands, with some finer calcareous or gypsiferous material, and low salinity groundwater overlying the brine in elevated areas (**Appendix A**). Copepods are smaller in size than stygofauna such as syncarids (often found in calcrete aquifers), and appear to disperse more easily, rarely being restricted to one calcrete system (Karanovic 2004). In contrast, the smaller islands generally have lower topographical relief, and are typically characterised by a shallower layer of sand and silt, followed by clay hosting the brine (**Appendix A**), which is not prospective habitat for stygofauna.

2.5. Surface Water Ecosystems

There are no Ramsar wetlands or wetlands of national importance in the vicinity of the Proposal Area. During major flood events, Lake Mackay, its island claypans and peripheral waterbodies are considered highly productive. There have been 53 aquatic invertebrate taxa recorded from the lake, and the peripheral wetlands. The diversity of the lake is lower (<15 taxa) than the peripheral claypans (>40 taxa) while five taxa have also been recorded from one of the larger island claypans. The lake tends to be more homogenous compared to the claypans, due to differences in water quality, substrate, and allochthonous inputs. When inundated, the lake 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 (Stantec 2021b).

The aquatic invertebrate community of Lake Mackay is dominated by halophilic branchiopods (brine shrimp *Parartemia laticaudata*) and copepods *(*cyclopoid copepod *Meridiecyclops platypus)*, with ostracods and insects occurring to a lesser extent. The claypans 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 (Stantec 2021b).

The higher diversity in the freshwater claypans was attributed to a broader range of habitat types, with 10 new taxa identified including two spinicaudatans (clam shrimp) and eight ostracods (seed shrimp). Two of these taxa were widespread throughout the playa and likely occur across the border into the NT. The peripheral wetlands to the south of the lake, also support eight new aquatic invertebrate species (two spinicaudatan and six ostracod taxa) (Stantec 2021b).

The productivity of algae and aquatic invertebrates throughout the lake and peripheral wetlands during flooded conditions provides important foraging conditions, as well as an optimal breeding environment, for waterbirds. One threatened waterbird species (Australian Painted Snipe; En) and up to eight migratory waterbird species have been recorded from Lake Mackay and surrounds during field surveys. Suitable breeding conditions occur for waterbirds, specifically Banded Stilts during larger inundation events (Stantec 2021b).

Lake Mackay is subject to a boom phase during flooding, comparable to other 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 surface water 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. These tend 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 (Stantec 2021b).

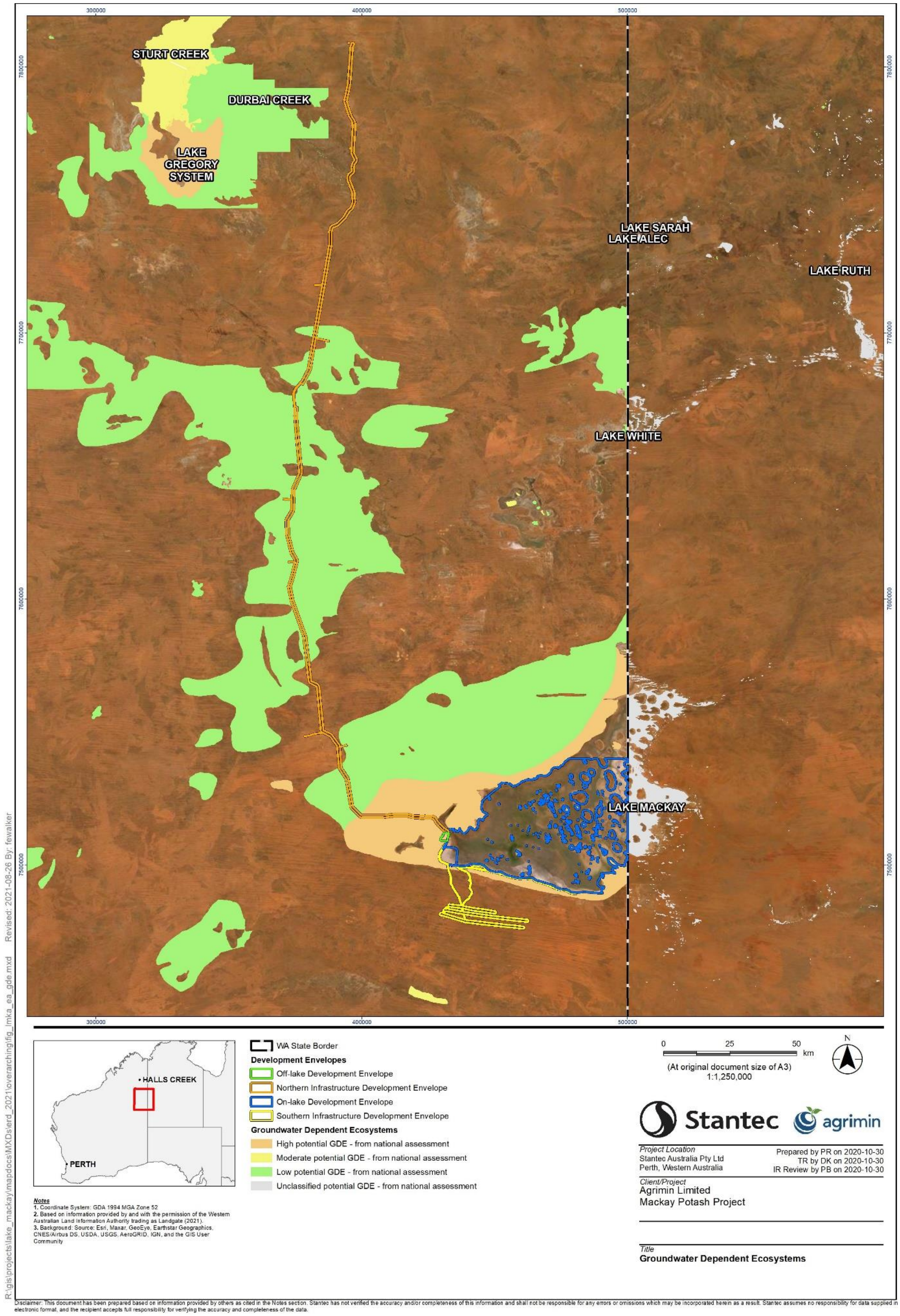

Figure 2-4: Groundwater Dependent Ecosystem mapping of potential GDEs in the vicinity of the Proposal Area (Source: BoM 2021).

3. Previous Investigations

3.1. Geology

Numerous exploration field work programs have been carried out between 2011 and 2020, to investigate and characterise the geology of the Proposal area. The technical memorandums and reports based on these programs are summarised in **Table 3-1**. These are also presented in Appendix I.13 to Appendix I.21 of the Environmental Review Document (ERD) for the Proposal (Stantec 2022), with key technical reports provided in **Appendix A** and **B** of this H3 Assessment. Initial exploration work on the lake comprised shallow drilling programs carried out between 2011 and 2015. Following Agrimin's acquisition in 2015, extensive exploration has been undertaken focusing on the geology of the lakebed sediments, with targeted island drilling in 2019. The location of key investigation bores is shown in **Figure 3-1**.

3.2. Groundwater

A summary of the main groundwater related investigations completed across the On-LDE are presented in **Table 3-1**. Numerous field programs have targeted the surficial lakebed sediments to determine the hydrogeological properties. As part of this, drilling, utilising various methods, has been completed across the lake, with over 250 bores installed, many of which are used for groundwater monitoring. Several bores have been equipped with data loggers, collecting up to five years of continuous water level data. In addition, trial trenches (up to 6 m in depth) have been excavated at 23 locations across the On-LDE, to understand groundwater properties, including the range of hydraulic properties, groundwater quality, groundwater drawdown and potential pumping rates from the lakebed sediments. Groundwater sampling and monitoring was also completed as part of drilling programs on the islands and for the SIDE (process water supply), while Southern Regional bore data was collected as part of subterranean fauna surveys. The results of these extensive investigations were used to develop an integrated groundwater flow and solute transport model for Lake Mackay. The location of key investigation bores is presented in **Figure 3-1**.

Table 3-1: Summary of key hydrogeological and geological studies.

Reference	Title	Outcome
Groundwater Exploration Services 2016	Lake Mackay Preliminary Groundwater Modelling Study	First lake groundwater model and conceptualisation of the system
Hydrorminex Geoscience 2017	Technical Report on the Lake Mackay Potash Project Western Australia	Initial resource calculations and refinement of model parameters
Advisian 2018	Prefeasibility Study: Hydrological and Hydrogeological Modelling	PFS resource defined, mine plan developed
Knight Piesold 2018	Hydrogeological Modelling for the Mackay SOP Prefeasibility Study	Hydrogeological modelling of lakebed sediments
Stantec 2019	Trench Test Analysis Report	Estimate hydraulic conductivity, specific yield and specific storage for the lakebed sediments through evaluation of 17 trench pump tests
Agrimin 2020	Closed Lysimeter Testing Memorandum	Characterisation of evaporation associated with near surface lakebed sediments
Agrimin 2020	Definitive Feasibility Study	DFS level study
Agrimin 2020	Infill Drilling Memorandum	NMR investigations, water quality and water level parameters estimated on a resource grid level around 2 long term pump test trenches (T13 and T02A)
Agrimin 2020	Infiltration Testing Memorandum	Characterise the infiltration parameters of the near surface lakebed sediments
Agrimin 2020	Island Drilling Memorandum	Initial drilling investigations competed on selected islands
Agrimin 2020	Regional Lake Groundwater Levels Memorandum	Characterisation of seasonal and long-term lakebed water level trends
Agrimin 2020	Shelby Tube Sample Memorandum	Recover undisturbed sediment samples for laboratory analysis and physical properties testing
Stantec 2020	Trench Pump Test Analysis Report	Analysis of 17 trench pump tests and estimate hydrogeological parameters
Agrimin 2020	Island Impacts Groundwater Memorandum	Characterise island hydrogeology and assess trench pumping on island water levels above lakebed sediments
Stantec 2020	Integrated Groundwater Flow and Solute Transport Model Report	Mine plan developed and mine reserve estimated.
Agrimin 2020	Long Term Pump Test Memorandum	Estimate hydraulic conductivity, specific yield, and specific storage for the lakebed sediments from 6-month pump tests on two trenches
Stantec 2020	Lake Mackay Stage 1 and Stage 2 Surface Water Assessment	Complete hydrological modelling for the Project area, to assess flooding frequency and the risk associated with development and understand the potential impacts on the hydrological regimes of the lake
Stantec 2020	Islands Characterisation Memorandum	Characterization of Lake Mackay Islands
Stantec 2020	Recharge Assessment Memorandum	Quantify profile hydraulic and solute transport properties that could be used to assess recharge at various groundwater depletion levels expected during mining operation
Stantec 2020	Recharge Lab Assessment Memorandum	Inform the likely variation in groundwater recharge as part of the regional modelling of the lakebed sediments
Agrimin 2021	Groundwater Sampling and Analysis Memorandum	Analytical information from on-lake monitoring bore sampling and analysis
Agrimin 2024	Consolidated Island Impact Memo	Updated and revised hydrogeological information from island monitoring bores and on-lake bores, including groundwater chemistry, groundwater levels and conceptualisation

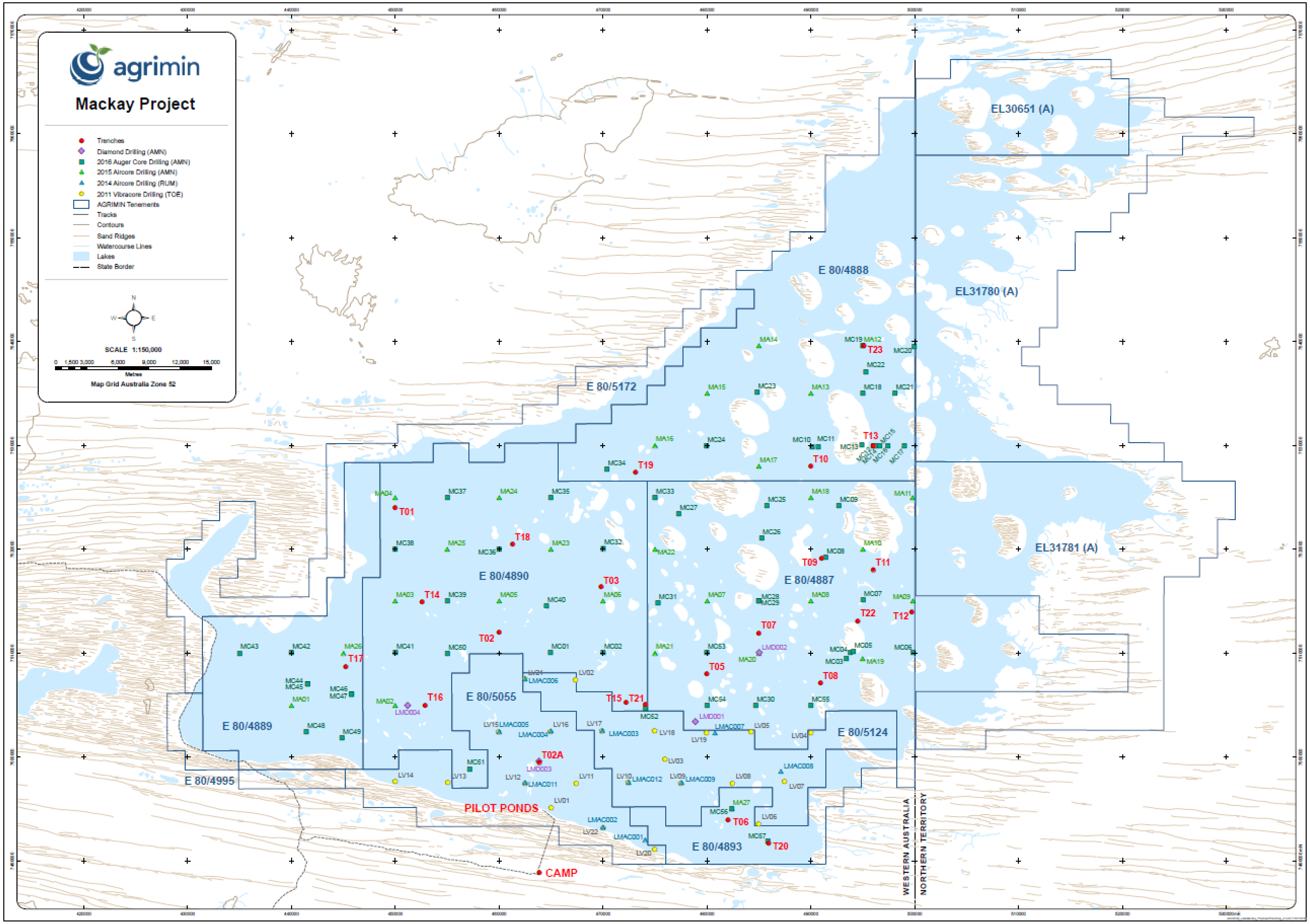

Figure 3-1: Lake Mackay trench test and monitoring bores locations.

4. Hydrogeology

4.1. Geology

Lake Mackay is located in the Great Sandy Desert on the border between Western Australia and the Northern Territory. The geology of the Lake Mackay area is summarised in the Webb 1:250,000 geological series map (Spaggiari *et al*. 2016). The lake overlies the western margin of the Paleoproterozoic Arunta Complex and Neoproterozoic Amadeus and Ngalia Basins. The Amadeus Basin occupies much of the southern quarter of the northern territory and extends 150km into Western Australia. The dominant surface geological units of Lake Mackay (**Figure 4-1**), are evaporitic sediments across the lakebed surface, aeolian and evaporitic sediment around the lake edges and islands and alluvial on the larger island features.

4.1.1. Lake

The surface of Lake Mackay typically comprises a thin crust (<5 mm), of evaporitic material, predominantly halite. In the west of the lake halite coverage is more extensive than in the east, where it becomes patchy and interspersed with increasing proportions of gypsum and windblown quartz sands. The western halite crust typically forms a near horizontal surface, whereas the lakebed surface in the east is noticeably more undulating, and contains air filled vugs/void spaces. The halite crust has been observed to dissolve rapidly after rainfall and reprecipitate when flood water evaporates.

Across much of the lake surface, the halite crust is underlain by variably decomposed organic material, which can be up to several cm thick and typically occurs at surface or within approximately 5 cm of surface. This organic layer is often exposed in patches where surficial halite is not present. This organic material typically has a high moisture content and is black in colour. The relatively thin crust of halite and organics is underlain by a variable lakebed sequence which displays distinct characteristics east-west across the lake area.

The shallow lakebed sediments are the primary geological unit of interest within the On-LDE and vary in composition from east to west due to varying depositional processes (**Table 4-1**). Island and claypan geologies are described separately due to their unique characteristics.

- **Western lake portion** 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 (**Figure 4-2**); and
- **Eastern lake portion** 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 (**Figure 4-3**).

The lacustrine or lakebed sediments sequence of Lake Mackay is characterised into three broad lithological units, including:

- Fine to coarse grained gypsum sand, with an approximate thickness of 1 m that varies laterally east-west across the lake (**Figure 4-4**). Gypsum sand horizons are noticeably thicker in the east. This unit progressively grades downward into clayey and silty sand approximately 3 m below ground level (mbgl).
- Sandy and silty clay, containing discrete interbedded layers of evaporites (including granular/crystalline gypsum, halite and calcite), and organics continues to around 150 mbgl. The density of the clays increases with depth; and
- A palaeochannel unit in the southern section of the lake, comprising sands and gravels, with minor silt and clay continues to a known depth of 211 mbgl. The upper part of this unit contains discrete detrital iron, lignites and evaporite horizons. The lakebed sediments are unconformably underlain by what is interpreted to be a highly weathered pelitic bedrock.

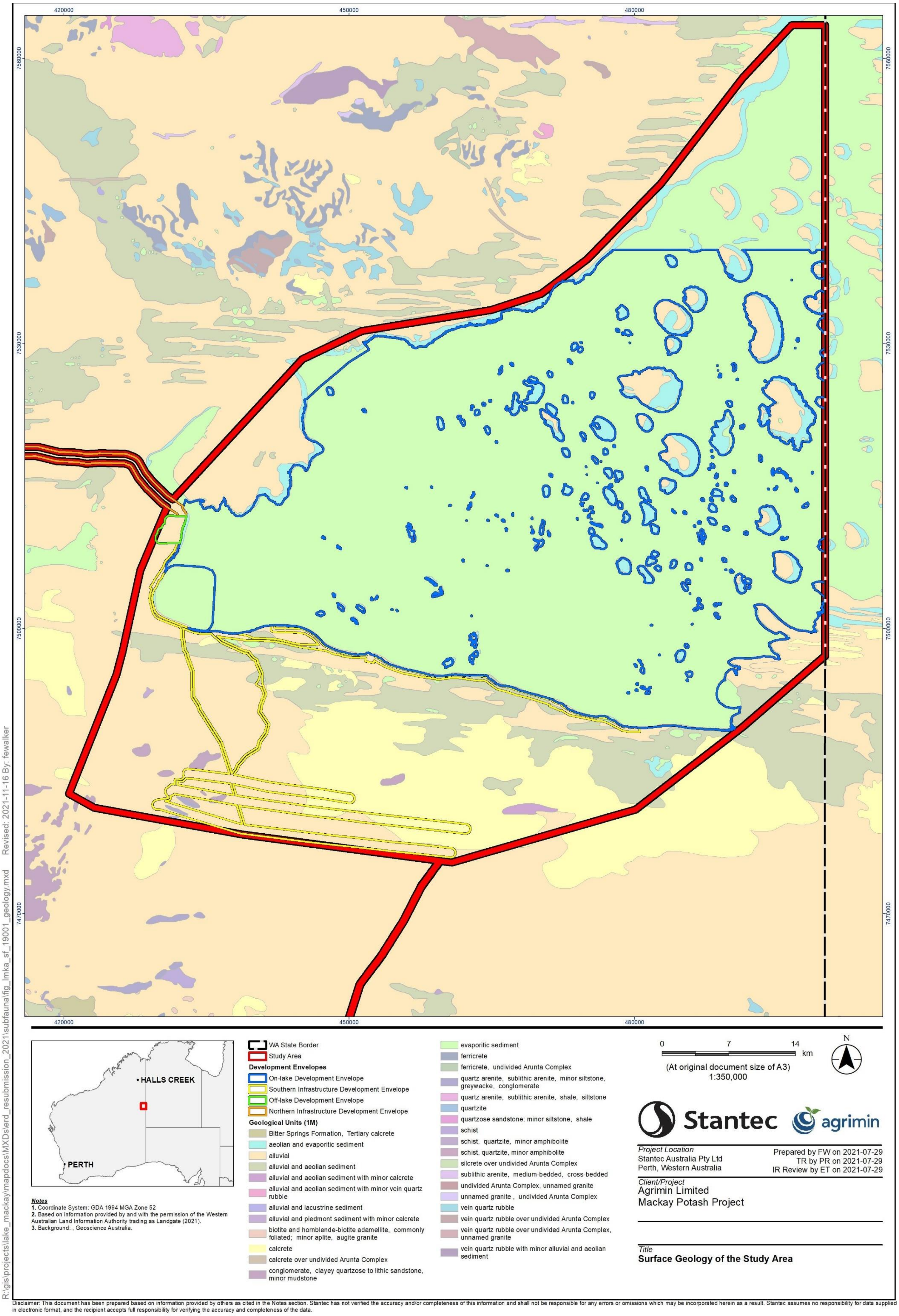

Figure 4-1: Detailed surface geology (1M scale) of the Proposal Area.

Table 4-1: Typical lithological descriptions for Lake Mackay (surface to 6 m below).

Lithology	Description
Surficial Halite	Surficial halite layer occurs as either; <5mm white crystalline evaporite layer in the western and central areas of the lake. In the east the surficial halite is intermixed with pale brown fine to medium gypsum sand and forms a brittle crust with many voids and vugs.
Organic Material	A dark grey organic layer (preserved material) ranges in thickness from 3 mm to 30 mm. This layer lies immediately below the salt crust in the western and central areas of the lake and is exposed at the surface in depressions where the surficial halite crust has been dissolved. In the east, this layer occurs at variable depths immediately above the water table and first occurrence of clay.
Gypsum Sand	Gypsum sand is widespread across the lake and occurs in the western and central areas as interbedded layers in silt and clay layers. Gypsum sand in the eastern region of the lake immediately underlies the brittle crust makes up a major portion of the sediment profile. It varies from fine to coarse and is friable and unconsolidated.
Red Brown Clay	Red brown clay with interspersed bands of crystalline gypsum sand is the dominant lithology on the lake. It occurs within 0.1m of the surface in the west and up to 2.0 m from the surface in the east.
Crystalline Gypsum	Crystalline gypsum occurs as both interspersed crystals <50 mm in size at the lake water table and large laterally continuous horizons of consolidated crystal growths >100 mm at between 3 to 6 m depth, primarily encountered in the eastern region of the lake.

4.1.2. Islands

Lake Mackay is host to more than 270 islands within the On-LDE and geological information collected from several exploration programs. Two groundwater bores were installed by Agrimin during a drilling program in 2016 (MC05 and MC13) and, five bores were installed on islands varying in size across the lake in 2019 (LMISL-001, LMISL-002, LMISL-003, LMISL-009 and LMISL-010). Drilling methodology and bore construction details for the 2019 drilling program are summarised in (Stantec 2021d).

The islands range from small unvegetated formations to large formations (large or landform islands) that host extensive sand dunes that have migrated across the deflated lakebed (**Figure 4-5**). The islands range from less than 1 m in height to more than 13.5 m, with the landform islands providing the greatest topographic relief. Drilling investigations completed on six lake islands confirmed that they are surficial features of variable thickness underlain by lakebed sediments and are not linked to another subsurface geologic feature.

The large and landform lake islands are composed of unconsolidated aeolian sand at surface and underlain by calcareous material and gypsiferous sand. Clay content increases with depth and typically marks the transition from island sediment to the lakebed sediments. The thickness of the island sequences varies depending on the size of the island and topographical elevation. Varying island geomorphologies are shown in **Figure 4-6**.

Table 4-2: Typical Island lithology descriptions (from surface up to 11 m below).

Island Category	Number of Islands	Max Elevation range (above lake surface - m)	Lithological Description	Associated Monitoring Bores
Landform Island	3	10 – 12	Aeolian sand, quartz and alluvial deposits, calcrete	MC13 LMISL-001 LMISL-002
Large Island	20	7 – 13	Aeolian sand, quartz and alluvial deposits, calcrete	MC05 LMISL-003
Intermediate Island (Elevated Dunes)	24	7 – 10	Aeolian sand, quartz and alluvial deposits, calcrete	None
Intermediate Island (Low Dunes)	8	5 – 9	Alluvial deposits, some aeolian sand, calcrete	None
Small Island (Alluvial)	211	1 – 7	Alluvial deposits, some aeolian sand, minor calcrete	LMISL-009 LMISL-010
Small Island (Gypsiferous)	5	2 – 6	Alluvial deposits, gypsiferous/clay deposits, minor calcrete	None

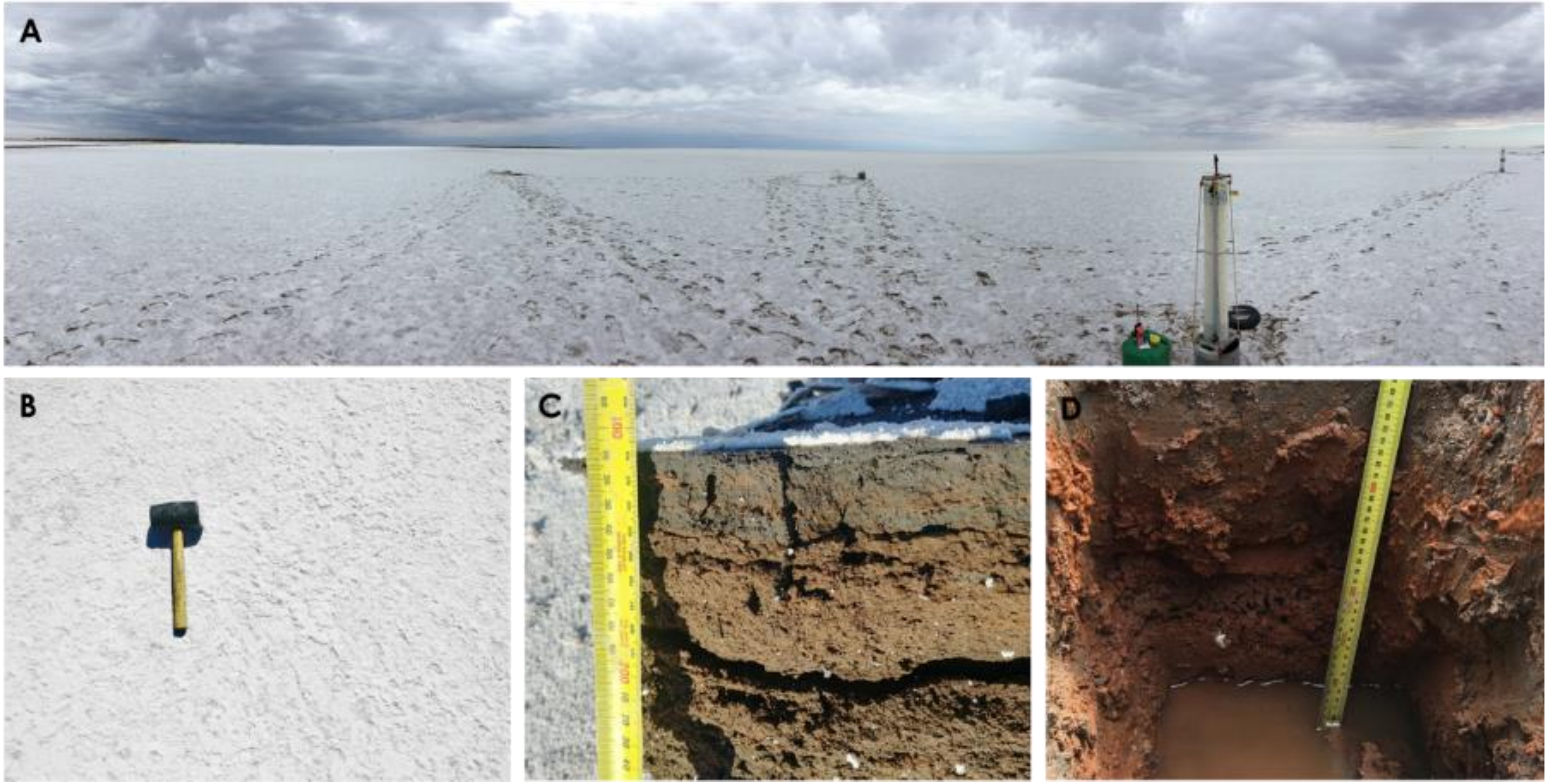

Figure 4-2: Western portion of Lake Mackay near surface sediment. (A) Surface expression of western lake sediment, (B) Evaporitic salt crust, (C) Organic mud and clay underlying salt crust, (D) Red-brown clay down to lake water table.

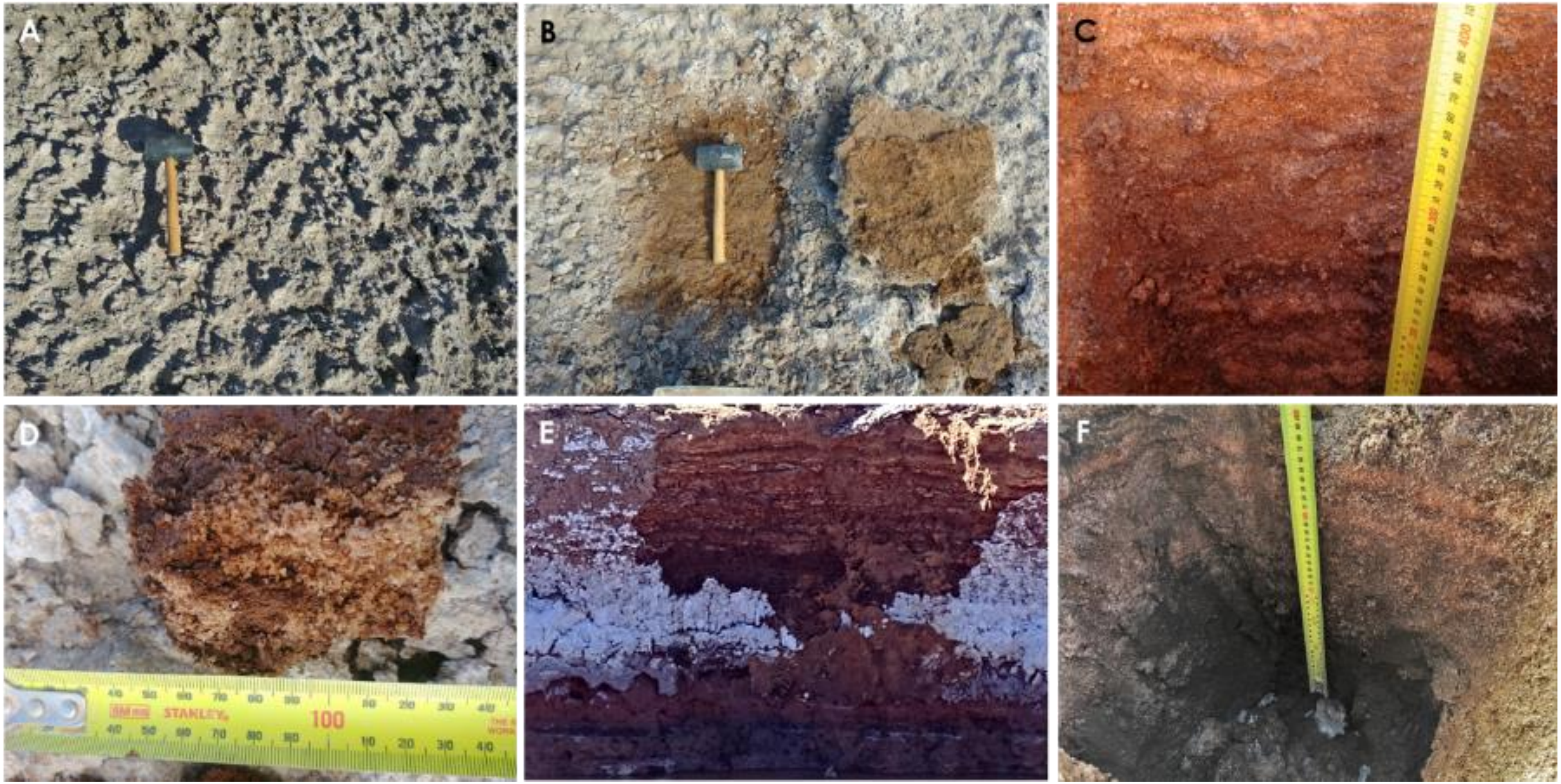

Figure 4-3: Eastern portion of Lake Mackay near surface sediment. (A), (B) Gypsiferous crust, (C), (D), (E) Coarse gypsum sand underlying crust, (F) Grey-brown to red-brown clay down at lake water table.

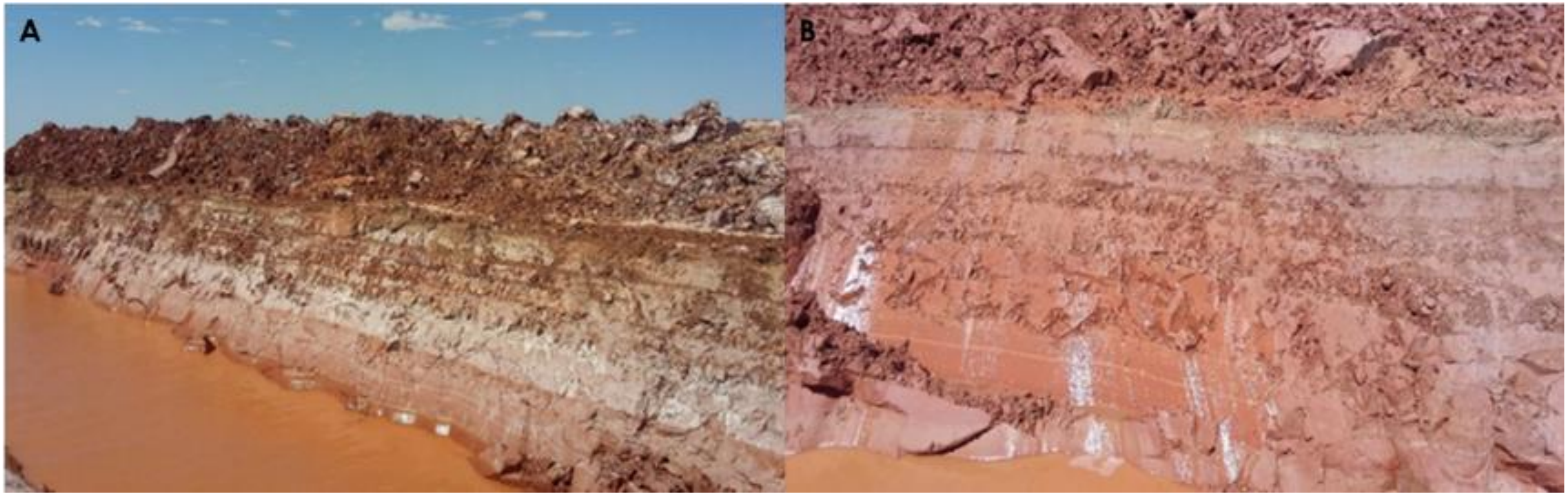

Figure 4-4: Example of lakebed stratigraphy (up to 3 m) exposed during the excavation of pilot trenches.

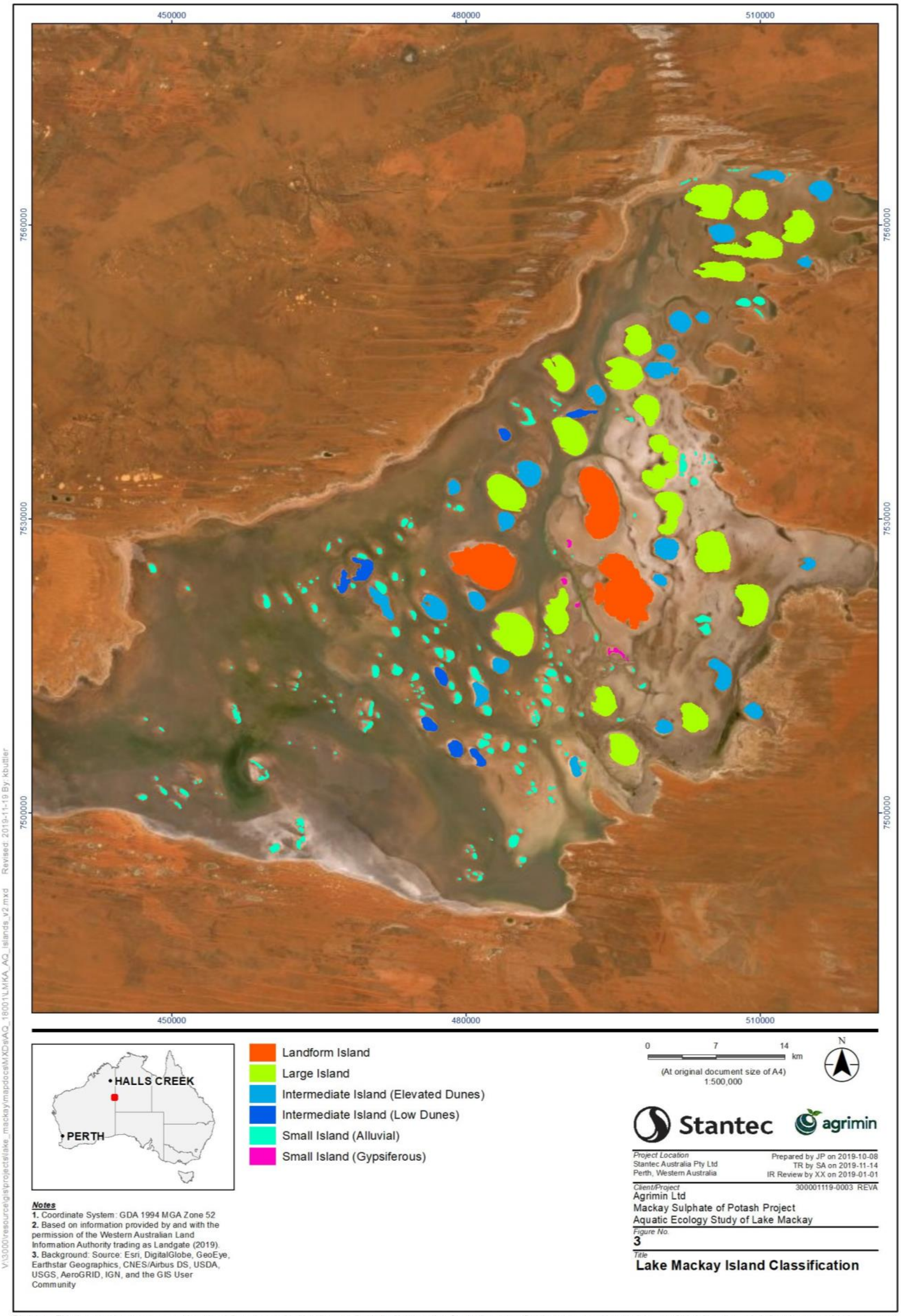

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Figure 4-5: Lake Mackay islands characterisation, indicating the six broad categories.

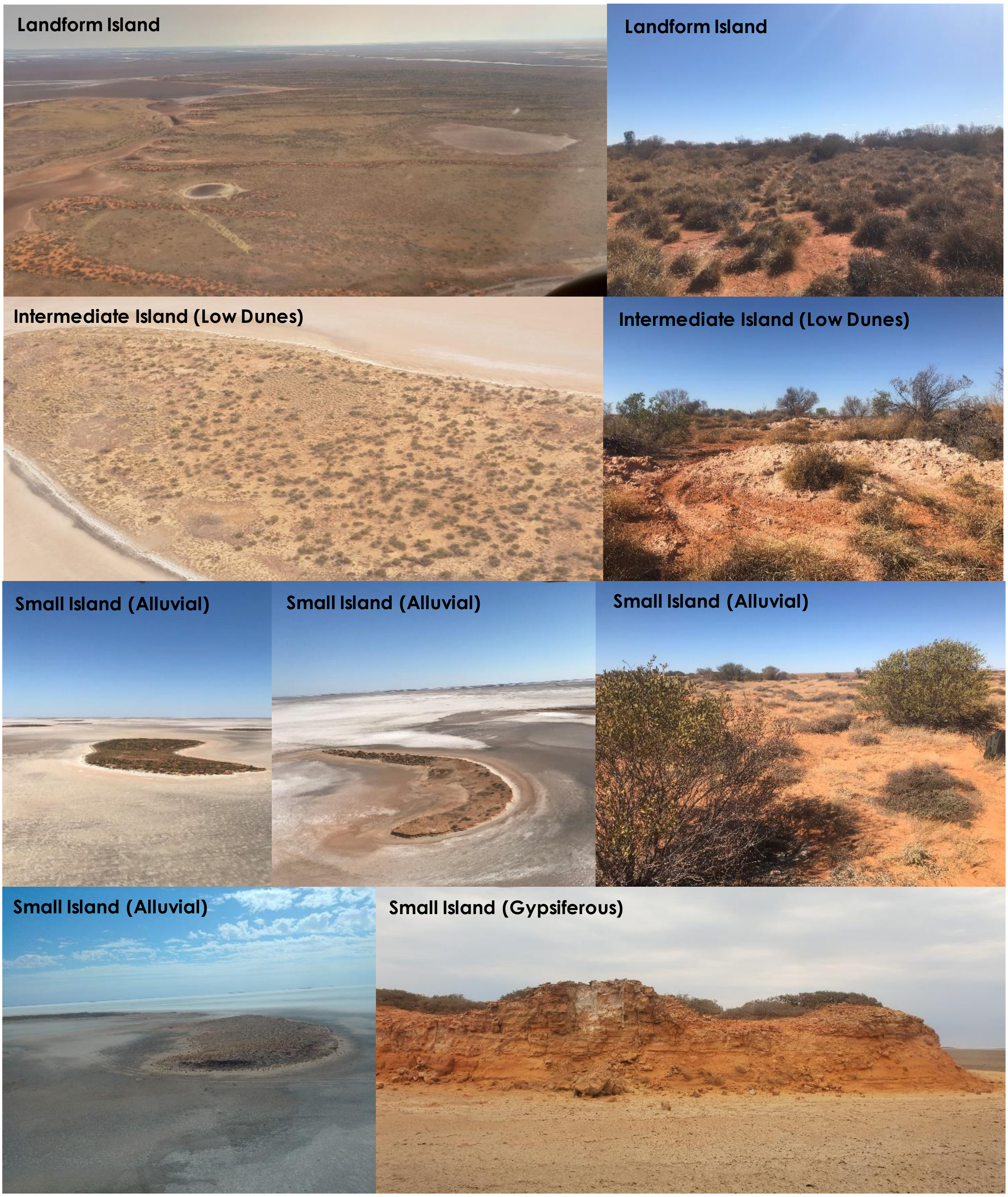

Figure 4-6: Island geomorphologies on Lake Mackay from largest to smallest, as indicated.

4.2. Hydrostratigraphy

4.2.1. Lake

4.2.1.1. Resource Zones

Stantec (**Appendix B**) defined two main lake resource zones, an upper zone (UZ) and a lower zone (LZ), that host potassium-rich brines in lakebed sediments. These lakebed sediments lie unconformably atop a consolidated basement surface that defines the lower limit of the resource. A resource model schematic which conceptualises the layout of these main resource zones and associated subdivisions in the resource model is shown in **Figure 4-7** (modelled for **Section 6**). The detailed conceptualisation of the lake and a representative landform island including trenching, is presented in **Figure 4-8** and is based on hydrogeological and hydrochemical properties, and high-resolution Lidar and drilling data. The vertical extents of the zones that host the potash brine resource and the model layer (**Section 6**) that correlates with each hydrostratigraphic interval is summarised below.

4.2.1.2. Upper Zone

The UZ extends from the lakebed surface to a vertical depth of 11 m (**Figure 4-7**). The UZ is subdivided into an upper zone top (UZT) and upper zone bottom (UZB). Exploration records indicate the lakebed sediments are saturated below an average depth of 0.5m below lakebed surface through most of the year although the water table does vary over the wet and dry seasons. The unsaturated interval from surface to approximately 0.5m below lakebed surface, not including islands, contains potassium salts precipitated as a result of past fluctuations in brine levels. All zones (horizons) below the unsaturated interval of the UZT to the basement surface are saturated with brine. The brine-saturated portions of the UZT extend from 0.5m to 3m below lakebed surface.

The UZB is a sedimentologically similar interval to the UZT above although contains a lower sand content. The UZB extends to a depth limit of 11m below the lakebed surface. The majority of the hydrologic and brine chemistry components used for resource estimation were sourced from test site locations located in the UZ.

4.2.1.3. Lower Zone

The LZ interval represents the zone between the UZ and the basement surface and is separated into three horizons LZ1, LZ2 and LZ3, as shown in **Figure 4-7**. The LZ1 and LZ2 are sedimentologically similar to the UZB above but with increased clay content. Separation of the LZ1 and LZ2 is based on the quantity and depth of drill hole penetration of the lakebed sediments below the UZ. The LZ3 includes an incised paleochannel that is predominantly a sandy interval as opposed to a relatively clay rich LZ2 above. A deep drilling program conducted by Agrimin from November 2019 to January 2020 encountered artesian conditions in paleochannel sediments in channels delineated using surface geophysics. The LZ3 unit, the extents of which are defined from geophysical surveys and drill hole penetrations, extend from a depth of 150m below surface to a maximum depth of 211m below surface.

4.2.1.4. Conceptual Hydrogeologic Processes

Brine will be produced from the lakebed sediments via shallow trenches excavated into the UZ and conveyed to a series of pre-concentration and production ponds to concentrate potassium salts prior to harvesting and processing in crystallization plant to produce SOP. Production trenches will fully penetrate the more permeable UZT sediments and partially penetrate the less permeable, but much thicker, UZB sediments. The trench network will be pumped down to a level at the base of the UZT. Initial drainage of the specific yield porosity in the UZT will occur in the area surrounding the trenches. As pumping continues the water levels between trenches are drawn down creating hydraulic gradients which cause brine to flow horizontally toward the trenches in the UZT and upper UZB, radially upward in the UZB to the trenches, and vertically from the UZT to the UZB, from the lower UZB to the upper UZB, and from the LZ1 to the UZB.

4.2.2. Islands

The surficial island geology comprising permeable aeolian sediment and where present, calcareous material of variable thickness, are underlain by lakebed sediments and not linked to another subsurface geologic feature. This upper surficial material hosts less saline groundwater, in the gypsum sands (with clay), sandy clay and clay lithologies (**Appendix A**).

The island groundwater is unlikely to be hydraulically isolated from the lake UZ and there may be hydraulic continuity. This is supported by the island lithology logs. The less saline groundwater appears to be a transition zone from the brine and may only be chemically differentiated by water density effects; less saline groundwater overlies the brine. Although present on the islands, this portion of groundwater is unlikely to be hydraulically independent from the brine groundwater hosted in the lakebed sediments. While there is no information available on the elevated central areas of the islands, there is also potential for discrete seasonally perched groundwater aquifer systems to occur within the shallower calcrete units, which may be hydraulically distinct from the lakebed sediment units. However, of the island bores that noted calcrete units (LMISL01, LMISL02, LMISL03, LMISL09 and LMISL10), the standing water levels were recorded between approximately 0.3 to 1.6 m below these units (**Appendix A**). This indicates that the calcrete units at these locations may not host a perched calcrete aquifer.

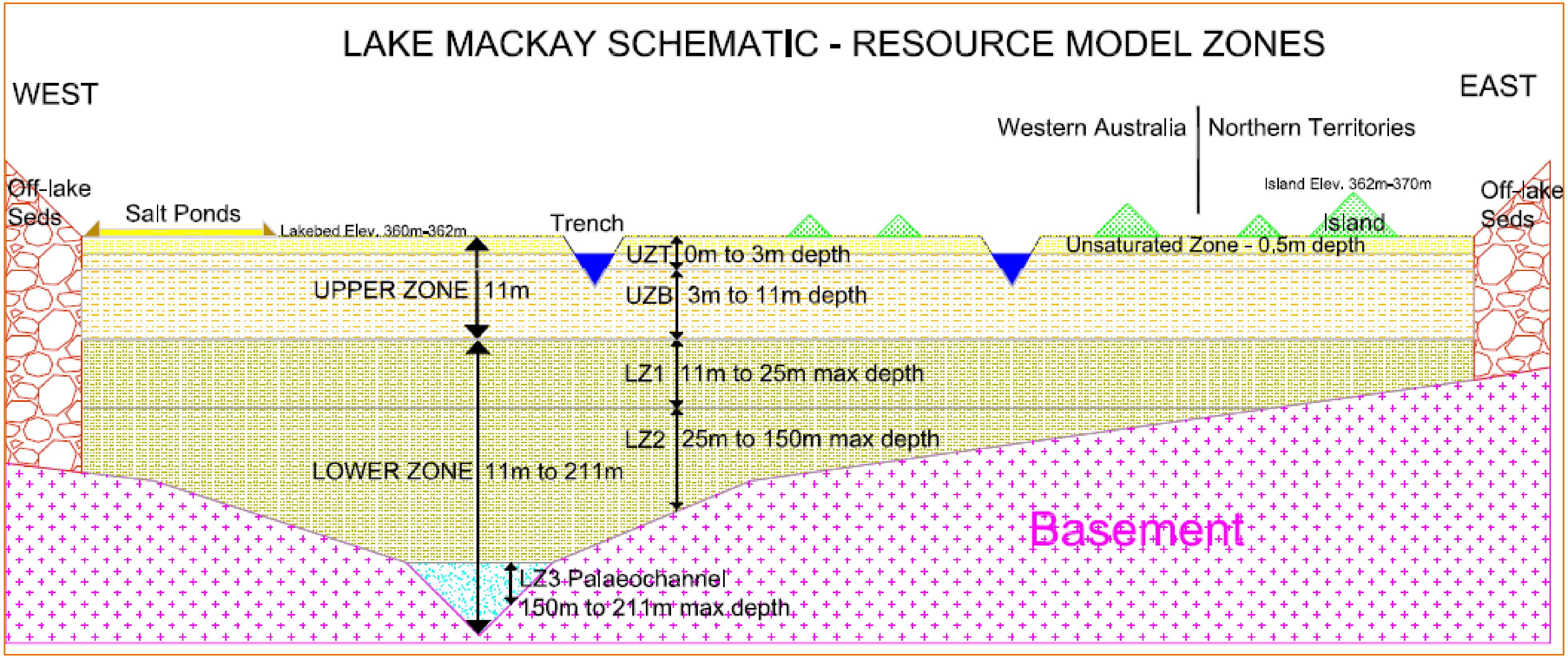

Figure 4-7: Resource model schematic cross section (horizontal distribution not to scale).

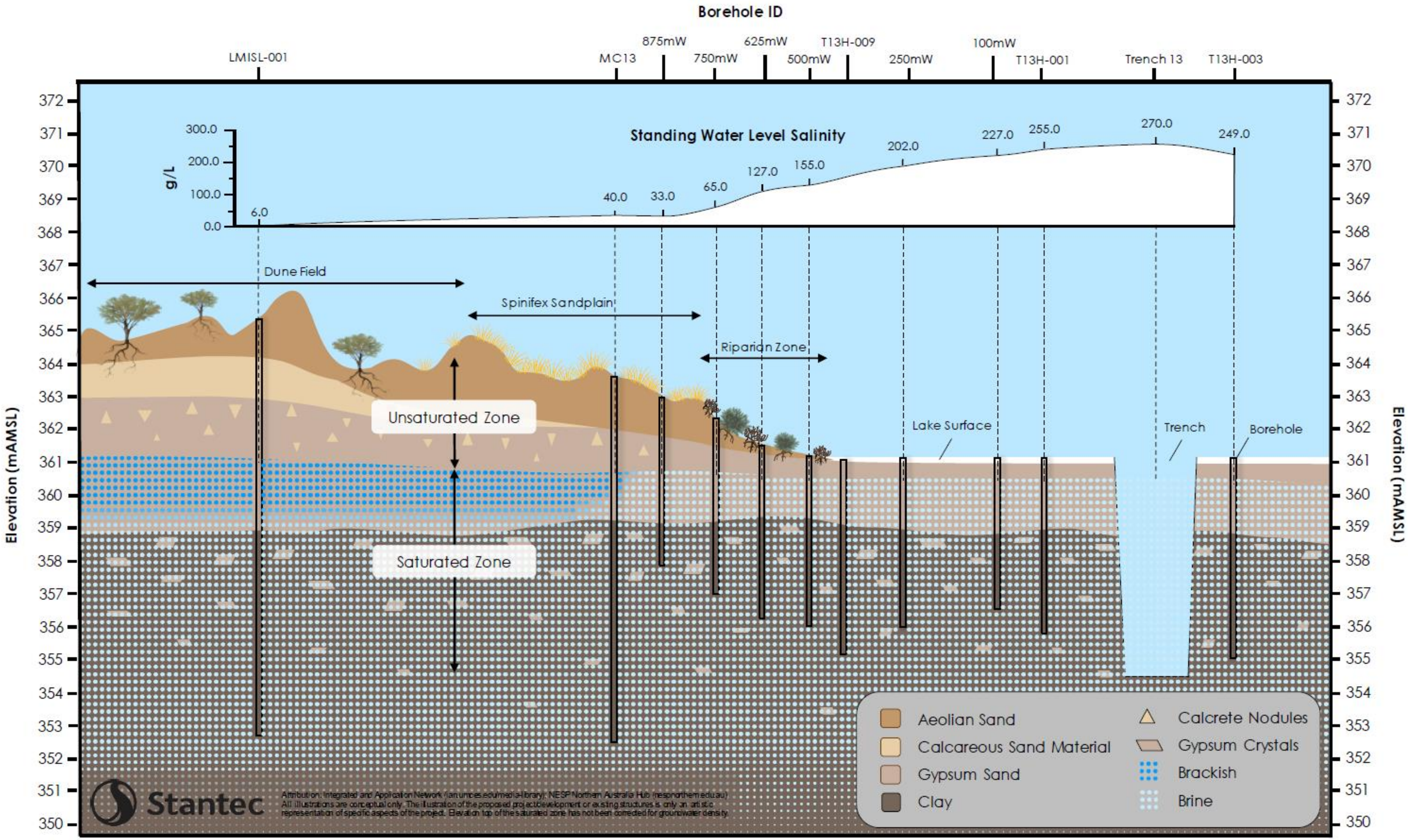

Figure 4-8: Conceptualisation of Lake Mackay and landform islands, based on high resolution Lidar data, salinity readings and drill log data.

4.3. Recharge and Discharge

4.3.1. Lake

Recharge, a key parameter investigated, is predominantly from direct rainfall onto the lake surface. Surface water contributions from the immediate catchment areas surrounding the lake are infrequent and only occur as a result of major rainfall events. As the lake is a terminal drainage point for the surrounding watershed, discharge is solely from evaporation and evapotranspiration.

Groundwater characteristics associated with the lakebed sediments varies from east to west across the lake (**Appendix B**), due to the differing geological composition and can be broadly summarised as follows:

- **Western lake portion** - relatively low infiltration rates (range 1.8 mm/h to 42 mm/h) and low hydraulic connectivity (range 0.46 m/day to 5.22 m/day) (**Appendix B**). This results in water remaining on the surface for several days following a rainfall event.

- **Eastern lake portion** - high infiltration capacity (range 1,280 mm/h and 5,750 mm/h) and high hydraulic conductivity (range 6.7 m/day and 200 m/day) (**Appendix B**). The high infiltration rates of this area result in surface water rapidly infiltrating the lakebed sediments following major rainfall events.

In addition, from extensive recharge and evaporation test work, the east and west portions of the lake were further subdivided into four recharge and evapotranspiration zones (Zones 1 to 4). Recharge as a percentage of the mean annual precipitation ranged from 38% to 43% in the western recharge Zones 1 and 2 respectively, and between 18% to 13% in the eastern recharge Zones 3 and 4 respectively (**Appendix B**). The relevance of this is that as groundwater levels decrease, the amount of recharge increases. The most recharge is experienced in Zones 1 and 2, with the least recharge occurring in Zone 4 (**Figure 4-9**).

While infiltration is high in Zone 4 (**Figure 4-9**), evaporation of stored water in the profile is quickly evaporated reducing the amount of time for water to migrate past the groundwater reference depth. Evaporation is likely to occur within the upper ~ 1 m of the lake sediments, where capillary forces facilitate evaporation of brine. Additional inflows and recharge to the lake system may occur from paleochannels connecting to Lake Mackay and intersecting the lake in the east and along the southern boundary, including groundwater upward migration from the basement.

4.3.2. Islands

During rainfall events, recharge occurs across the island footprint, with evaporation effects reducing some recharge potential, including from vegetation, through evapotranspiration. Rainfall that is not captured by these outputs, is percolated through the highly porous sands and clay into the less saline water table, where a noticeable increase in groundwater head levels have been recorded (**Appendix A**).

The larger islands may be considered significant recharge zones. Initial data collected from field investigations on one of the major landform islands are that the island features act as recharge zones to the underlying lakebed sediments. Above average rainfall events (>300 mm in one month) are likely to result in significant recharge of low salinity groundwater on the landform islands, saturating the vadose zone and increasing groundwater levels to within 0.6 m of the surface (**Appendix A**). This process is also likely responsible for sustaining vegetation on the islands.

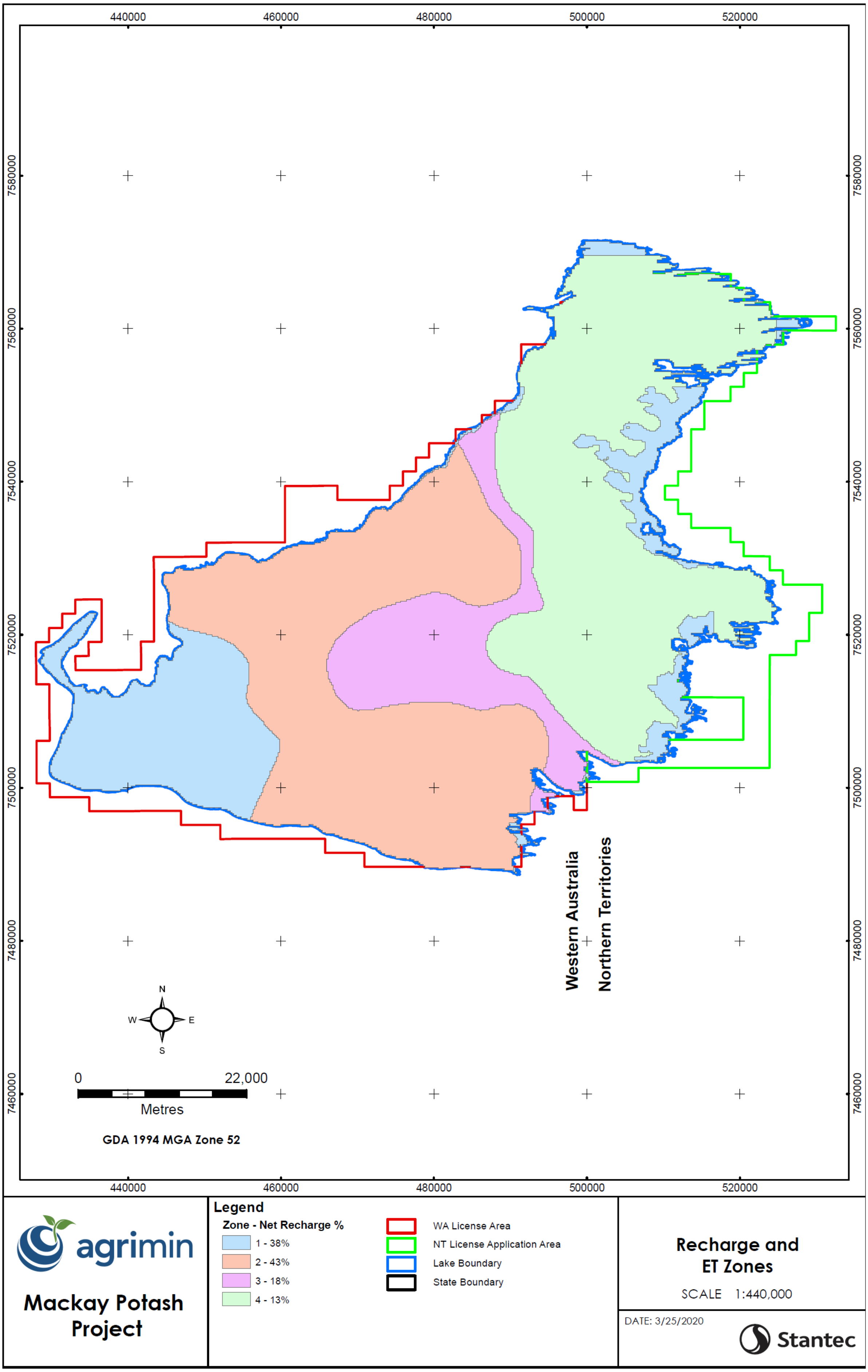

Figure 4-9: Recharge and evapotranspiration zones (not to scale).

4.4. Groundwater Flow and Water Levels

4.4.1. Lake

Stantec (**Appendix B**) described a shallow groundwater gradient that generally follows the topography of the lake and flows from northwest to southeast. Groundwater elevations for the shallow lakebed sediments from March 2019 during the wet season and September 2019 at the end of dry season are presented in **Figure 4-10** and **Figure 4-11**, respectively. Horizontal groundwater gradients range from a high of 0.0002 metres/metre (m/m) at western edge of the lake to 0.00002 m/m in the center of the Lake and average on the order of 0.000045 m/m across the lake from northwest to southeast.

Eleven bores across the lake have been instrumented with datalogging pressure transducers over various time periods with three lake surface bores (MA02, MA09, and MA13B) having data starting in September 2015. Hydrographs are provided in **Figure 4-12A-C**. The lake hydrographs show yearly fluctuations in water levels over a range of approximately 0.5 m to 1 m between the November to April wet season and May to October dry season. Immediate water level responses to large rainfall events are observed indicating a large portion of precipitation from larger rainfall events is recharging the brine aquifer.

Groundwater elevation hydrographs from September 2015 to September 2019 are plotted with the rainfall records from the Kintore Station (Walungurru) and the Agrimin Pilot Ponds weather station. The Kintore Station and Pilot Ponds rainfall data indicate that 2018 and 2019 were much dryer than normal years in comparison to long-term rainfall records from the former. Wet season precipitation in 2018 and 2019 appears to occur in less intense rainfall events over a shorter than normal wet season.

Water levels over the period from September 2015 to April 2017 show much less seasonal fluctuation than those over the period from April 2017 to September 2019. Prior to April 2017, MA02 water levels generally range from just at or below ground surface to about 40cm below ground surface. During the abnormally dry period from April 2017 to September 2019 much larger differences between wet season and dry season water levels are observed with MA02 water levels ranging from just below ground surface to approximately 70 cm below ground surface during this dry period. Based on the long-term rainfall record from Kintore, the 2015 and 2016 water levels appear to be more representative of water table conditions that could be expected during most of the LoM.

Bores were installed in the paleochannel, which comprised of two multilevel completions (LMD-001 and LMD-003), and one completed over the entire depth interval. Field observations during drilling and bore completion activities indicate an artesian pressure within the paleochannel completions. The water level in bore LMD-003 has been measured at 2.2 m above ground surface before being capped.

4.4.2. Islands

The depth to groundwater on the islands of Lake Mackay varies, depending on immediate topography, however, is typically less than 5 mbgl (**Appendix A**). Groundwater levels are influenced by a dynamic equilibrium between precipitation, evaporation, and evapotranspiration. Hydrographs are presented in **Figure 4-13A-C**. The island hydrographs, show the landform island bores in the east (**Figure 4-13A-B**), with minimal response to rainfall fluctuations with a gradual decreasing head at MC13, however some slight seasonal variation at LMISL01. Immediate water level responses to large rainfall events are observed in the small island bore LMISL09 (**Figure 4-13C**), in the west, which demonstrates the characteristically increased head during wetter periods, and a decline into the drier periods.

The island groundwater system is a vertically and laterally continuous aquifer, with a saline transition (mixing) zone. The lower salinity (brackish) groundwater from recent recharge, is the upper portion and the more saline (brine) is the deeper portion, where the transition zone, via diffusion would occur. No significant distribution of advection flow would take place in the transition zone, given the very shallow lake brine gradient (see **section 4.4.1** above). A vertical density distribution would occur in this transition zone, potentially resulting in less saline groundwater being confined to the island footprint and dependent on the lithological thickness, enabling the local water table to be greater than the typical lakebed sediment brine levels. These pseudo-closed systems would temporarily host fresher and shallower groundwater, which is evident by the presence of gypsum crystals, which indicates a fluctuating water table (**Appendix A**).

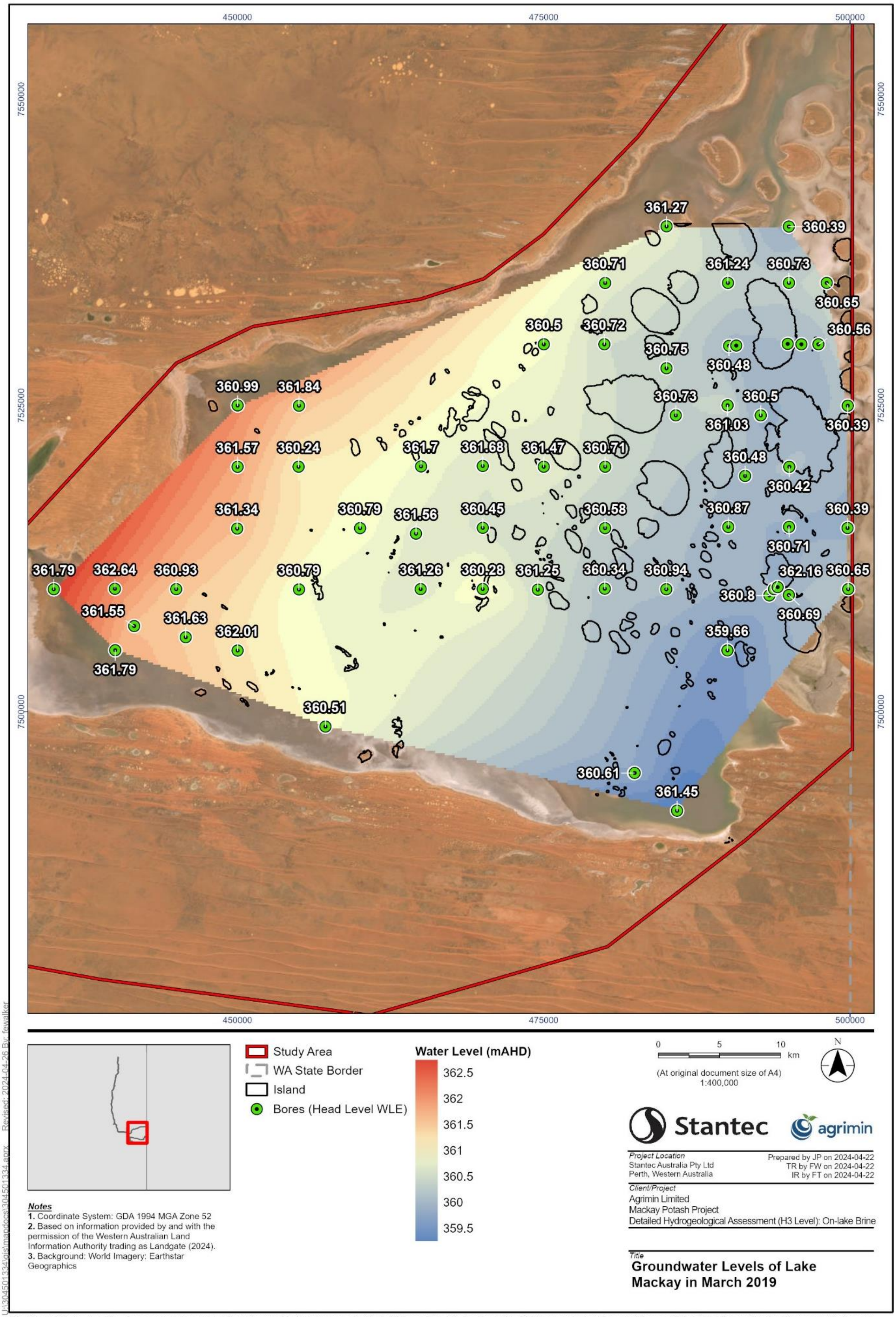

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Figure 4-10: Groundwater levels of Lake Mackay in March 2019 (wet season), indicating bore head levels.

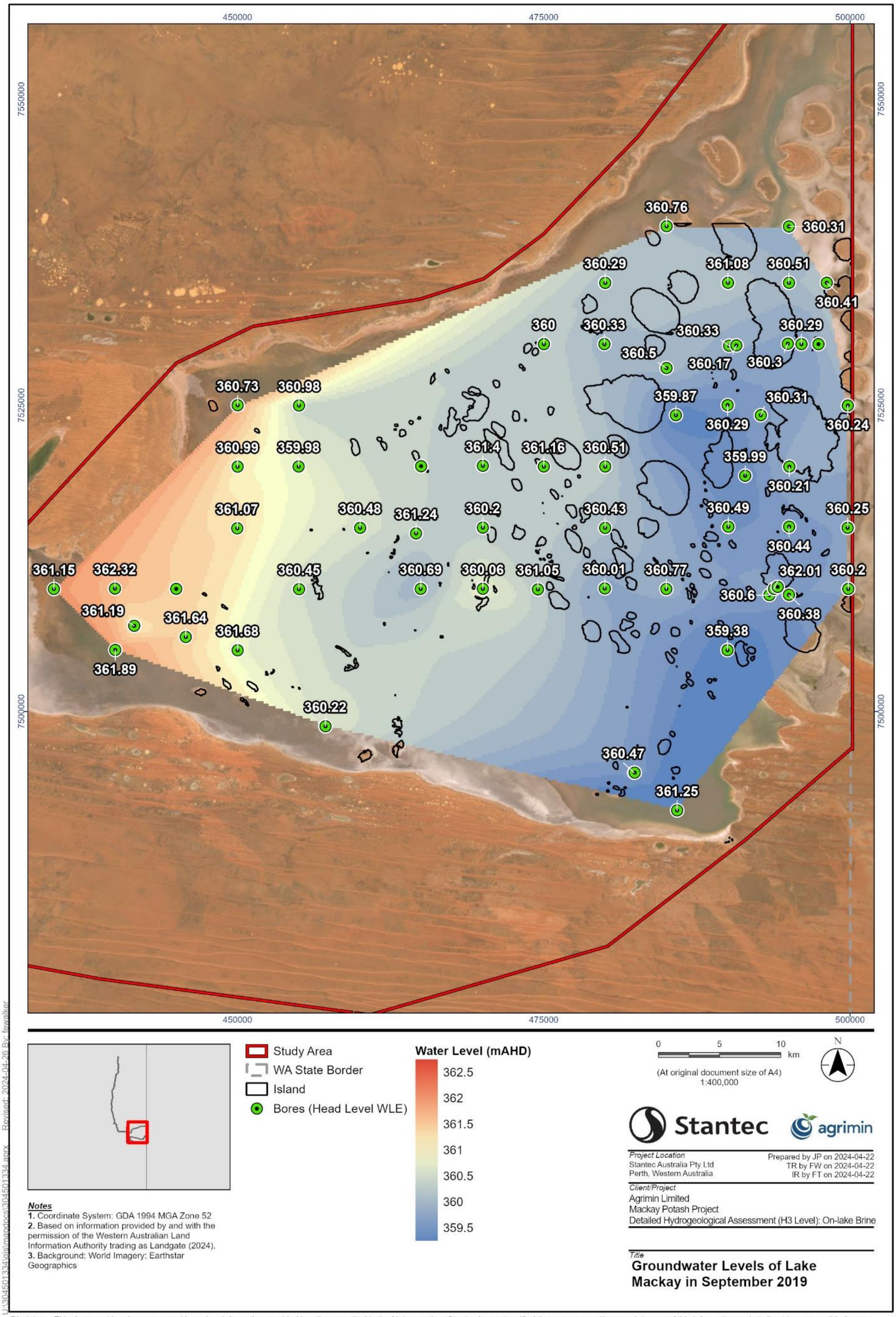


Figure 4-11: Groundwater levels of Lake Mackay in September 2019 (dry season), indicating bore head levels.

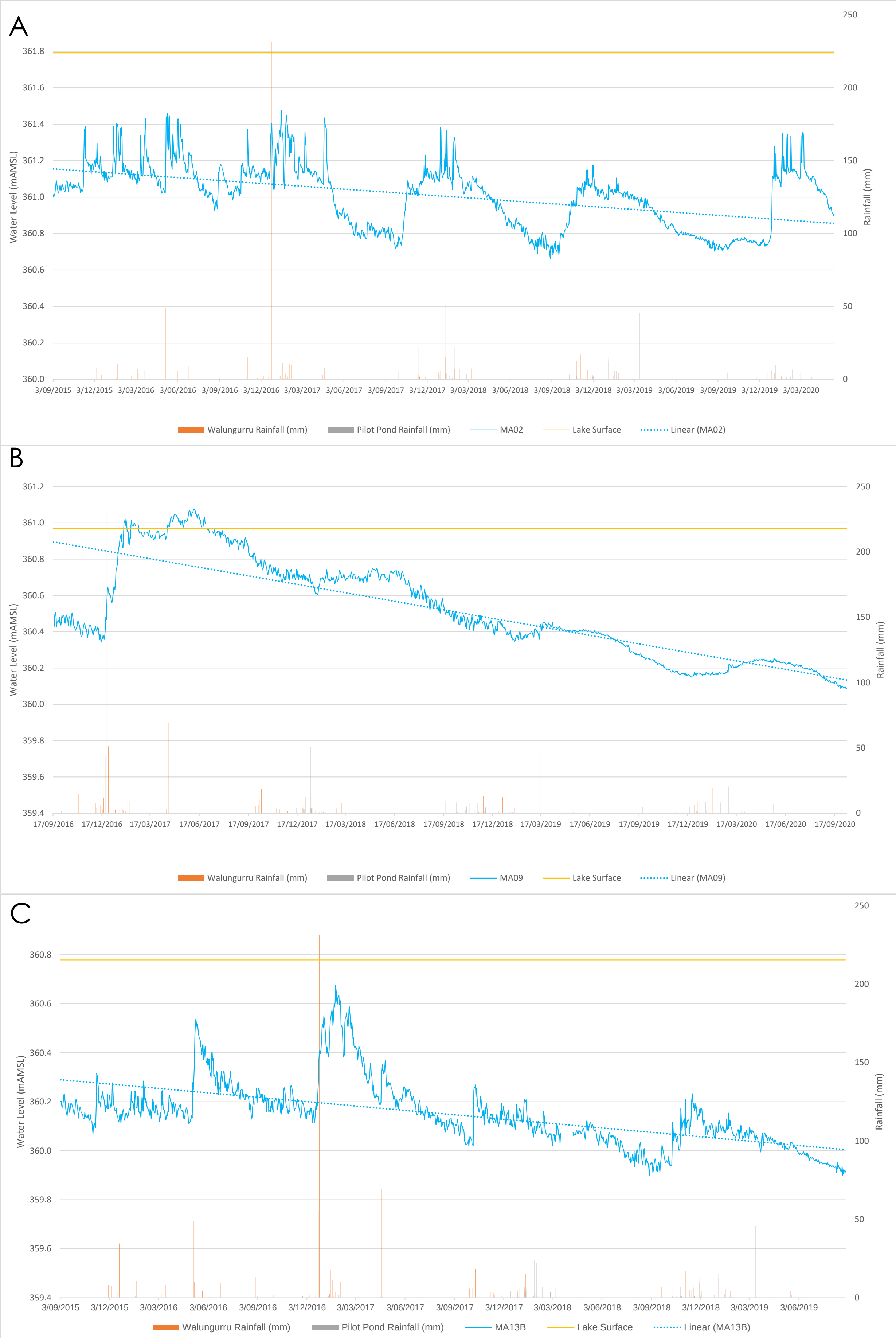


Figure 4-12: Seasonal fluctuation in lake bore groundwater levels compared to rainfall. (A) Western portion of the lake (MA02), (B) eastern portion of the lake (MA09), and (C) northern portion of the lake (MA13B).

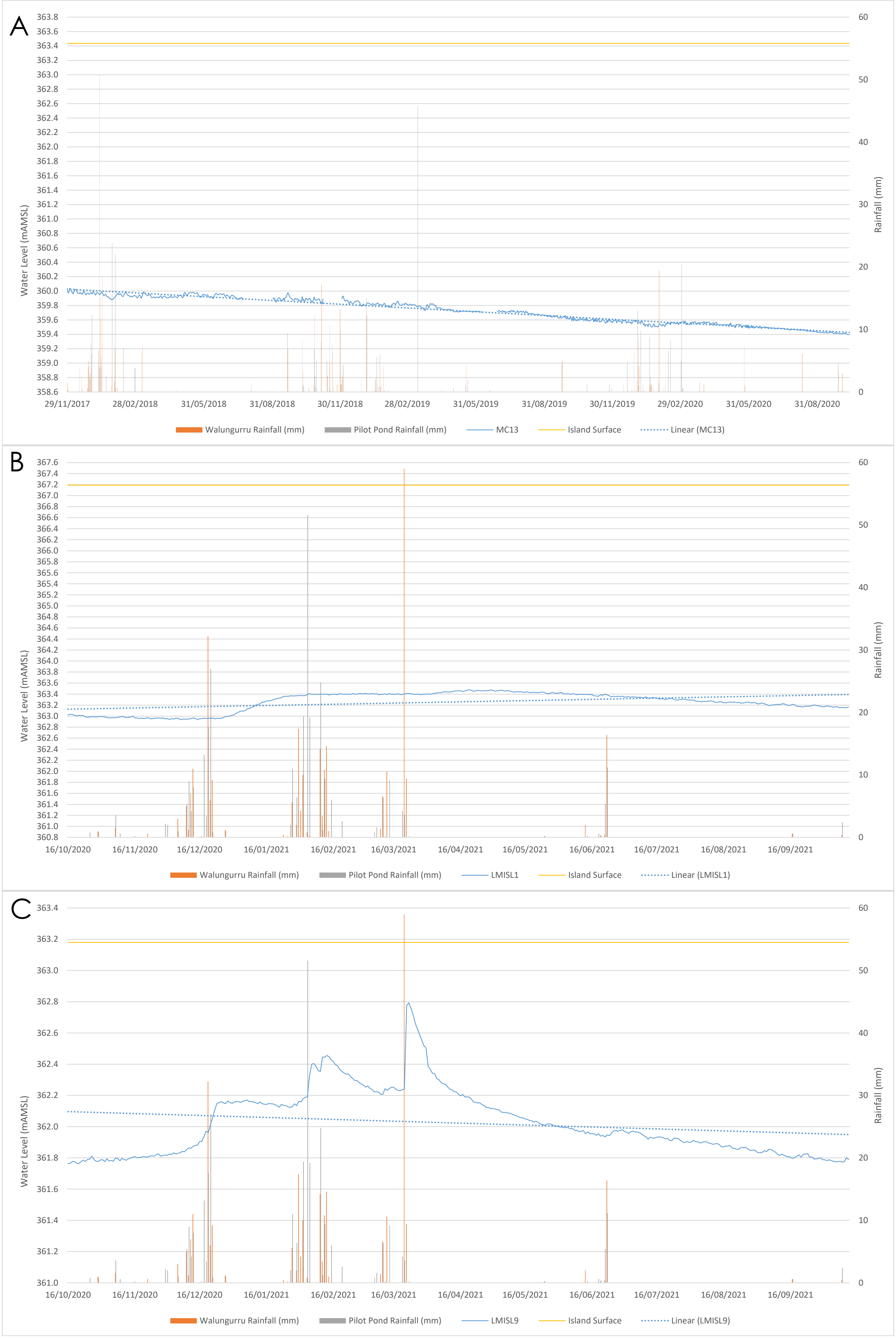


Figure 4-13: Seasonal fluctuation in island bore groundwater levels compared to rainfall. (A) Landform island riparian zone in the east (MC13), (B) landform island in the east (LMISL01), and (C) small island in the west (LMISL09).

4.5. Trench Pump Tests

The following sections summarise the analysis of 15 short-term trench pumping tests (Stantec 2019, **Appendix B**) and two long-term (6-months) trench pumping tests (Agrimin 2020, **Appendix C**). The hydraulic properties estimated from the 15 short-term trench test analyses informed the construction of the lake-scale groundwater flow and mass transport model (**Section 6**). The two long-term trench pumping tests provided drawdown data for the development of the lake-scale groundwater flow and mass transport model and an understanding of potential island groundwater drawdown effects.

4.5.1. Short-Term Trench Test Analysis

Pump testing of prototype trenches was conducted by Agrimin, between August 2017 and September 2018, and the data were analysed by Stantec (2019, **Appendix B**). A series of trenches were excavated generally 100 m long, 6 m wide at the surface, 1 m wide at the base, and 6 m deep. During trench construction groundwater flowing into the trench was controlled and removed by pumping or removal by construction equipment, which created an initial cone of depression around the trenches. Following construction, the groundwater was given time to equilibrate prior to the trench test being initiated. The duration of trench tests generally ranged between 3 to 77 days long and test locations were divided into three analytical groups related to inputs or the absence of precipitation data (**Table 4-3**).

Data were analysed by developing local scale groundwater flow models of each trench using Modflow-Surfact Version 4.0 and discretized to represent the area and aquifer thickness affected by trench pumping. The models were calibrated to drawdown observed in nearby piezometers, and trench tests were analyzed for bulk hydraulic properties of the shallow lakebed sediments (hydraulic conductivity, specific yield, and specific storage).

Modelling analysis of hydraulic conductivity estimates ranged from 0.45 m/d to 171 m/d; specific yield estimates ranged from 0.013 to 0.295, with most estimates on the order of 0.10 to 0.15; and specific storage estimates ranged from $4x10^{-6}$ m^{-1} to $5x10^{-3}$ m^{-1}.

A summary of the trench pumping test analysis outputs is provided in **Table 4-3**. The complete report, including trench pumping test locations is provided in **Appendix B**.

Table 4-3: Short-term trench test analysis summary and parameter estimates (Source: Stantec 2020).

Trench ID	Approximate Volume Pumped (m^3)	Test Duration (days)	Observed Brine Inflow Rate (Low / Moderate / High)	Estimated Parameters		
				Horizontal Conductivity (m/day)	Specific Yield (-)	Specific Storage (m^{-1})
Group 1 - Standard Length Without Significant Precipitation Reported						
T01	450	3	Low	0.46	0.013	1.28×10^{-4}
T03	350	9	NA	1.53	0.122	4.95×10^{-3}
T06	5,050	27	High	24.3	0.025	4.04×10^{-6}
T18	1,200	21	Low	6.34	0.140	6.54×10^{-4}
T20	3,000	40	Low/Moderate	2.85	0.150	1.50×10^{-3}
Group 2 - Earlier Tests Without Precipitation Information						
T02	Unknown	5	Moderate	2.81	0.109	5.00×10^{-3}
T05	950	77	Moderate/Low	17.3	0.167	3.23×10^{-3}
T14	900	21	Moderate/High	19.5	0.062	2.34×10^{-4}
T16	7,800	57	Moderate	9.33	0.295	5.44×10^{-4}
T22	4,500	25	Moderate/High	2.81	0.109	5.00×10^{-3}
Group 3 - Standard Length With Significant Precipitation Reported						
T08	1,500	20	Low	6.69	0.082	2.37×10^{-4}
T09	17,500	42	Moderate/High	65.92	0.17	1.05×10^{-4}
T10	20,000	30	Moderate/High	171	0.116	8.76×10^{-4}
T11	6,800	45	Moderate/High	6.57	0.163	5.00×10^{-3}
T23	1,650	22	Low	6.86	0.11	2.31×10^{-4}

4.5.2. Long Term Trench Test Analysis (Agrimin 2020)

Two long-term trench pumping tests were conducted by Agrimin (2020, **Appendix C**). One at Trench 02A (T02A) – located west, near a small island, and one at Trench 13 (T13), located east near a landform island. The test locations were selected based on their proximity to lake islands, and the contrasting hydrogeological properties of the surficial lakebed sediments. Each test aimed to assess drawdown effects in proximity to the trenches and nearby islands, rainfall response to recharge and drawdown, and groundwater chemistry.

Trench design and pumping methods were similar to the short-term trench pumping tests; however, a series of piezometers were installed at regular intervals around each trench and along a transect, running from the trench onto the nearest island. The test duration of T02A was 207 days and at T13 was 184 days and during each test pumping rates, water levels, rainfall (site gauge) and groundwater chemistry data were collected at regular intervals.

The test results at both locations identified no direct groundwater drawdown on the lake islands and that recorded groundwater fluctuations were a result of seasonal variations related to rainfall infiltration and evapotranspiration. Groundwater chemistry within the trench and piezometers indicated that dilution effects following rainfall events and wet season are minimal. No clear salinity gradient was identified from T02A to the nearby small island, however, between T13 and the landform island a decreasing salinity gradient was identified. The complete memorandum, including trench pumping test locations and data output are provided in **Appendix C**.

5. Groundwater Chemistry

5.1. Lake

Groundwater sampling and monitoring at Lake Mackay (**Appendix D**) indicates the lakebed sediments are characterised by circumneutral pH (mean of 6.6), with naturally elevated nitrate concentrations (**Table 5-1**). Groundwater salinity of the lakebed sediments varies across the lake, although is typically greater than 200,000 mg/L, with a maximum of approximately 340,000 mg/L (**Table 5-1**). In contrast, the major ionic constituents of the lakebed sediments are consistent, comprising a cation dominance of Na>>K>Mg>Ca, and an anion sequence of Cl>>SO_4>HCO_3 (**Table 5-1**, Figure 5-1

Figure 5-1). 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 (**Table 5-1**). A large chemistry data set exists for the on-lake monitoring bores and trenches. From 346 samples, the mean TDS of the on-lake brine resource was 214,678 mg/L.

Table 5-1: Summary of groundwater quality from lakebed sediments from monitoring bores and trenches.

Parameter	Records	Min.	Mean	Median	Max.
pH (units)	32	5.34	6.63	6.68	7.22
Salinity (TDS)	346	6,569	214,678	228,456	339,995
Magnesium	213	57	2,551	2,240	6,790
Calcium	213	140	598	602	1,220
Sodium	213	6,823	88,786	89,062	134,348
Potassium	213	390	3,088	3,080	9,640
Chloride	213	164	131,987	132,050	186,950
Sulphate	213	3,870	19,688	19,325	60,900
Bicarbonate	28	10	37	20	210
Nitrates	32	4	31	11	151

Note: all parameters are mg/L, except where shown.

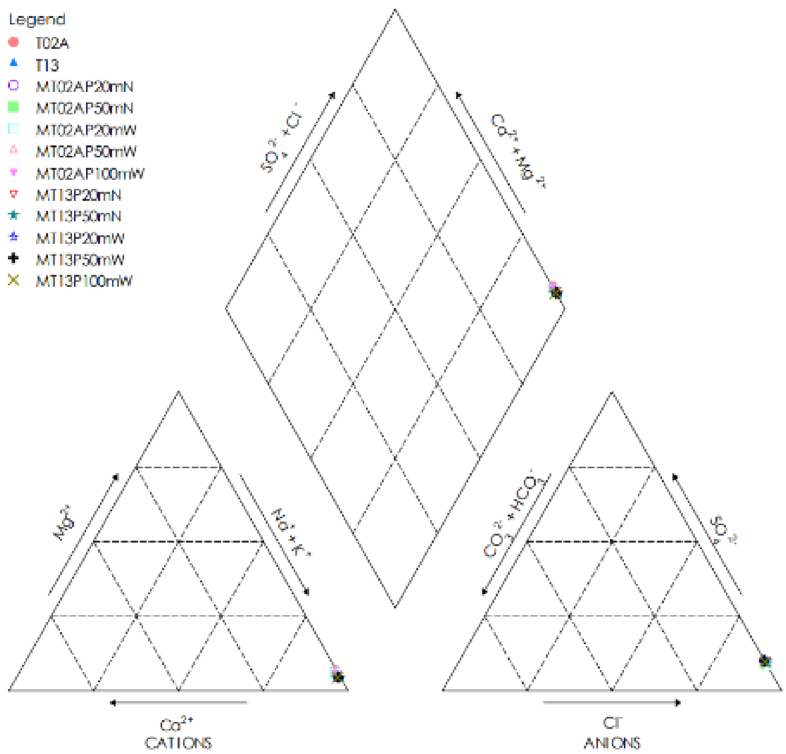


Figure 5-1: Piper plot showing ionic composition of groundwater within the lakebed sediments.

5.2. Islands

The largest landform islands in the eastern portion of the lake appear to host a lower salinity groundwater, within the porous gypsiferous sands that overlay the clay dominant lakebed sediments (brine). Lower salinity groundwater is likely associated with the infiltration of rainfall into the shallow, permeable aeolian sediment and where present, with calcrete outcrops. Groundwater sampling and monitoring at the larger islands (**Appendix D**) showed that the pH is typically close to neutral (mean 6.9), with naturally elevated nitrate concentrations (**Table 5-2**). Salinities are typically below 60,0000 mg/L, with an ionic composition dominated by Na and Cl (**Table 5-2**,**Figure 5-2**).

Agrimin (2024, **Appendix A**) collected salinity data from the long-term pumping tests which showed that a significant lateral salinity profile is present from Trench 13 to landform island bore (LMISL1). Up to 350m west of Trench 13 brine TDS measured approximately 200,000 mg/L, reducing to between 150,000 and 120,000 mg/L in the MC13 bore and then into the landform island habitat, where values decreased to approximately 50,000 to 6,000 mg/L (**Figure 5-3A**). A slight lateral salinity profile is present from Trench 2 to the small island bore (LMISL009), however not as significant as Trench 13, given the salinity levels are within the same order of magnitude. Up to 500 m west of Trench 2, salinity levels reduce from over 200,000 mg/L to less than 150,000 mg/L, with the island bore measured as 115,000 mg/L (**Figure 5-3B**).

Agrimin (2024, **Appendix A**) collected vertical salinity profile data from LMISL009 which showed a freshwater horizon from 1.42 m below ground level (mbgl), with a sharp increased salinity gradient into the brine at 2 mbgl. From 2 mbgl to 4.5 mbgl salinity levels showed a slight increase (**Figure 5-3A**). Continuous salinity and rainfall measurements were recorded at LMISL009 for approximately six months (June 2020 to December 2020) and showed salinity levels were relatively consistent with some fluctuations between 83,000 mg/L and 78,000 mg/L. Rainfall did not appear to alter the salinity levels, which is likely due to the probe having been deployed below the transition zone (mixing zone). Although, there was a slight increased saline trend following rainfall events, which could be a result of solute mobilisation following rainfall recharge (**Figure 5-3B**).

Island groundwater salinity levels and water quality may vary for the following reasons:

- Seasonality: variations in wetter and drier periods. Significant rainfall events may result in lowered salinity levels (more freshwater recharge) and increased evaporation and evapotranspiration may result in higher salinity levels (less available freshwater mixing);
- Bore depths: bores drilled into deeper underlying lakebed sediments may contribute to higher salinity levels, if installed into the deeper lakebed sediments;
- Sampling methodology: purged or not purged; and
- Island locality: eastern compared to western region island characteristics and lithological thickness atop the lakebed sediments may vary.

Table 5-2: Summary of groundwater quality from the islands during drilling.

Parameters	Records	Minimum	Mean	Median	Maximum
pH (units)	2	6.83	6.87	6.87	6.90
Salinity (TDS)	2	41,864	48,988	48,989	56,113
Magnesium	3	3	298	373	520
Calcium	3	625	965	1,080	1,190
Sodium	3	165	9,838	12450	16,900
Potassium	3	20	285	325	510
Chloride	3	362	16,612	20,425	29,050
Sulphate	3	1,335	4,160	5,295	5,850
Bicarbonate	3	40	105	105	170
Nitrates	3	8	38	38	68

Note: all parameters are mg/L, except where shown.

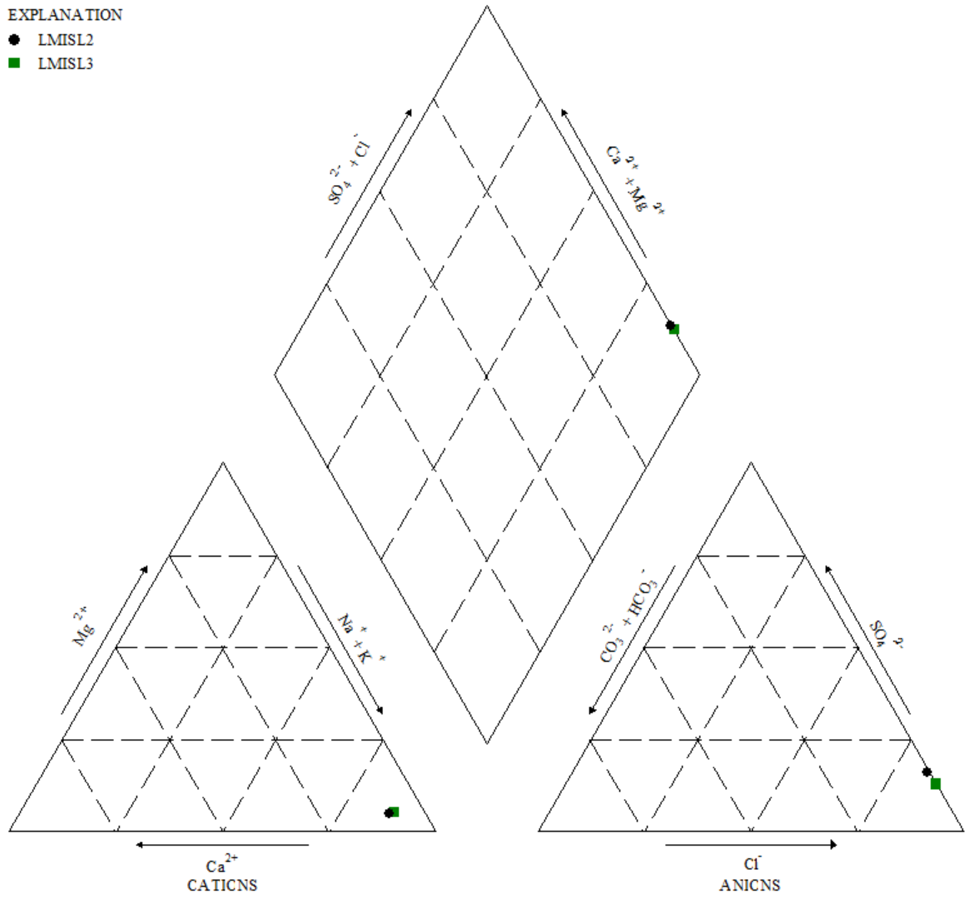
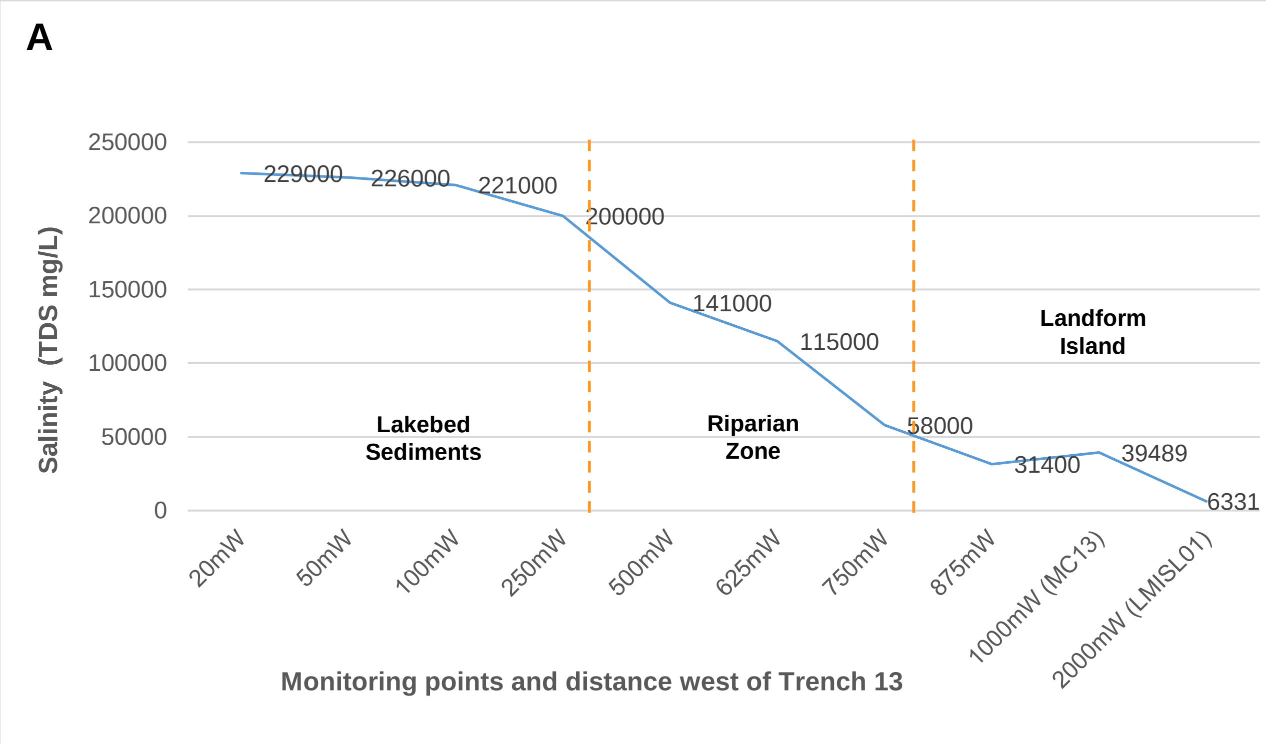


Figure 5-2: Piper plot showing ionic composition of groundwater in LMISL002 (landform island) and LMISL003 (large island).



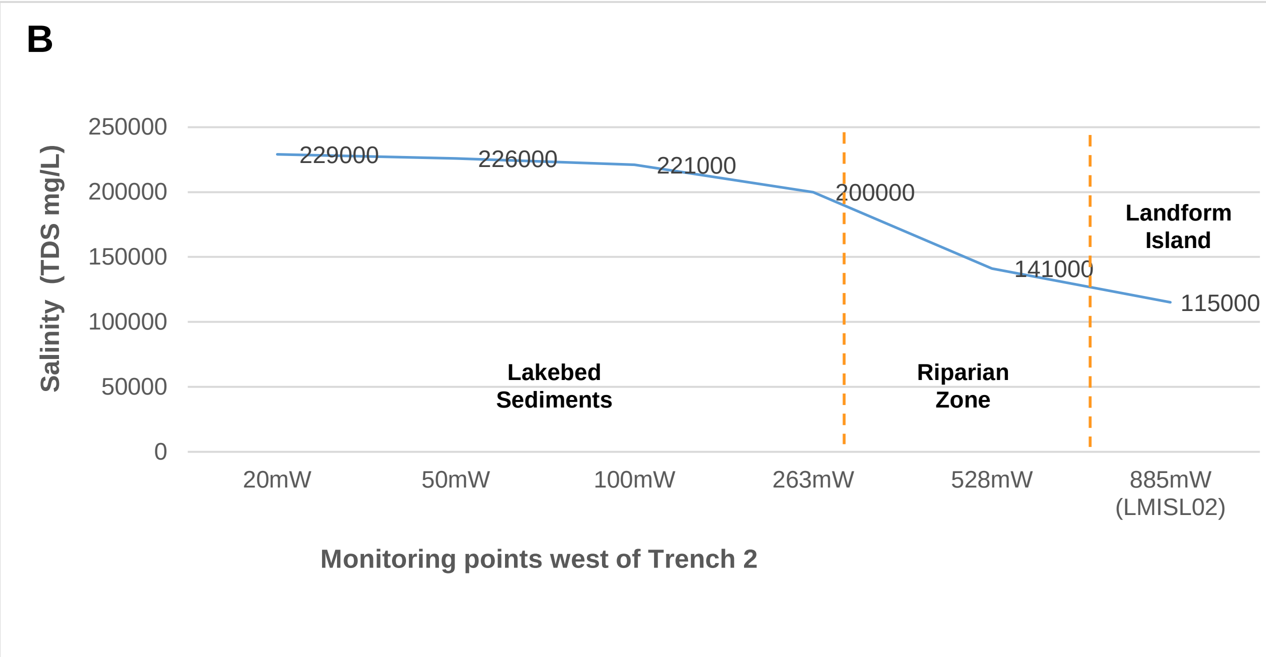


Figure 5-3: Horizontal salinity profile at each monitoring point, west of (A) trench 13 to landform island bore LMISL01; and, (B) west from Trench 2 to small island bore LMISL09.

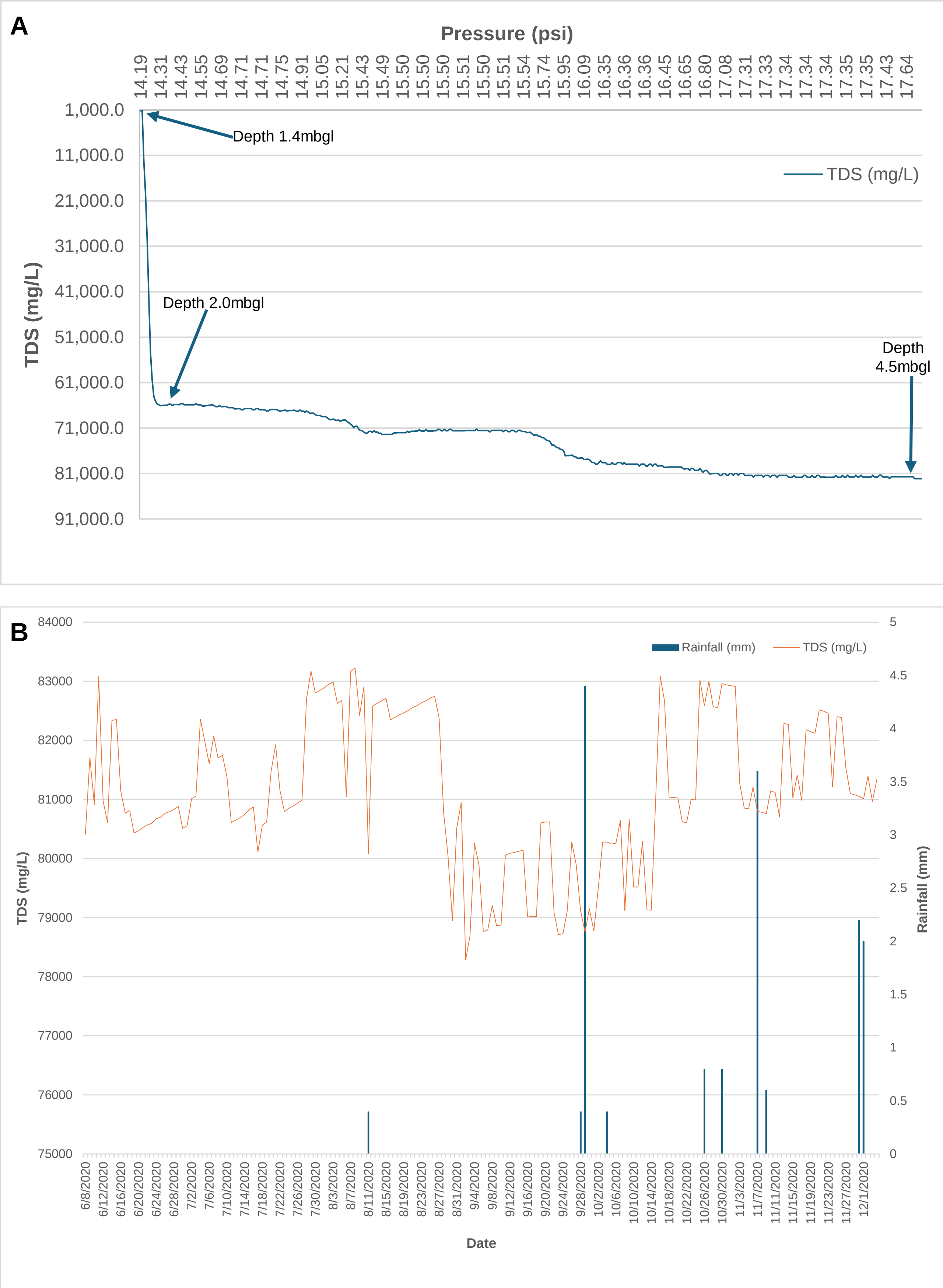


Figure 5-4: Small island bore LMISL09 (A) vertical salinity (TDS) profile gradient; and (B) continuous salinity (TDS) and rainfall measurements for six months.

6. Groundwater Flow Modelling

6.1. Background and Objective

The following sections summarise and provide detail of the numerical groundwater flow components of the integrated groundwater flow and solute transport model report developed by Stantec in 2020, with the complete modelling report presented in **Appendix B**. The model was developed for Agrimin to support a mine proposal that produces SOP by extraction of brine from the lakebed sediments, using a solar evaporation process to precipitate potassium and sulphate rich mineral salts. The model objective was to simulate brine abstraction to meet the projects requirements of 540,000 tpa of SOP mass.

6.2. Model Uncertainty & Limitations

The spatial scale and complex physical and chemical environment at Lake Mackay present some specific challenges and limitations. Although a significant amount of field data has been collected over the past several years to help develop a conceptual basin model, Lake Mackay covers a geographic area of approximately 3,500 km^2. This vast spatial scale necessitates interpolation of field data over distances of hundreds to thousands of metres. Therefore, various degrees of uncertainty exist in the distribution of hydraulic and transport properties across the lake.

6.3. Numerical Model Description

A groundwater flow and solute transport model was constructed using MODFLOW-SURFACT (Hydrogeologic, Inc. 2011), which contains proprietary flow, transport, and solver packages which are particularly suited to modeling the complex hydrogeological flow and chemical transport processes associated with brine production. The modeling was conducted using the pre- and post-processor Groundwater Vistas, version 6. The complete model construction details are provided in **Appendix B**.

The model consists of 6 layers of varying thickness representing the different hydrostratigraphic units and extends from the lakebed surface to top of basement and correspond to the hydrostratigraphic units detailed in **Section 4.2**.

6.3.1. Boundary Conditions

Model boundary conditions include no-flow, constant head, general head, and drains. General head boundaries were used to simulate flow between lakebed sediments and alluvium along the model perimeter, and no-flow boundaries are assigned along the lake perimeter. Constant head boundaries were used to represent paleochannel flow where these enter the model domain. Drain boundaries were used to simulate flow to the production trench network.

6.3.2. Model Hydraulic Parameters

Hydraulic conductivity was distributed across model layers one, two, and three (representing the UZT and UZB) based on detailed analyses of the trench pumping tests at 17 locations distributed relatively evenly across the lake (**Appendix B**) and from nuclear magnetic resonance (NMR) borehole logging data collected at the two detailed infill drilling sites (T02A and T13). The mean hydraulic conductivity in the UZT is approximately 9 metres per day (m/d) and generally increases from west to east and ranges from approximately 0.8 m/d in a few isolated areas to over 200 m/d.

LZ1 (Layer 4) and LZ2 (Layer 5) horizontal hydraulic conductivity was set to 0.1 m/d with vertical hydraulic conductivity set to one-thousandth of the horizontal conductivity, based on the much higher clay content in these intervals. Model Layer 6 (LZ3) represents coarse paleochannel sediments on top of basement formations and was set to 10 m/d and the vertical one-tenth of the horizontal hydraulic conductivity.

Total porosity and specific yield were imported from the resource model (**Appendix B**). Total porosity of various hydrostratigraphic layers was estimated from lab analysis and borehole geophysics (NMR) conducted by Agrimin in 2019 as described in **Appendix B**. An average total porosity of 0.46 was applied to the UZT in model Layer 1, and an average total porosity of 0.42 was applied to layers representing the UZB and LZ horizons.

Specific yield for the various lithologic layers was estimated from the analyses of trench pumping tests, water level changes recorded during rainfall events of known duration and magnitude at the specific trench test locations, borehole geophysics (NMR) measurements collected at 22 T02A and T13 infill drilling locations, and from core samples collected at 20 recharge sampling locations. This is described in detail in **Appendix B**.

Specific yield in the UZT ranges from 0.06 to 0.14. An average specific yield of 0.05 was applied to the UZB and LZ1, 0.04 to the LZ2, and 0.12 to the paleochannel sediments in the LZ3. A specific storage of $1x10^{-3}$/m was assigned to all layers which is representative of the unconsolidated nature of the UZ and LZ sediments.

6.3.3. Model Recharge and Evapotranspiration

Four recharge and ET zones were used as estimated from the site-specific recharge studies (Stantec 2020b and **Appendix B**). Recharge as a percentage of mean annual precipitation ranges from 43% in the western recharge zone to 13% in the eastern recharge zone. Recharge as a percentage of mean annual precipitation were defined as four zones (**Section 4** and **Figure 4-9**)

- Zone 1 (West): 38%
- Zone 2 (Central West): 43%
- Zone 3 (Central East): 18%
- Zone 4 (East): 13%

6.4. Calibration

A steady state condition was simulated by running the pre-mining model in transient mode for a long enough time period such that the change in aquifer storage between stress periods in the overall model water balance was less than 0.002% of the total water inflows and outflows indicating a steady state condition was reached. The pre-mining model was calibrated to water levels measured during September 2019 at 58 bores distributed across Lake Mackay. The final calibrated model potentiometric surface for the UZT is shown in **Figure 6-1.**

The scope and size of the Lake Mackay groundwater model precludes a transient calibration to the relatively small-scale stresses in relation to the overall model domain and grid size from trench pumping tests conducted at numerous locations over the lake area. Transient calibrations to these tests were conducted using local scale models, and the results from these local scale model calibrations were used to distribute hydraulic conductivity and specific yield in the UZT for the lake-wide model.

The model reports a final standard error (RMS) of 2.2 m, the scale root mean squared (SRMS) is 8.1% (target of <10%). The SRMS value is considered acceptable. The complete calibration methodology and results are provided in **Appendix B**.

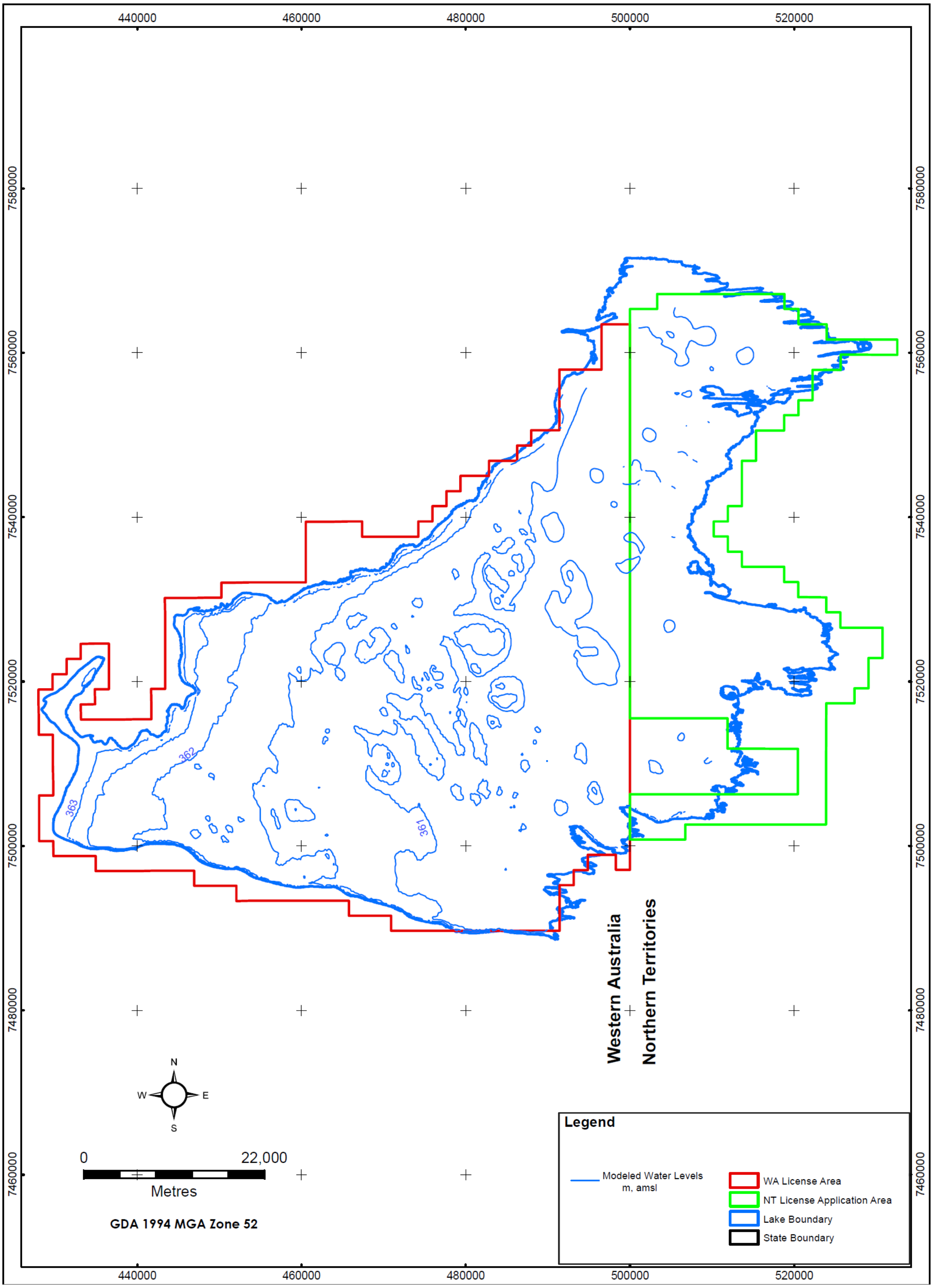


Figure 6-1: Modelled potentiometric surface map (UZT) – calibration model (Stantec 2020, Appendix B).

6.5. Predictive Simulations

6.5.1. Lake – Predicted Drawdown and Recovery

The following section summarises data from the modelling report presented in **Appendix B** and includes the predicted drawdown following implementation of BMUs for brine abstraction. The data and information collated is based on trench pumping and recharge modelling. Groundwater drawdown of the brine within the lakebed sediments (up to 100 GL/a) will be progressive, facilitated by the implementation of BMUs over the 20-year operation of the Proposal. The BMUs will initially commence in the southern portion of the lake, traversing east, west and northwards by mine year 17 (see **Figure 2-2**). Over the LoM, pumping schedules and extraction rates will vary across BMUs to maximise potassium concentrations for production.

Numerical groundwater modelling indicates predicted drawdown will vary spatially and temporally across the lake during operations, associated with differences in hydrogeological properties (**Appendix B**). The regional lake drawdown extent is limited to the lakebed sediments and drawdown does not extend beyond On-LDE. Generally, trench water levels within the BMUs will be drawn down to a sustained level of up to approximately 3 mbgl within two years after pumping begins, with an associated lowering of groundwater levels occurring laterally away from the trenches. Predicted drawdown is greatest in the immediate vicinity of the trenches and drawdown rapidly decreases laterally away from the trenches.

The predicted drawdown (levels and percent saturated aquifer thickness) over the production area of Lake Mackay is summarised in **Table 6-1** and shown in **Figure 6-2**. The deepest drawdown of up to approximately 3.0 m (equivalent to 30% saturated aquifer thickness) is expected at the trenches and in areas of higher permeability (**Appendix B**). This corresponds to more pronounced drawdown extents and average drawdown in the eastern portion of the lake (within Zones 3 and 4), compared to the west (Zones 1 and 2) (**Table 6-1**). The average drawdown across all zones ranges from 0.4 to 0.8 m over the LoM, corresponding to average saturated aquifer thickness drawdown of less than 8% (**Table 6-1**). This is comparable to seasonal variation of between 0.5 to 1.0 m.

In the areas between trenches (1 km apart), in Zones 1 and 2, drawdown generally ranges from 0.0 to 1.5 m during operations (**Figure 6-2**). As abstraction progresses to the north and east and into the higher hydraulic conductivity/lower recharge zones in the east (Zones 3 and 4), between 0 m to 1.8 m of drawdown is predicted between trenches and islands (**Figure 6-2**). However, due to the higher recharge, drawdown beneath the landform islands is much less (**Figure 6-2**).

Table 6-1: Summary of predicted drawdown across the zones of Lake Mackay (including island buffers).

Zone and Drawdown		Year 5	Year 10	Year 20
ZONE 1	Maximum drawdown (m)	2.79	2.54	2.07
	Average drawdown (m)	0.57	0.52	0.41
	Average saturated aquifer thickness* drawdown (%)	5.43%	4.95%	3.90%
ZONE 2	Maximum drawdown (m)	3.3	3.05	2.73
	Average drawdown (m)	0.58	0.57	0.47
	Percentage of aquifer* impacted	5.52%	5.43%	4.48%
ZONE 3	Maximum drawdown (m)	2.9	2.65	2.43
	Average drawdown (m)	0.53	0.81	0.59
	Average saturated aquifer thickness* drawdown (%)	5.05%	7.71%	5.62%
ZONE 4	Maximum drawdown (m)	2.64	2.39	1.68
	Average drawdown (m)	0.75	0.73	0.74
	Average saturated aquifer thickness* drawdown (%)	7.14%	6.95%	7.05%

*Note: * average saturated aquifer thickness based on 10.5 m of brine.*

Two examples of drawdown and recovery over time at a location in the central and eastern portion of the lake within a BMU are presented in **Figure 6-3A-B,** respectively. Brine abstraction from this BMU commences in year 4 with drawdown in the trench (**Figure 6-3A**) increasing over the initial two years of operation until pumping water levels are reduced, resulting in recovery and less drawdown. Water levels continue to recover gradually until mine year 20, at which time groundwater levels recover to pre-abstraction water levels within one year. In **Figure 6-3B,** the example shows drawdown in the eastern portion of the lake in between trenching. Although brine abstraction from this BMU only commences in mine year 10, some initial drawdown occurs due to higher hydraulic conductivity. Once brine abstraction commences, maximum drawdown of 1.2 m is recorded after 3 years, with drawdown levels then decreasing, due to lower abstraction rates and reduced pumping water levels. Water levels mostly recover to pre-abstraction water levels after a period of five years. Drawdown modelling undertaken to understand potential changes in the lakebed sediments on the NT side of the border, indicated groundwater changes were limited spatially (to approximately 1 km) and were well within the known natural variation of groundwater levels (Stantec Consulting Services 2021).

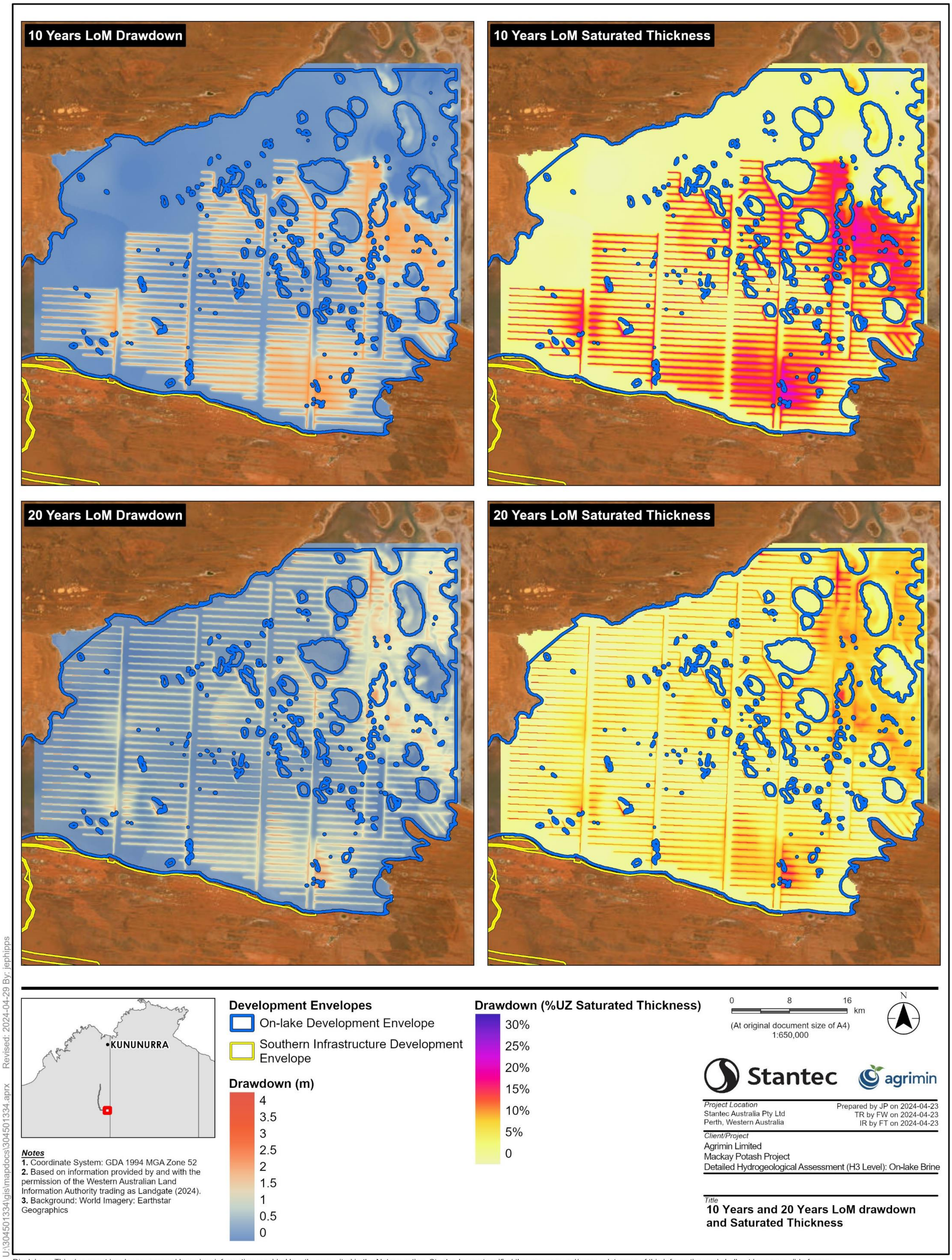


Figure 6-2: Predicted drawdown and saturated thickness across Lake Mackay (including buffers) at (A) 10 years LoM drawdown, (B) 10 years LoM saturated thickness, (C) 20 years LoM drawdown, and (D) 20 years LoM saturated thickness.

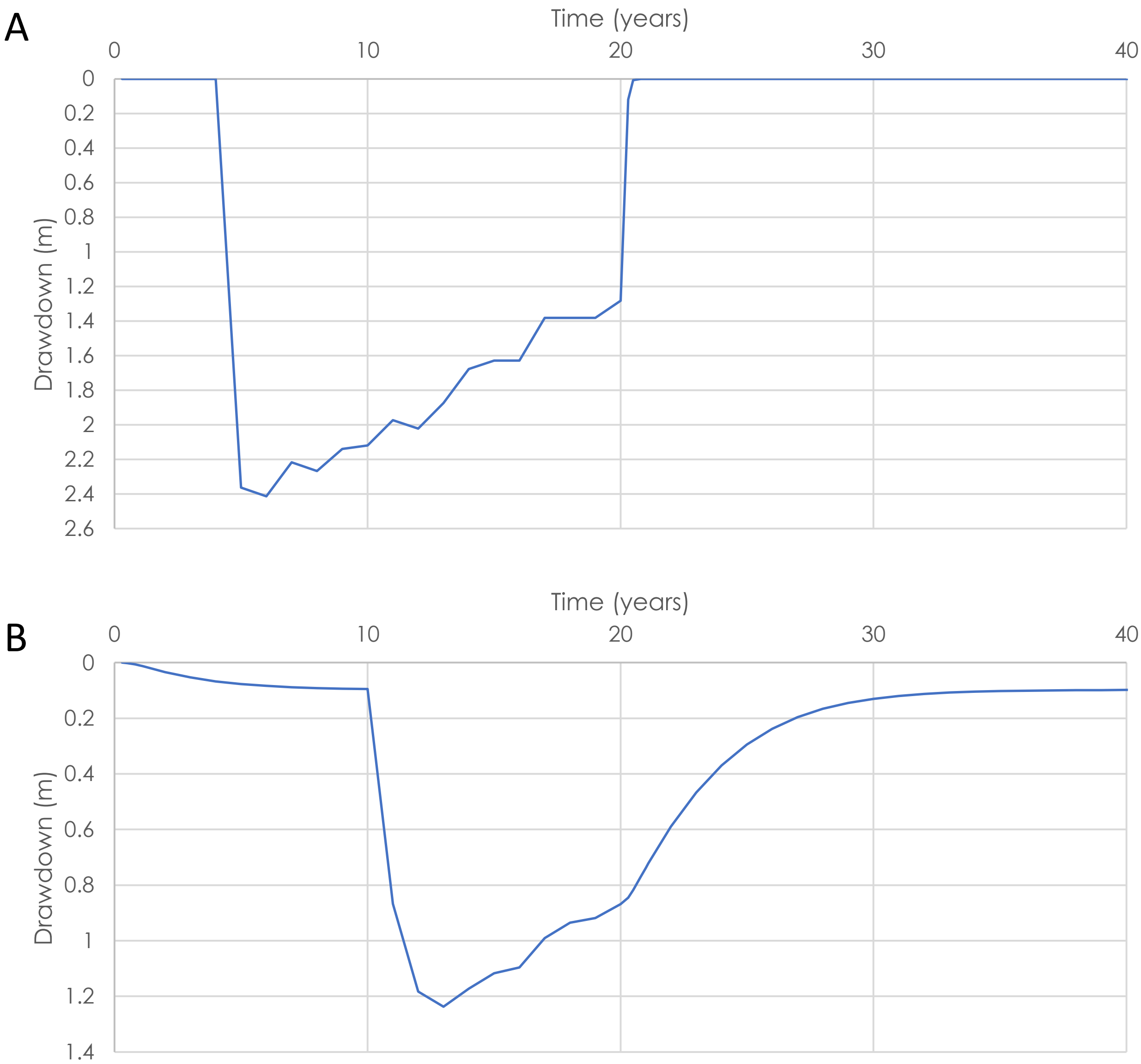


Figure 6-3: Variability in drawdown conditions and water level recovery over the LoM. (A) high net recharge location in the central portion of the lake (within a trench), and (B) a low net recharge location in the east (in between trenching).

Recharge modelling indicates that as groundwater levels decrease from abstraction, recharge increases (**Appendix B**). The most recharge will occur in the southwest portion of Lake Mackay. While infiltration in the northeast portion of the lake is high, stored water in the profile rapidly evaporates, with the net effect of reducing recharge potential. Modelling also assumed that recharge beneath the islands is the same as the lakebed sediments in the eastern portion of the lake. Under natural conditions, the percentage of rainfall on the islands resulting in recharge is likely to be higher, due to the more permeable dune sands.

Recovery of groundwater levels following cessation of brine at LoM (year 20), is predicted to occur over a period of two to five years once pumping ceases, to within 95% of baseline conditions and will recover completely after seven years (**Appendix B**). It is also estimated that a rainfall event of more than 300 mm within one month will reset the groundwater levels of the lake to within 0.6 mbgl, effectively returning the system to baseline conditions (Stantec 2021e). Staged abstraction of brine from the BMUs (beginning in the south) will also enable periodic recovery of groundwater levels across the lake over the LoM.

6.5.2. Islands – Predicted Drawdown and Recovery

On islands, the hydraulic connectivity of groundwater in the low salinity calcrete and gypsiferous sandy units, to underlying silty/clayey lakebed sediments is under investigation and requires seasonal monitoring. This is complex due to the variability of the island lithology and aeolian sand sequence thicknesses. However, this unit is a source of recharge to the lakebed sediments and therefore a transitional zone exists both in the occurrence of groundwater and in water quality (Agrimin 2020).

Numerical modelling assumes that recharge beneath the islands is the same as the lakebed sediments in the eastern portion of the lake (**Appendix B**). However, as the larger islands are composed of highly permeable dune sands, the percentage of rainfall that recharges the brine aquifer beneath the islands is likely higher than the surrounding lower permeability lakebed sediments. As the largest of these, the landform islands also provide a greater recharge footprint, reducing the effects of drawdown, indicating the model is conservative, and likely overestimates drawdown in these areas.

The model predicts a maximum groundwater level drawdown of up to approximately 2.9 m and an average 0.6 m of brine beneath the small islands in the south of Lake Mackay at year 5, decreasing by year 20 of operations (**Table 6-2**, **Figure 6-4A**). For the intermediate, large and landform islands at year 20 maximum and average drawdown is comparatively lower **Table 6-2**. The maximum drawdown across all islands typically occurs along the margins (**Figure 6-4A-D**).

Beneath the landform islands at year 20, the maximum predicted drawdown is approximately 1.4 m, with an average drawdown of approximately 0.35 m (**Figure 6-4C, Table 6-2**). This is also evident in **Figure 6-5**, which shows that most of the landform islands in the eastern portion of the lake have a predicted drawdown of <0.25 m. Based on the modelling, which includes buffers, drawdown is negligible for most of the landform islands and within the range of natural seasonal variation. Drawdown of the brine is also considered unlikely to influence groundwater dependent vegetation and stygofauna habitats on these islands, which are supported by low salinity or freshwater conditions in the transition zone.

Predicted drawdown and recovery on the landform island at bore MC13 (approximately 1.2 km from planned trenching) over time is presented in **Figure 6-6**, with brine extraction from this BMU planned to start at year 10. The maximum predicted drawdown at this bore location is approximately 0.10 m, expected at year 12 (**Figure 6-6**). Water levels then gradually increase over an eight-year period and fluctuate as the pumping level in the BMU is adjusted until production ceases on completion at year 20. Post cessation, groundwater levels will completely recover after seven years based on average annual rainfall, with larger events (>300 mm in one month) resetting the system more rapidly.

Table 6-2: Summary of predicted groundwater drawdown across the islands (including island buffers).

Island Type	Drawdown	Year 5	Year 20
Small Islands	Maximum drawdown (m)	2.89	2.19
	Average drawdown (m)	0.62	0.52
Intermediate Islands	Maximum drawdown (m)	NA	1.23
	Average drawdown (m)	NA	0.31
Large Islands	Maximum drawdown (m)	NA	1.56
	Average drawdown (m)	NA	0.47
Landform Islands	Maximum drawdown (m)	NA	1.37
	Average drawdown (m)	NA	0.36

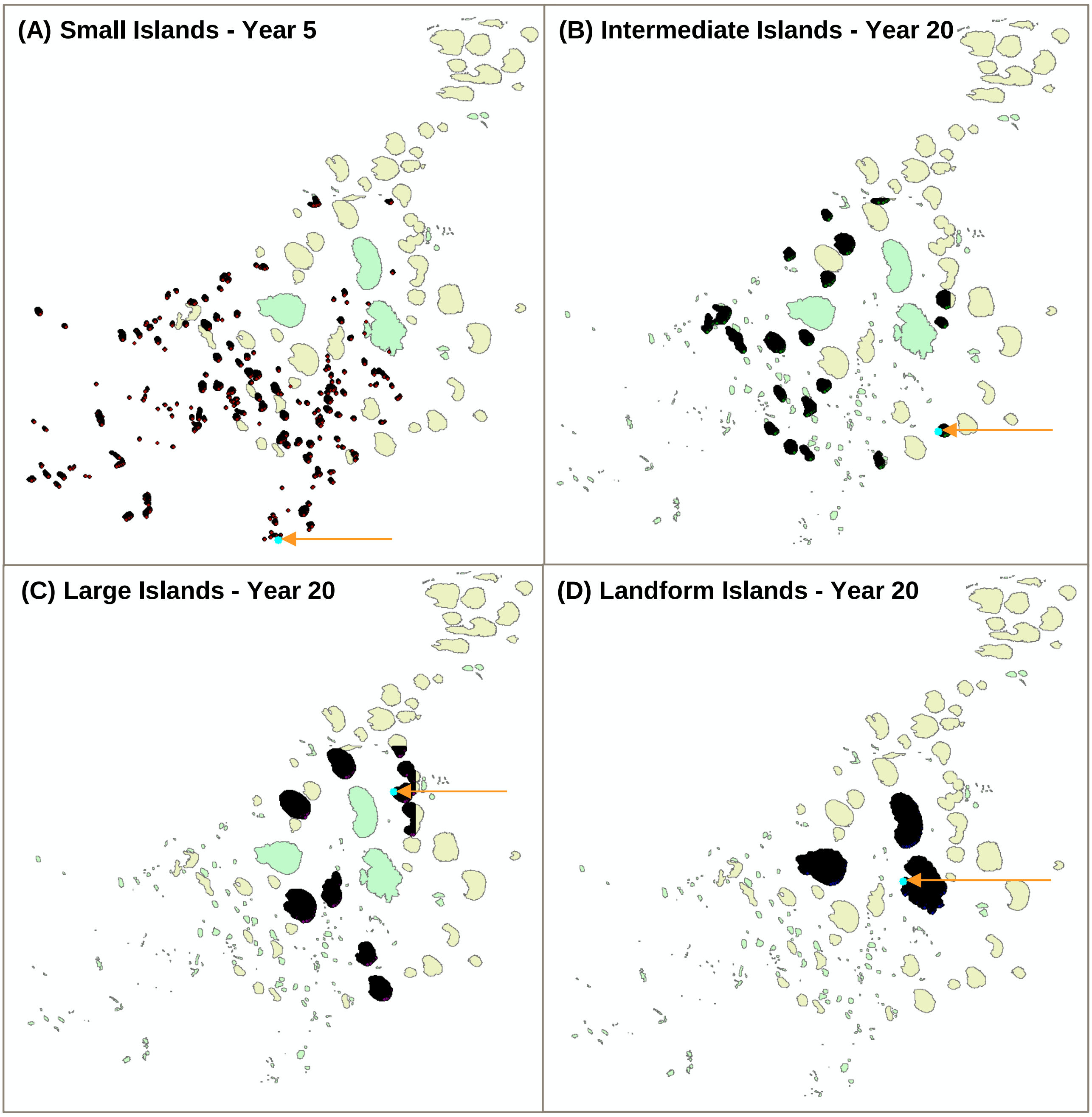


Figure 6-4: Predicted drawdown across the islands at (A) year 5 for small islands, and year 20 for (B) intermediate islands, (C) large islands, and (D) landform islands. Maximum drawdown location indicated by orange arrows.

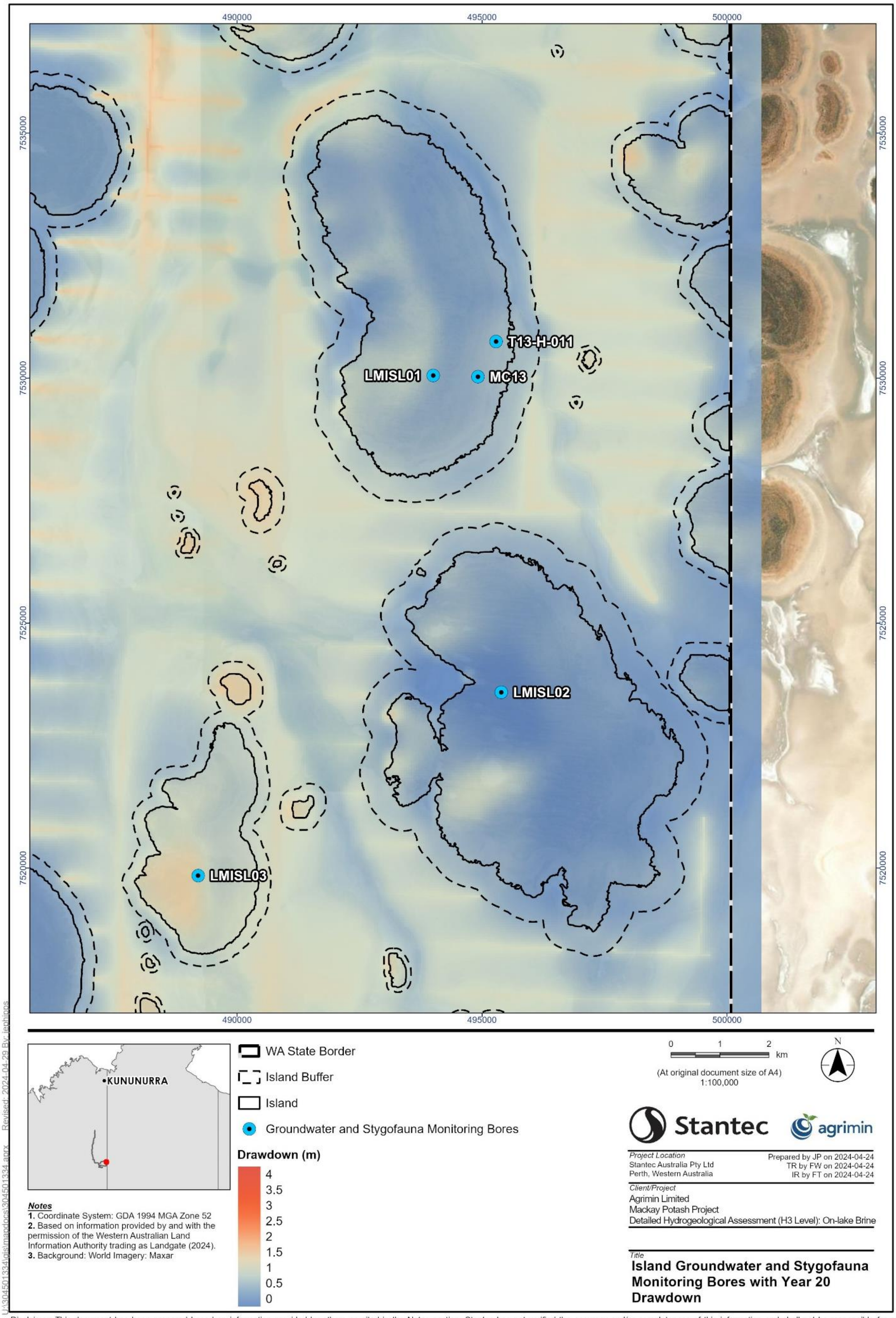


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Figure 6-5: Drawdown modelled on the eastern landform islands at year 20 of mining, indicating the location of existing groundwater monitoring and stygofauna monitoring bores and island buffer zones.

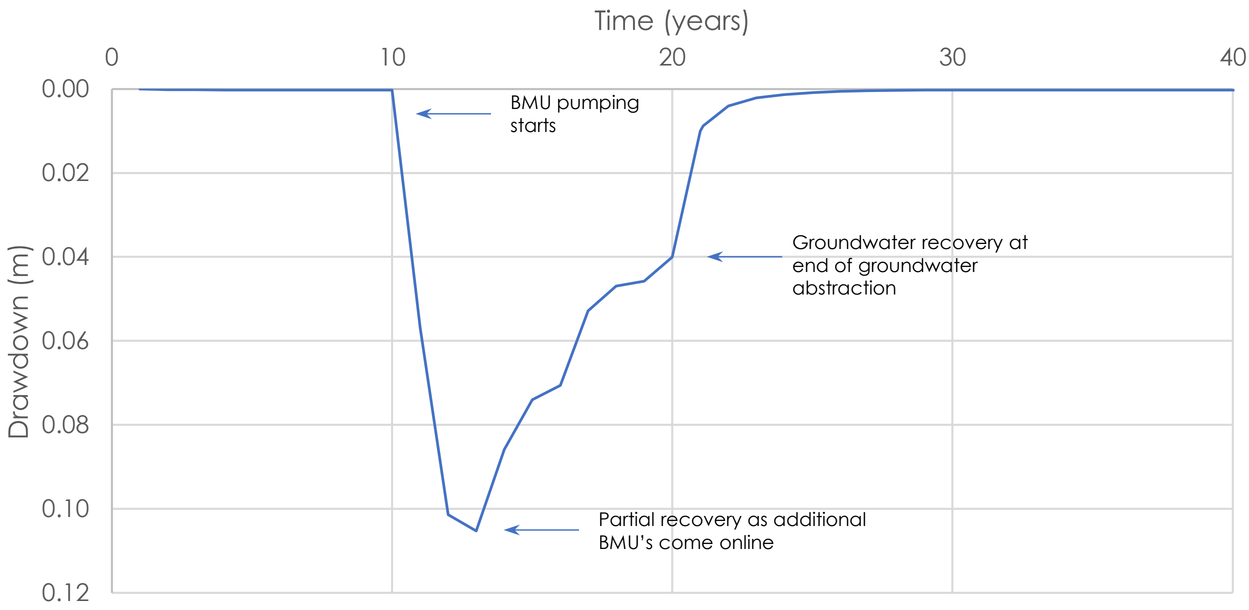

Figure 6-6: Predicted drawdown variability and water level recovery over the LoM on landform island bore MC13.

6.5.3. Water Balance Modelling and Climate Change

Stantec completed inundation and water balance modelling to assess changes in groundwater and inundation levels of Lake Mackay under baseline and operational scenarios for the Proposal (Stantec 2021e). Analysis of satellite imagery and Weather Observations from Space (WoFs) data from 1987 to 2021, found the lake is typically dry and only holds water for only approximately 27% of the time. This was closely correlated to water balance modelling, using the GoldSim probabilistic software package.

Model results indicated there may be a predicted average decrease in groundwater levels across the lake of approximately 0.7 m by year 10 of operations (**Figure 6-7A-D**). This compares to seasonal variation of 0.4 to 0.7 m, with an average of fluctuation of 0. 3m. Baseline and operational scenarios are shown conceptually in **Figure 6-7A-D**, for dry and flooded conditions. A minor reduction may also be observed in the number of smaller inundation events (where <20% of the lake is inundated), corresponding to a 10% decrease in the time the lake holds water. However, 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.

Climate change predictions for the region include a projected increase in drought periods as well as increased intensity of extreme rainfall events. Together with the potential influence of operations from the Proposal, this may have a temporary effect in reducing the number of minor inundation events over the life of mine. However, current projections indicate that large inundation events will not be substantially affected. The predicted increase in extreme rainfall events, supported by rainfall records and satellite imagery analysis (post 2000), may also offset operational changes, with rainfall events of >300 mm in one month anticipated to reset lake groundwater levels.

6.6. Sensitivity Analysis

The complete model sensitivity analysis methodology and results are provided in **Appendix B**.

6.6.1. Model Input Parameters

A sensitivity analysis was conducted on selected model input parameters to assess which parameters have the most influence on the predicted mine plan SOP production. Four sensitivity simulations were run for each parameter for a total of 24 sensitivity simulations. The parameters with the most influence on the predicted mine plan SOP production (hydraulic conductivity and net recharge) have been studied extensively across the lake.

Note that hydraulic conductivity of the UZT production interval and recharge as percentage of mean annual precipitation have been extensively investigated and analysed, and are presented in **Appendix B**.

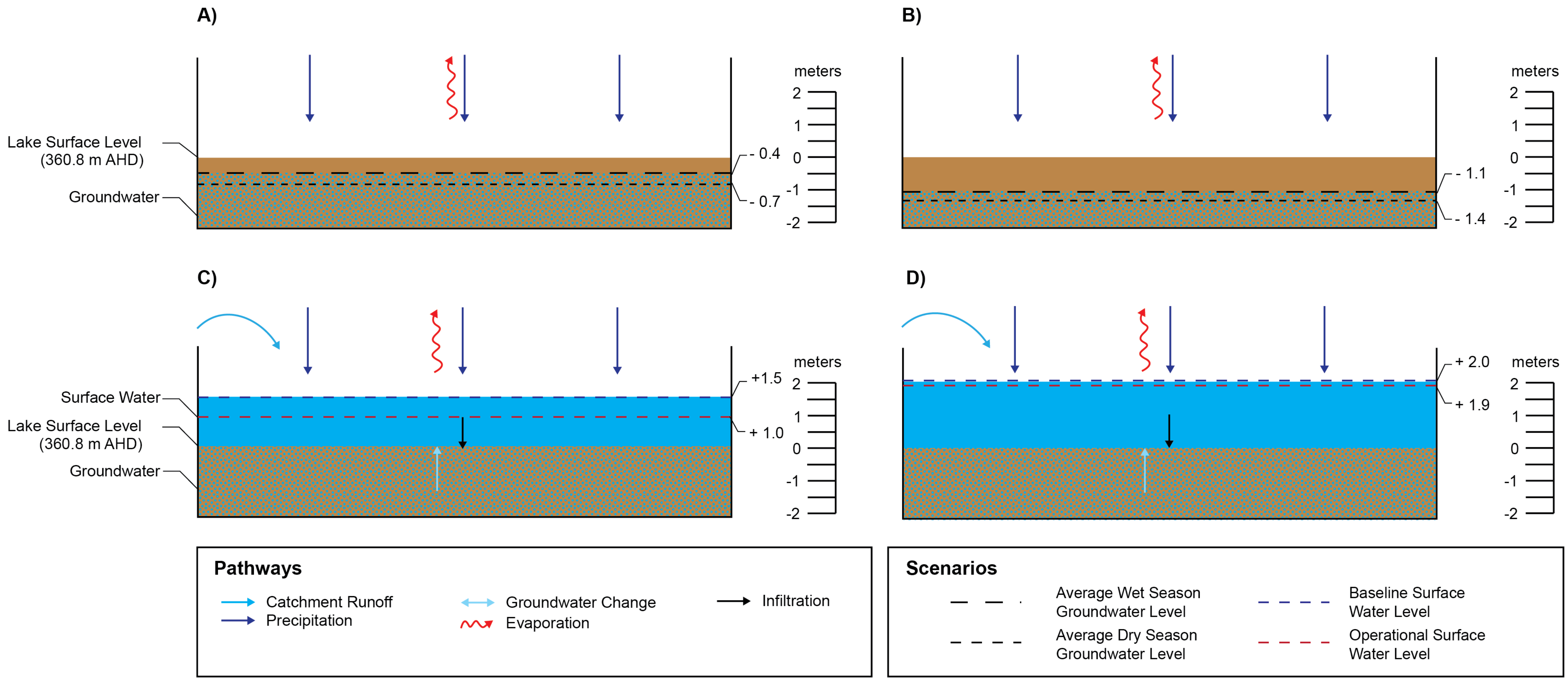

Figure 6-7: Conceptualisation of water balance modelling (GoldSim results) for Lake Mackay during dry conditions under (A) baseline, and (B) operational (year 10) scenarios, and during inundated conditions under baseline and operational scenarios at (C) surface water level expected to be exceeded 25% of the time, and (D) maximum surface water level.

7. Environmental Impact Assessment

7.1. Sensitive Receptors and Potential Impacts

The final configuration of the brine supply network will comprise a main feed canal (up to 4 m deep) and gravity-fed infiltration and second order trenches (located at 1 km spacing). The trench network will be separated into BMUs to facilitate the abstraction of SOP at the required grade for evaporation and processing, over the 20-year LoM. Within the On-LDE, this equates to a direct disturbance of 15,000 ha, or less than 5% of the total playa habitat. A detailed environmental impact assessment (EIA) was completed for the on-LDE in the ERD document (Stantec 2022), while a comprehensive management and monitoring program are presented within the Inland Water Environmental Management Plan (IWEMP). A summary of the key components of the EIA and management and mitigation measures for the on-LDE are provided in the subsequent sections.

The potential risks to sensitive environmental receptors across and near the on-LDE were assessed. This includes other groundwater users, riparian vegetation on lake margins and islands, groundwater dependent vegetation and stygofauna on the larger islands, and surface water ecosystems of the lake and islands. The impacts to these receptors from the brine abstraction for the Proposal may include a reduction in groundwater yields, changes to groundwater chemistry (increased salinity), or a decrease in available surface and groundwater habitat or the quality of this habitat both on the lake and islands. No cumulative environmental impacts were identified, given the remote nature of the Proposal and a lack of nearby groundwater users.

The closest confirmed groundwater bore users are located a substantial distance from the on-LDE (>40 km) and include the Kiwirrkurra community and two registered bores (along the Kiwirrkurra track). There is also an unregistered hand pump bore 20 km to the south of the on-LDE. None of these users will be affected by the abstraction of brine groundwater from the lakebed sediments.

The environmental studies completed for the Proposal indicate there are no potentially sensitive environmental receptors associated with the brine, which is too saline to support groundwater dependent ecosystems. In addition, numerical modelling indicates that the drawdown is limited to the lakebed sediments and does not extend beyond the lake into the riparian zone. As riparian vegetation communities are not groundwater dependent, there are no expected impacts to the margins of the lake or islands. The numerous claypans on the periphery of the lake and larger islands are also not anticipated to be influenced by abstraction of the brine. These waterbodies are likely perched and hydraulically disconnected from underlying groundwater with a surface water regime driven by rainfall and evaporation.

There are several records of groundwater dependent vegetation (*Allocasuarina decaisneana*) from the centre of landform islands, more than 2 km from the margins (**Figure 7-1** and **Figure 7-2**). Stygofauna (copepod taxa) are also known from the large and landform islands (**Figure 7-1** and **Figure 7-2**). It is likely that both potentially sensitive receptors occur more broadly on landform islands that extend into the Northern Territory (where there are negligible impacts from the Proposal), and that they are associated with less saline or freshwater groundwater that overlies the brine. The larger islands are also likely to be zones of higher recharge, due to the prevalence of surficial dune sands and may be considered semi-closed systems. This corresponds to lower predicted drawdown of the brine beneath most of the islands (<0.25 m), which is well within seasonal variation (typically 0.5 to 1.0 m). Buffers of up to 500 m from the trench network to landform islands have also been introduced, to mitigate any potential impacts on groundwater habitats of the landform islands. Due to recharge of fresh and low salinity groundwater on the islands overlying the high-density brine, saline intrusion in not anticipated.

The lake supports the highest ecological values during rare, major inundation events, during which time aquatic biota and waterbirds are widespread in surface waters across the playa. This includes several new aquatic invertebrate taxa and migratory listed waterbird species. However, there are no significant impacts anticipated from the abstraction of brine for the Proposal. Water balance modelling indicates there will be a negligible change to the duration, maximum extent, depth, and frequency of surface water on the lake, during large inundation events. Drawdown is predicted to vary spatially and temporally on the lake, dependent on the schedule of abstraction from the BMUs and permeability of the lakebed sediments. The deepest drawdown will occur in proximity to the trenches (up to 3 m), with the average ranging from 0.5 to 0.8 m, within the natural seasonal variation, although will be higher in the eastern portion of the lake. Staged abstraction of brine from the BMUs (beginning in the south) will enable periodic recovery of groundwater levels, with aquifer thickness typically predicted to reduce by <10% over the LoM. In addition, large rainfall events (>300 mm in one month), will effectively reset groundwater levels to within baseline levels. This is expected to maintain the lake's hydrological processes and ecological values.

There are no expected significant impacts from brine abstraction on other groundwater users or potentially sensitive environmental receptors (**Table 7-1**). Most of the risks are considered negligible or minimal, and do not require intensive management. It is anticipated that the hydrogeological characteristics of the islands will prevent significant impacts to groundwater dependent vegetation and stygofauna supported by freshwater or low salinity habitat conditions. In addition, brine abstraction from BMUs in the vicinity of the landform islands does not begin until year 10 of operations, which will allow for further groundwater monitoring and investigation. As a precautionary measure, the implementation of buffer zones, as well as interim triggers and thresholds have been established to protect potentially sensitive receptors on the landform islands (**Table 7-1**). Aquatic biota and waterbirds are not expected to be impacted, as major flooding will not change as a result of operations, maintaining the ecological values and functions of the lake. Recovery following cessation of abstraction is predicted to occur after approximately seven years, based on average annual rainfall, aided by large rainfall events.

Relevant monitoring requirements and management actions specific to groundwater are summarised in subsequent sections, while additional measures are outlined in associated in the IWEMP and FVEMP to maintain ecological values (**Table 7-1**). It is expected that prior to construction, planned additional drilling, groundwater testing and monitoring will provide supplementary hydraulic characterisation, and the conceptual site model and numerical model and to improve understanding of connectivity of groundwater on the islands to the underlying brine. This may also result in adaptive management to revise triggers and thresholds.

7.2. Management and Monitoring

Management provisions and monitoring to detect any changes outside of the predicted modelled drawdown extent within the on-LDE (**Table 7-1**) include measures at the pre-construction and operational phase of the Proposal, outlined below. Triggers and thresholds were established and considered hydrogeological characteristics and connectivity, likely seasonal variation, and potential receptor habitat of groundwater on the landform islands. The detailed rationale, triggers and thresholds, and associated management actions are presented in the IWEMP.

Pre-construction Phase

- Quarterly baseline monitoring of groundwater levels (measured daily, downloaded quarterly) and groundwater samples collected for analysis (pH, salinity, anions and cations, with metals to be analysed biannually) from existing monitoring bores on the lake and islands (**Figure 7-3** to **Figure 7-6**);
- Installation of additional bores in the vicinity of the larger islands and on these islands, for baseline monitoring of groundwater levels prior to operation, which will be used for operational monitoring, associated with groundwater dependent vegetation and stygofauna (**Figure 7-3** to **Figure 7-4**);
- Investigation into the construction and location of bores on-lake and larger islands (considering hydrogeology and hydraulic connectivity), to ensure data capture aligns with modelled predictions; and
- Collation and analysis of baseline monitoring data (anticipated to be collected over a minimum of a two-year period) to adaptively manage and refine the existing model and adaptively manage trigger and threshold criteria as required.

Operational Phase

- Quarterly operational monitoring of groundwater levels (measured daily, downloaded quarterly) and groundwater samples collected for analysis (pH, salinity, anions and cations, with metals to be analysed biannually) from abstraction and monitoring bores, and bores installed near potentially sensitive receptors (**Table 7-1**, **Figure 7-1** and **Figure 7-2**, detailed in the IWEMP);
- Monitoring of bores on the islands near potentially sensitive receptors and on the lake, against interim trigger and threshold criteria (summarised in **Table 7-1**, listed per monitoring bore in **Appendix D**, and detailed in the IWEMP), to prevent impacts outside of those predicted by the modelling;
- 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);
- 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;
- Detailed management actions associated with triggers and thresholds are provided in the IWEMP; and
- In the event thresholds are exceeded, adaptive management of BMUs will occur to limit abstraction and drawdown near landform islands or buffers from trenches to islands may be extended, where possible, to prevent impacts.

While there are no expected impacts associated with abstraction of groundwater from the on-LDE, monitoring against interim triggers and thresholds will provide an early warning to detect a reduction in groundwater levels outside of predicted modelling for drawdown on the islands, enabling additional management actions to be developed by Agrimin if required, aligning with the IWEMP. In addition, climate change predictions for the Proposal Area indicate there may be an increase in the frequency of extreme rainfall events, projected with high confidence (Watterson *et al.* 2015). This has been evidenced by long-term climate records in the region, with an increase in the frequency of rainfall events above 50 mm recorded since 2000, typically associated with ex-tropical cyclones (Stantec 2021d). These types of events will assist with accelerating recharge and recovery of the perched island groundwater system during and following cessation of abstraction at the 20-year LoM.

Table 7-1: Potential impacts and risk from the proposed groundwater extraction On-LDE, sensitive receptors and mitigation and management measures where required, in relation to monitoring and reporting requirements from the IWEMP.

Component	Potential Impact	Sensitive Receptor	Risk	Monitoring and Reporting	Groundwater IWEMP Trigger Criteria	Groundwater IWEMP Threshold Criteria	Justification and Mitigation for IWEMP Triggers and Thresholds
Groundwater Yields	Abstraction of 70-100GL/annum of groundwater from the brine in the lake sediments may reduce availability for other groundwater users.	Other groundwater users (registered bores)	**Negligible**	• Not required for other groundwater users. • Monitoring of groundwater levels as per the Section 5C Licence to Take Groundwater and annual reporting.	• Abstraction of the brine in the lakebed sediments exceeds 95 GL/a	• Abstraction of the brine in the lakebed sediments exceeds 100 GL/a	• Not required as the brine is not suitable for use by other groundwater users. • The management of abstraction will align with the Section 5C Licence to Take Groundwater, with detailed management actions associated with the triggers and thresholds are provided in the IWEMP.
Groundwater Levels	Abstraction of groundwater over the LoM, reducing groundwater levels. This may reduce the availability of groundwater for other bore users, limit access to groundwater for dependent vegetation and reduce available habitat for stygofauna.	Other groundwater users (registered bores)	**Negligible**	• Not required.	• NA	• NA	• Not required as the brine is not suitable for use by other groundwater users.
		Riparian vegetation on lake margins and larger islands	**Negligible**	• Monitoring of riparian vegetation (lake margins and larger islands) and reporting as per the FVEMP, applying adaptive management.	• NA	• NA	• Not required as riparian vegetation on lake margins and islands is not groundwater dependent. • Modelling indicates there is no anticipated drawdown on lake margins. • Higher recharge occurs on larger islands due to dune sands, correlating to less drawdown and increased recharge, reducing potential impacts. • Analysis of riparian vegetation monitoring will include interpretation of findings, to detect any changes.
		Groundwater dependent vegetation on larger islands	**Negligible**	• Quarterly monitoring of groundwater levels from new bores (MBISLGW01-10) on-lake and in riparian zone of larger islands, as well as existing island bores, totalling 18 bores (**Figure 7-4**). • Monitoring of the above as detailed in the IWEMP and reporting against groundwater triggers and thresholds, applying adaptive management. • Monitoring of groundwater dependent vegetation (tree health of *Allocasuarina decaisneana*) and reporting as per the FVEMP, applying adaptive management.	• Drawdown exceeds 2 m at new groundwater monitoring bores on lake and in riparian zone in the vicinity of large and landform islands (**Appendix F**) 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 (**Appendix F**) AND • Subsequent investigation determines the change is related to abstraction	• Predicted groundwater drawdown of brine is mostly <0.25m on landform islands and is not anticipated to significantly alter vertical/lateral extent of low salinity or freshwater groundwater. • *Allocasuarina decaisneana* (potential groundwater dependent species) records are known from several landform islands, typically occurring in central areas on elevated ground, >2km from margins. • Buffer zones have been implemented between the trenches and islands (up to 500m 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. • Detailed management actions associated with triggers and thresholds are provided in the IWEMP. • Detailed management actions associated with triggers and thresholds are provided in the FVEMP for groundwater dependent vegetation (*Allocasuarina decaisneana* Desert Oak). • Triggers and thresholds have been set considering the likely hydrogeological characteristics of the aquifer and seasonal variation. • In the event thresholds are exceeded, adaptive management of BMUs will occur to limit abstraction and drawdown near landform islands or buffers from trenches to islands may be extended, where possible.

Component	Potential Impact	Sensitive Receptor	Risk	Monitoring and Reporting	Groundwater IWEMP Trigger Criteria	Groundwater IWEMP Threshold Criteria	Justification and Mitigation for IWEMP Triggers and Thresholds
		Stygofauna inhabiting low salinity groundwater on larger islands	**Minimal**	• Quarterly monitoring of groundwater levels from new bores (MBISLGW01-10) on-lake and in riparian zone of larger islands, as well as existing island bores, totalling 18 bores (**Figure 7-4**). • Monitoring of the above as detailed in the IWEMP and reporting against groundwater triggers and thresholds, applying adaptive management. • Monitoring of stygofauna communities (copepods) from island bores (LMISL01-03, MC13, LMISL05-06) and reporting as per the IWEMP, applying adaptive management.	• Drawdown exceeds 2 m at new groundwater monitoring bores on lake and in riparian zone in the vicinity of large and landform islands (**Appendix F**) <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 in the vicinity of large and landform islands (**Appendix F**) <u>AND</u> • Subsequent investigation determines the change is related to abstraction	• Predicted groundwater drawdown of brine is mostly <0.25m (within seasonal variation) on landform islands and is not anticipated to significantly alter vertical/lateral extent of low salinity or freshwater groundwater. • Most of the stygal copepod records are from approximately >1km 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 500m 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. • Detailed management actions associated with triggers and thresholds are provided in the IWEMP. • Detailed management actions associated with triggers and thresholds are provided in the IWEMP for stygofauna on the islands, • Triggers and thresholds have been set considering the likely hydrogeological characteristics of the aquifer and seasonal variation. • In the event thresholds are exceeded, adaptive management of BMUs will occur to limit abstraction and drawdown near landform islands or buffers from trenches to islands may be extended, where possible.
Groundwater Chemistry	Potential to draw brine groundwater from the brine lakebed sediments into low salinity landform island groundwater. This may reduce the quality of groundwater for other bore users and adversely affect groundwater dependent vegetation and stygofauna.	Other groundwater users (registered bores)	**Negligible**	• Not required.	• NA	• NA	• Not required as the brine is not suitable for use by other groundwater users.
		Groundwater dependent vegetation on larger islands	**Negligible**	• Quarterly sampling and analysis of groundwater chemistry (including salinity) from new bores (MBISLGW01-10) on-lake and in riparian zone of larger islands, as well as existing island bores, totalling 18 bores (**Figure 7-4**). • Monitoring of the above as detailed in the IWEMP and reporting against relevant groundwater guidelines, applying adaptive management. • Monitoring of groundwater dependent vegetation (tree health of *Allocasuarina decaisneana*) and reporting as per the FVEMP, applying adaptive management.	• NA	• NA	• Not required as no significant change anticipated in groundwater chemistry from baseline conditions. • *Allocasuarina decaisneana* (potential groundwater dependent species) records are known from several landform islands, typically occurring in central areas on elevated ground, >2km from margins. • Large islands are recharge zones, with higher infiltration rates following rainfall, limiting drawdown. • Predicted drawdown of brine underlying islands is within the natural seasonal variation. • Predicted groundwater drawdown of brine is mostly <0.25m on landform islands and is not anticipated to significantly alter vertical/lateral extent of low salinity or freshwater groundwater. • Analysis of groundwater samples and *Allocasuarina decaisneana* monitoring will include interpretation of groundwater quality, to detect any changes.
		Stygofauna inhabiting low salinity groundwater on larger islands	**Minimal**	• Quarterly sampling and analysis of groundwater chemistry (including salinity) from new bores (MBISLGW01-10) on-lake and in riparian zone of larger islands, as well as existing island bores, totalling 18 bores (**Figure 7-4**). • Monitoring of the above as detailed in the IWEMP and reporting against relevant groundwater guidelines, applying adaptive management. • Monitoring of stygofauna communities (copepods) and reporting as per the IWEMP, to confirm there is no evidence saline water intrusion over LoM.	• NA	• NA	• Not required as no significant change anticipated in groundwater chemistry from baseline conditions. • Most of the stygal copepod records are from approximately >1km from island margins on elevated areas, although are likely dispersed across most of the larger islands. • Large islands are recharge zones, with higher infiltration rates following rainfall, limiting drawdown. • Predicted drawdown of brine underlying islands is within the natural seasonal variation. • Predicted groundwater drawdown of brine is mostly <0.25m on landform islands and is not anticipated to significantly alter vertical/lateral extent of low salinity or freshwater groundwater. • Analysis of groundwater samples and stygofauna monitoring will include interpretation of groundwater quality, to any detect changes.

Component	Potential Impact	Sensitive Receptor	Risk	Monitoring and Reporting	Groundwater IWEMP Trigger Criteria	Groundwater IWEMP Threshold Criteria	Justification and Mitigation for IWEMP Triggers and Thresholds
Surface Water Ecosystems	Potential to reduce surface water levels and hydroperiod of the lake and island claypans due to surface water-groundwater connection with brine. This may reduce the frequency of inundation and adversely affect claypan ecosystems.	On-lake ecosystem during inundation	**Minimal**	• Quarterly monitoring of groundwater levels from existing on-lake bores within BMUs shown in **Figure 7-5** and **Figure 7-6** (totalling 36 bores). • Monitoring of the above as detailed in the IWEMP and reporting against groundwater triggers and thresholds, applying adaptive management. • Monitoring of groundwater levels as per the Section 5C Licence to Take Groundwater and annual reporting. • Monitoring of surface water inundation extent and duration, water quality, aquatic ecology and riparian vegetation and reporting as per the IWEMP and FVEMP.	• Drawdown exceeds 2 m at on-lake groundwater monitoring bores (**Appendix F**) AND • Subsequent investigation determines the change is related to abstraction	• Drawdown exceeds 3 m at on-lake groundwater monitoring bores (**Appendix F**) AND • Subsequent investigation determines the change is related to abstraction	• 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. • Detailed management actions associated with triggers and thresholds are provided in the IWEMP. • Analysis of groundwater, surface water, aquatic ecology and riparian vegetation monitoring will include interpretation of findings, to detect any changes.
		Claypan ecosystems on large islands during inundation	**Negligible**	• No specific groundwater monitoring of claypans or reporting required. • Monitoring of claypan ecology (surface water quality and biota) and reporting as per the IWEMP and FVEMP, to confirm there is no evidence of impacts as predicted.	• NA	• NA	• Not required as claypans are hydraulicly discrete from groundwater on islands. • Monitoring and reporting on claypan ecology will include interpretation of findings, to detect any changes.

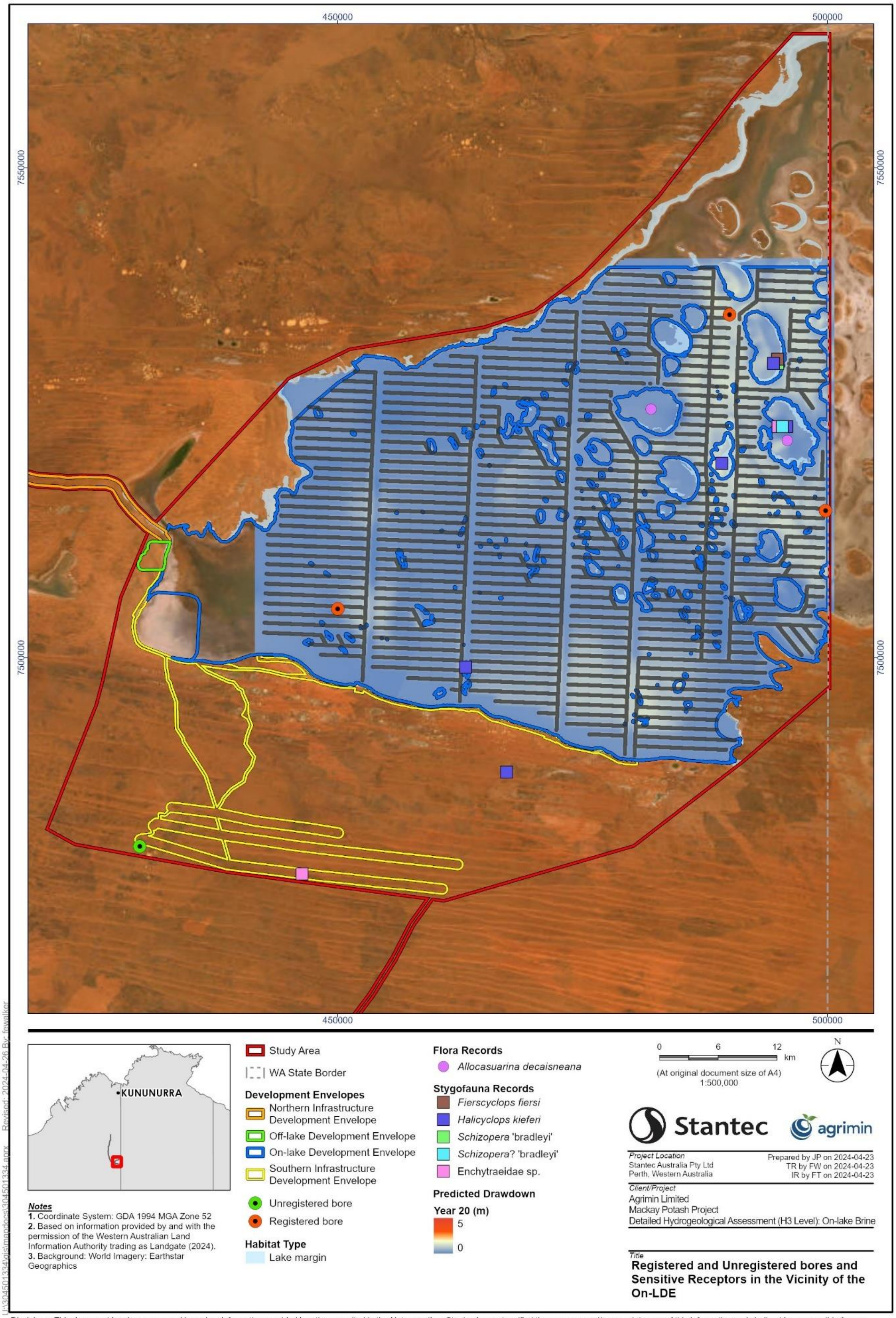

Figure 7-1: Registered (Agrimin) and unregistered bores, riparian zone habitat (mapped as lake margin), *Allocasuarina decaisneana* and stygal copepods and in the vicinity of the on-LDE, compared to the maximum predicted drawdown at 20 years.

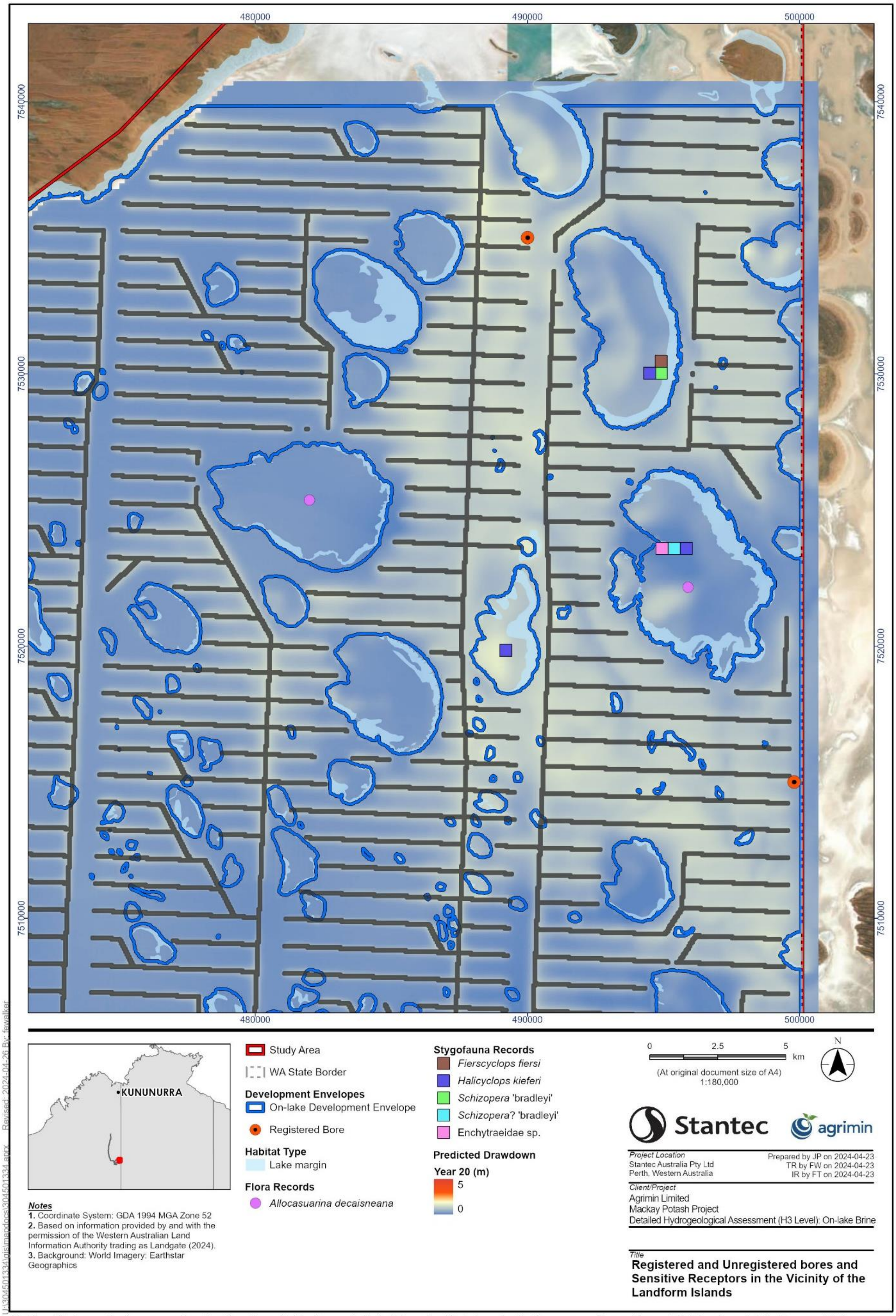

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Figure 7-2: Registered (Agrimin) bores, riparian zone habitat (mapped as lake margin), *Allocasuarina decaisneana* and stygal copepods and in the vicinity of the on-LDE, compared to the maximum predicted drawdown at 20 years.

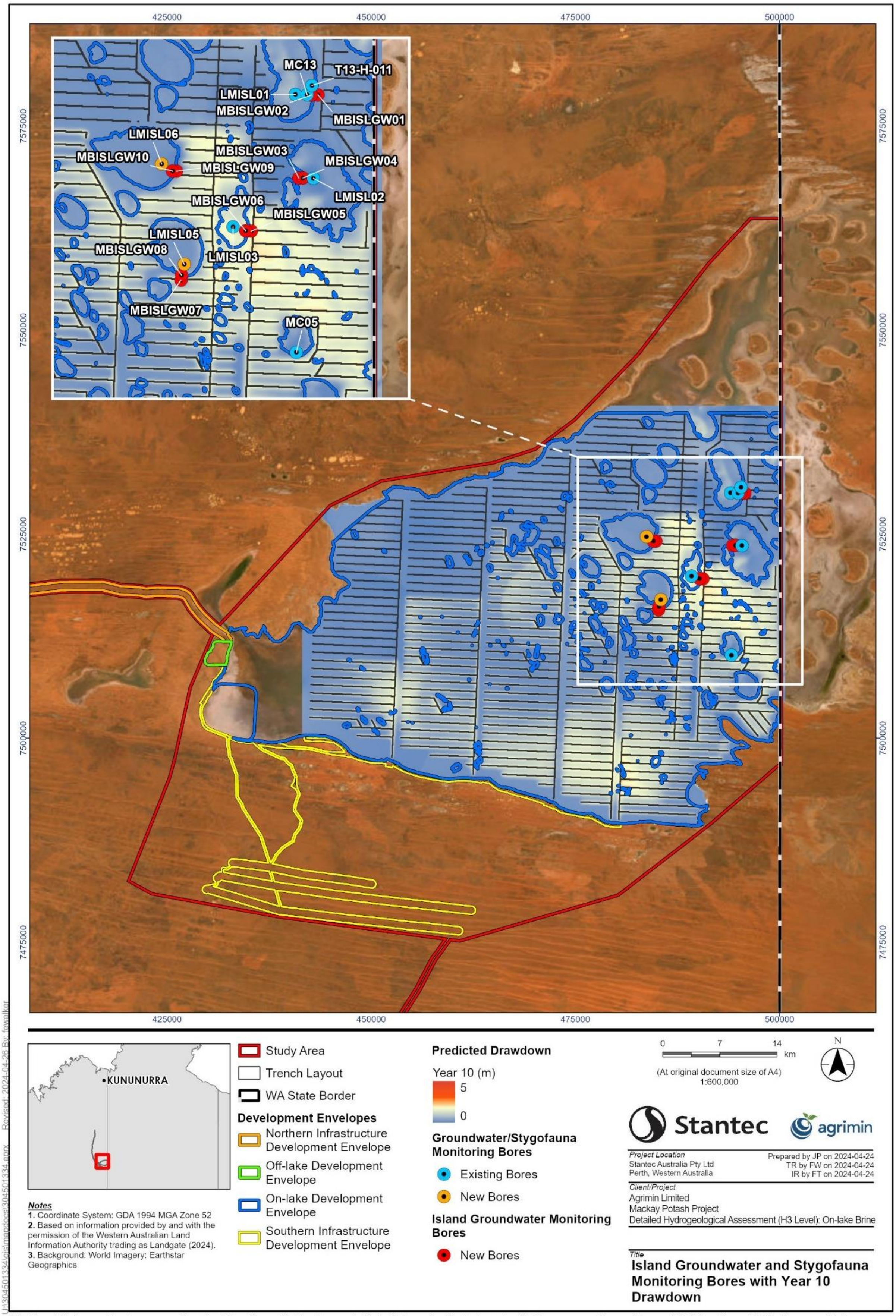

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Figure 7-3: Proposed monitoring bores (showing existing and new bores) on the lake islands, compared to the maximum predicted drawdown at 10 years LoM.

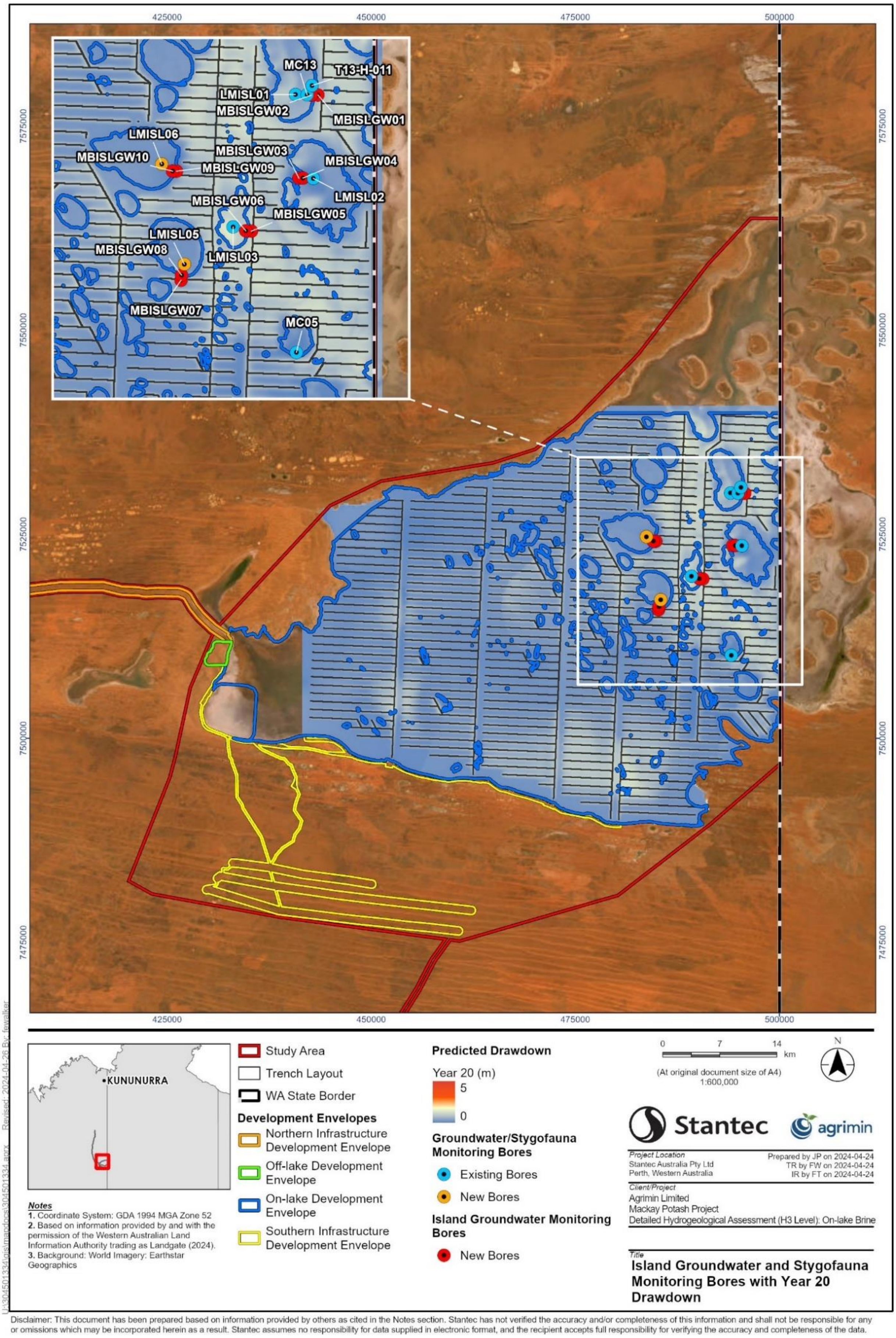

Figure 7-4: Proposed monitoring bores (showing existing and new bores) on the lake islands, compared to the maximum predicted drawdown at 20 years LoM.

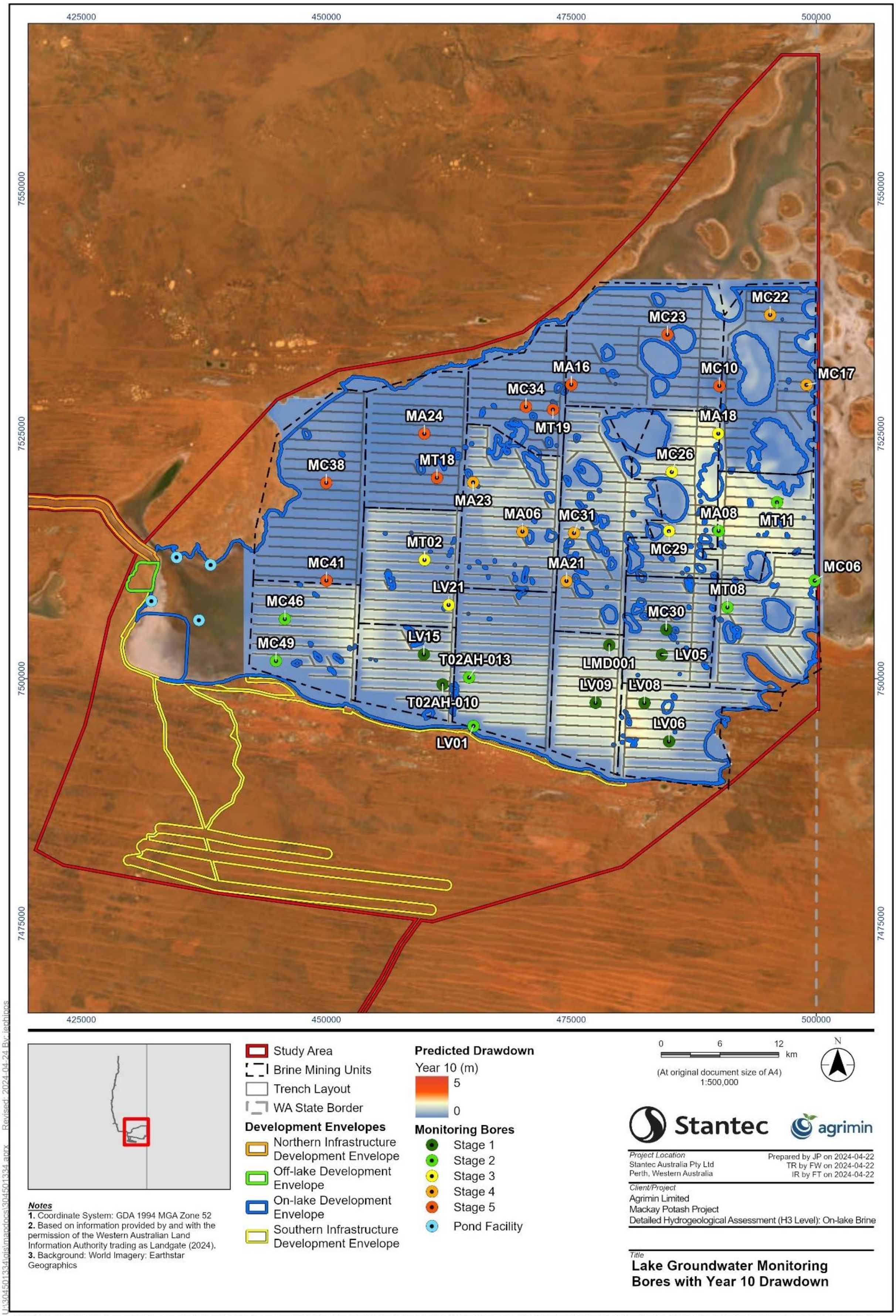

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Figure 7-5: Proposed monitoring bores (also showing existing bores) within the on-LDE, compared to the maximum predicted drawdown at 10 years LoM.

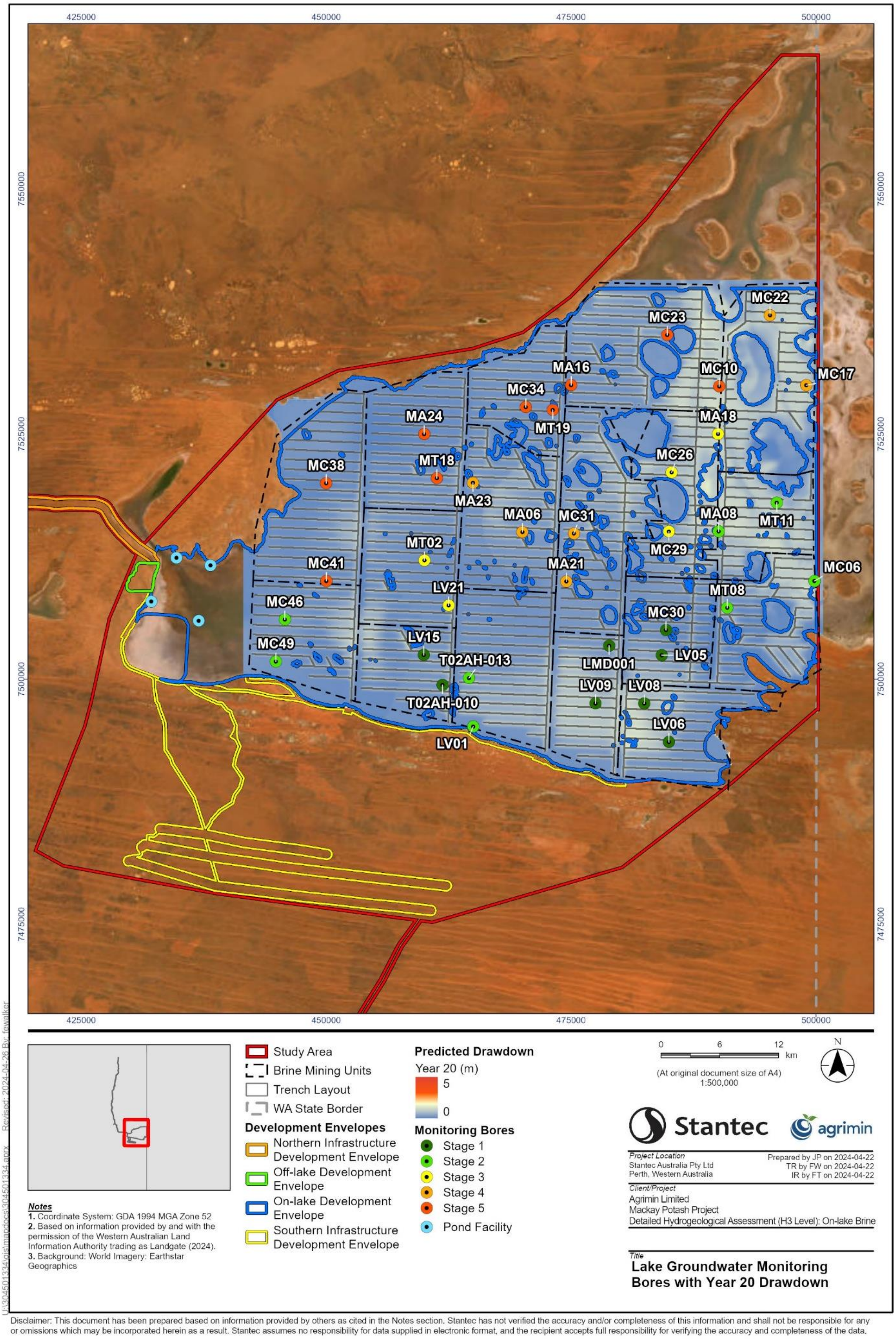

Figure 7-6: 78Proposed monitoring bores (also showing existing bores) within the on-LDE, compared to the maximum predicted drawdown at 20 years LoM.

8. Conclusions and Management

A trench network will be constructed to access potassium bearing brine in the sediments of Lake Mackay, the design of which has been optimised to minimise disturbance to the lake and islands, while enabling the resource (target production of 9 Mt of SOP) to be extracted over the 20-year Life of Mine. The brine will be progressively abstracted from BMUs during operation and will only begin in the central and eastern portions of the lake at approximately year 10. Annual brine abstraction volumes are expected to range from 70 to 100 GL/a, depending on the required flow and potassium grade to meet the annual SOP mass targets.

Predicted groundwater drawdown, based on the numerical modelling, will vary spatially and temporally across the lake during operations, dependent on the schedule of abstraction from the BMUs over the LoM and the permeability of the lakebed sediments. The drawdown extent and average drawdown is more pronounced in the eastern portion of the lake due to the higher permeability of lakebed sediments. The deepest drawdown of up to approximately 3 m will occur at the trenches, while between trenches, generally ranges from 0.0 m to 1.5 m and up to 1.8 m in the east near the landform islands (with abstraction only beginning in this area at year 10).

Drawdown in the trenches typically increases over the initial two years of pumping, which is subsequently reduced, with staged abstraction within BMUs resulting in recovery and less drawdown. However, the average drawdown across the lake ranges from 0.4 to 0.8 m, which is comparable to seasonal variation in groundwater levels (0.5 to 1.0 m). This corresponds to a reduction in the average saturated aquifer thickness of the brine, which is generally less than 10% over the LoM.

The maximum drawdown of the brine in the lakebed sediments beneath the landform islands is expected to range from 1.4 m on the island fringes with an average of 0.35 m, with most of the islands subject to a drawdown of less than 0.25 m (at year 20). Based on the modelling, with buffers implemented that limit trench construction near the islands, drawdown is predicted to be minimal at the margins of the islands and negligible beneath the islands and will typically be within the range of natural seasonal variation. Recovery of groundwater levels to within 95% of baseline conditions then occurs over a period of two to five years once pumping ceases. Under natural conditions, the percentage of rainfall on the islands resulting in recharge is also likely to be higher, due to the more permeable dune sands, limiting drawdown of low salinity groundwater overlying the brine. The landform islands may therefore be considered semi-closed systems, with predicted drawdown impacts minimal.

The proposed trench network and brine abstraction from the On-LDE is not anticipated to impact groundwater users or potentially sensitive environmental receptors, with negligible to minimal risk. There are no other registered groundwater users in the vicinity of the lake, with no cumulative environmental impacts identified, given the remote nature of the development. The brine also provides unsuitable habitat for groundwater dependent ecosystems.

The impact assessment indicated there is no risk to claypans on the margins of the lake and islands, which are likely hydraulically distinct, while riparian vegetation is not groundwater dependent and not anticipated to be affected by drawdown. The largest landform islands on the lake support groundwater dependent vegetation (*Allocasuarina decaisneana*) and stygofauna (copepods), the records of which are typically located more than 1 km from the island margins. These potentially sensitive receptors are associated with low salinity or fresher groundwater that is overlying the brine in the lakebed sediments. However, as the landform islands are likely areas of high recharge and are considered semi-closed systems, predicted drawdown impacts are minimal. Buffers of 500 m from the trench network to the landform islands will also be implemented to prevent potential impacts. Due to recharge from rainfall, and differences in density of the low salinity and brine groundwater, saline intrusion into the upper transition zone is not expected.

The lake supports the highest ecological values during rare, major inundation events, during which surface waters are highly productive, due to emergent aquatic biota, attracting waterbirds for foraging and breeding. Several new aquatic aquatic invertebrate taxa and migratory listed waterbird species are known from the lake, although they are widely distributed. There are no significant impacts anticipated from the abstraction of brine for the Proposal on the hydrological regime of the lake in major floods. Predicted drawdown varies across the lake over the LoM, however, water balance modelling indicates a negligible change to the duration, maximum extent, depth, and frequency of surface water, during these events. In addition, large rainfall events will effectively reset groundwater levels to within baseline levels, and the lake's hydrological processes and ecological values are anticipated to be maintained during operations for the Proposal.

Quarterly monitoring of groundwater levels (daily logging data) and sampling of existing monitoring bores for chemical analysis both on the lake and the landform islands will be undertaken during pre-construction. Additional monitoring bores will also be installed on the lake in the vicinity of the landform islands and within the riparian zone of these islands, to monitor drawdown extent and collect long term data, aligning with the Inland Waters Environmental Management Plan (IWEMP). While no significant impacts are expected on potentially sensitive receptors on landform islands, monitoring against triggers and thresholds will provide an early warning to detect a reduction in groundwater levels outside of predicted modelled drawdown on the lake and islands. This will enable management actions to be implemented by Agrimin as required, which are detailed in the IWEMP.

Prior to construction of the trench network, baseline monitoring data may also be used to revise modelling and trigger and threshold criteria. In the unlikely event drawdown levels exceed thresholds, key mitigation measures include modification of the BMU schedule and increasing the buffer zones to landform islands to further reduce impacts. Brine abstraction from BMUs in the vicinity of the landform islands also begin at year 10 of operations, which allows for further groundwater monitoring and investigation. Recovery (to 95%) following cessation of operations, is predicted to occur over short period (two to five years) aided by intensive rainfall events, which are expected to increase in the frequency due to climate change.

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10. Appendices

Appendix A Island Consolidation Memorandum (Agrimin 2024)

To:	Stantec
From:	Agrimin Technical Team
Subject:	Consolidated Island Impact Memo (updated from 2020)
Date:	April 2024

1. Overview

The following memo combines data and results from fieldwork and reports relating to the on-lake brine sediments and islands on Lake Mackay. The data supporting the current understanding of the lake islands is sourced from seven monitoring bores drilled on islands varying in size and location (Figure 1). Hydrogeological investigations and data collection associated with the islands on Lake Mackay have been ongoing since 2016 when the initial MC series of island and on-lake monitoring bores were installed. In 2019 an additional 5 island monitoring bores were installed (the LMISL series).

Approximately 271 islands of varying sizes (1ha- 2,700ha) are found within the on-lake study area of 2500km². Accessibility to the islands has been mostly limited to helicopter, which has limited the drilling equipment used during these investigations.

The focus for data interpretation is on the landform islands that support more diverse habitats for biological communities and species.

The following technical memorandums form the basis for this consolidated report:

- Island Drilling Memo, Agrimin 2019
- Island Characterisation Memo, Stantec 2020
- Island Impacts Groundwater Memo, Agrimin 2020
- Regional Lake Groundwater Monitoring Memo, Agrimin 2020
- Long Term Pump Test Memo, Agrimin 2020

2. Island Characterisation

Preliminary island characterisation was completed by Stantec Australia. Island size, topography, geology, hydrogeology, and ecology were considered when completing the assessment. A summary of the methodology and results from this work is presented in the Island Characterisation Memorandum (Stantec 2020), Appendix C. There are 271 islands on the surface of Lake Mackay. Most of these islands are located in the eastern region of the lake and the islands have been characterised into six categories, summarised in Table 1 below.

Table 1 Island characterisation summary (Stantec, 2020)

Island Category	Number of Islands	Area (ha) of Islands/class.	% of Islands/Class.	Size Range (ha)	Max Elevation range (m)	Surface Geology	Associated Monitoring Bore
Landform Island	3	7052	1.10	>2000	10 – 12	Aeolian sand, quartz and alluvial deposits, calcrete	MC13 LMISL-001 LMISL-002
Large Island	20	17392	7.33	>500 - 1500	7 – 13	Aeolian sand, quartz and alluvial deposits, calcrete	MC05 LMISL-003
Intermediate Island (elevated Dunes	24	6208	8.79	>100 – 500	7 – 10	Aeolian sand, quartz and alluvial deposits, calcrete	
Intermediate Island (Low Dunes)	8	1379	2.39	> 100 – 50	5 – 9	alluvial deposits, some eolian sand, calcrete	
Small Island (Alluvial)	211	3715	77.66	<100	1 – 7	alluvial deposits, some eolian sand, minor calcrete	LMISL-009 LMISL-010
Small Island (Gypsiferous)	5	116	1.83	<100	2 – 6	alluvial deposits, gypsiferous/clay deposits, minor calcrete	
Totals	**271**	**35862**	**100**				

3. Island Geology

Geological information for the lake islands has been obtained from several exploration programs. Two bores were drilled as part of a lake wide drilling program in 2016 (MC05 and MC13). In 2019, five bores were installed on islands varying in size across the lake. Drilling methodology and bore construction details for the 2019 drilling program are summarised in *Island Drilling Memo, Agrimin, 2019* (Appendix A).

In general, the islands are composed of unconsolidated aeolian sand at surface which is underlain by calcrete and gypsiferous sand. Clay content increases with depth and typically marks the transition from island sediments to lake bed sediments. The thickness of the island sequences varies depending on the size of the island and the elevation of the bore collar relative to the elevation of the surrounding lake. Summarised lithology logs for the bores are presented in Tables 1 to 7 below.

Table 2 – MC05 Lithology log

Depth (m)	**Lithology**	**Description**
0.0 – 1.80	**Aeolian sand**	Yellow-red fine-grained sand, loose, unconsolidated, dry
1.80 – 3.0	**Sandy clay**	Red-brown sandy clay, firm
3.0 – 3.75	**Clay**	Red brown clay with minor sandy clay, moist, firm, high plasticity
3.75 – 7.5	**Clay**	Red brown clay with minor 5mm band of gypsum sand, firm, high plasticity
7.5 - 9.75	**Clay**	Red brown clay, firm, high plasticity

Table 3 – MC13 Lithology log

Depth (m)	**Lithology**	**Description**
0.0 – 1.50	**Aeolian sand**	Yellow, poorly graded sand, loose, unconsolidated sand
1.50 – 2.25	**Sand**	Yellow, well graded sand, loose
2.25 – 3.0	**Sand** with minor clay	Red-brown gypsum sand with minor red brown clay, firm
3.0 – 3.75	**Sandy clay** with minor sand	Red-brown sandy clay with minor fine gypsum sand, firm, high plasticity
3.75 – 5.25	**Clay**	Red-brown clay, firm, high plasticity
5.25 – 10.5	**Clay** with minor crystalline gypsum	Red-brown clay with minor crystalline gypsum bands, firm, high plasticity
10.5 – 11.25	**Clay** with minor sand	Red-brown clay with minor fine sand interval at base of run, firm, high plasticity

Table 4 – LMISL-001 Lithology log

Depth (m)	**Lithology**	**Description**
0 – 0.6	**Aeolian sand**	Very fine grained, dry, well sorted sand transitioning to dry beige-red.
0.6 – 1.7	**Calcrete**	Pale beige calcareous material with minor sand, moderately cemented in parts, dry.
1.7 – 2.0	**Calcrete** with minor clay	Pale beige calcareous material with minor red brown clay, damp.
2.0 – 2.4	**Sandy clay** with minor cemented calcrete	Pale red sand with nodules of moderately consolidated sand and calcrete nodules.
2.4 – 3.0	**Sandy clay** with minor calcrete	Red brown clayey sand (>5%), minor calcrete with increasing gypsum sand.
3.0 – 3.4	**Gypsum sand**	Gypsum sand, fine grained, well sorted, damp to moist.
3.4 – 4.0	**Gypsum sand** with minor clay	Gypsum sand, well sorted, minor clay, first water.

Depth (m)	Lithology	Description
4.0 – 4.5	**Gypsum sand** with minor clay and gypsum crystals	Gypsum sand with increasing clay content, saturated
4.5 – 5.0	**Gypsum sand**	Gypsum sand with minor gypsum crystals (1-8mm)
5.0 – 6.0	**Gypsum sand** with minor clay	Gypsum sand with minor clay, saturated
6.0 – 8.0	**Clay**	Red brown clay, with minor green-beige clay in parts, saturated
8.0 – 12.7	**Clay** with minor gypsum crystals	Red brown clay with minor gypsum crystals 1-10mm, saturated

Table 5 – LMISL-002 Lithology log

Depth (m)	Lithology	Description
0.0 – 0.6	**Aeolian sand**	Pale red brown gypsum sand, unconsolidated, dry, increasing moisture at base of run.
0.6 – 1.7	**Gypsum Sand** with minor calcrete	Red-brown gypsum sand with minor beige white calcrete, moderately consolidated
1.7 – 2.5	**Gypsum Sand** with minor clay	Red-brown to beige medium gypsum sand with minor red brown clay
2.5 – 3.5	**Clay** with minor crystalline gypsum	Red brown clay with minor gypsum crystals 1-40mm, damp
3.5 – 4.0	**Clay** with minor gypsum crystals	Red-brown clay with minor gypsum crystals 1-20mm, wet.

Table 6 – LMISL-003 Lithology log

Depth (m)	Lithology	Description
0.0 – 0.4	**Aeolian sand** with minor calcrete	Pale red brown gypsum sand, well sorted, fine grained, unconsolidated, dry, minor beige calcrete at base of run.
0.4 – 1.0	**Calcrete**	Pale beige-white calcrete, hard, well consolidated, dry, slow drilling
1.0 – 2.1	**Calcrete**	Pale beige-white calcrete, minor red-brown discolouration, hard, well consolidated, damp
2.1 – 2.6	**Calcrete** with minor gypsum sand	Pale beige-white calcrete with minor gypsum sand, damp-moist
2.6 – 3.6	**Gypsum sand** with minor clay	Red-brown gypsum sand transitioning to red-brown clay at base of run, minor dark grey organic mud, moist-wet
3.6 – 4.6	**Clay**	Red-brown clay, moist-wet

Table 7 – LMISL-009 Lithology log

Depth (m)	Lithology	Description
0.0 – 0.7	**Aeolian sand** with minor calcrete	Pale red brown gypsum sand, well sorted, fine grained, unconsolidated, dry
0.7 – 1.7	**Gypsum sand** with minor clay and organic mud	Pale red-brown gypsum sand, minor dark grey-brown organic layer, transition to red-brown clay at base of run, moist-wet.
1.7 – 2.5	**Clay**	Red-brown clay, minor interspersed gypsum crystals
2.5 – 4.0	**Clay** with crystalline gypsum	Red-brown clay with bands of crystalline gypsum

Table 8 – LMISL-010 Lithology log

Depth (m)	Lithology	Description
0.0 – 0.5	**Aeolian sand** with minor calcrete	Pale red brown gypsum sand, well sorted, fine grained, unconsolidated, minor consolidated nodules 1-50mm, dry
0.5 – 0.7	**Calcrete**	Pale beige-white to light brown calcrete, hard, well consolidated, dry, slow drilling
0.7 – 1.0	**Calcrete**	Pale beige-white calcrete, hard, well consolidated
1.0 – 1.4	**Calcrete** with minor gypsum sand	Pale beige-white calcrete with minor gypsum sand
1.4 – 2.9	**Gypsum sand** with minor clay	Pale red-brown gypsum sand, well sorted, medium-fine grained, damp-moist
2.9 -3.5	**Clay**	Red-brown clay, minor green-grey mottle, moist
3.5 – 3.8	**Clay** with minor gypsum crystal	Red-brown clay, minor gypsum crystals

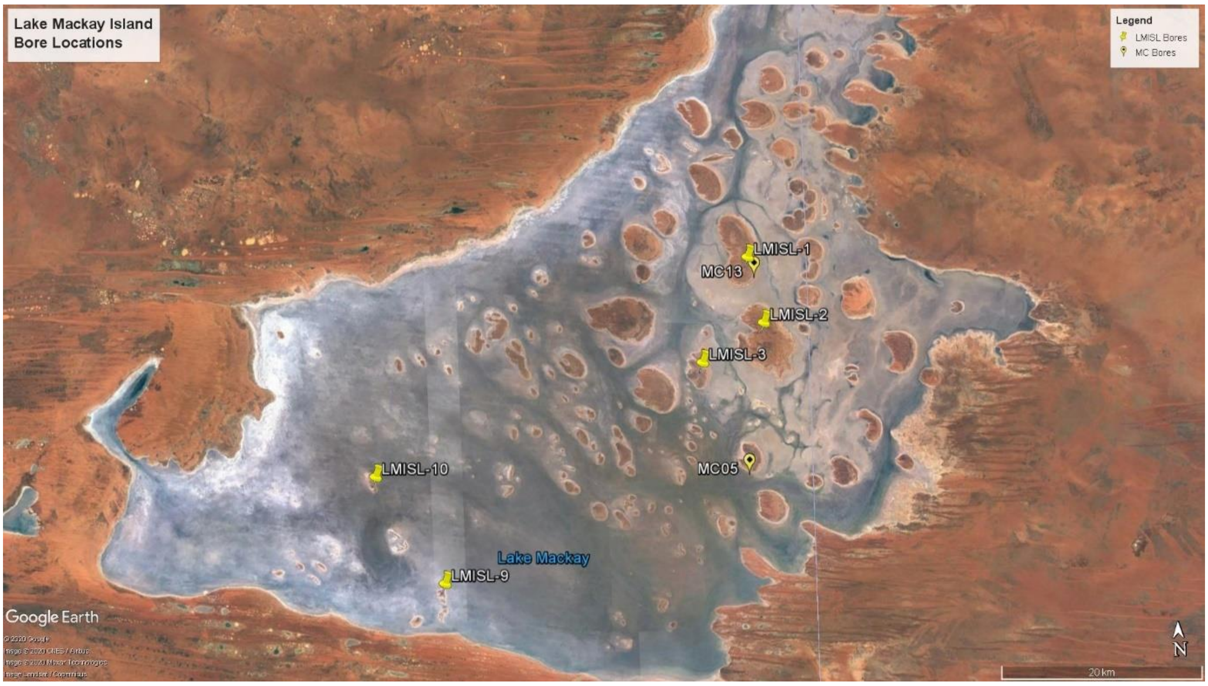


Figure 1 – Island monitoring bore locations

4. Water Quality

A summary of water quality (TDS only) from the island bore locations are presented in Table 9. The island water quality varies for several reasons including:

- Seasonality (wet and dry periods)
- Bore depths (depth drilled into underlying lake-bed sediments)
- Sampling methodology (purged/not purged)
- Island locality (east vs west island characteristics)

Groundwater samples taken from monitoring bores located on large lake islands are summarised in Table 9. These include major anions and cations.

Table 9: Large Island Groundwater Chemistry

Parameter	Records	Min.	Mean	Median	Max.
pH (units)	2	6.83	6.87	6.87	6.90
Salinity (TDS)	2	41,864	48,988	48,989	56,113
Magnesium	3	3	298	373	520
Calcium	3	625	965	1,080	1,190
Sodium	3	165	9,838	12450	16,900
Potassium	3	20	285	325	510
Chloride	3	362	16,612	20,425	29,050
Sulphate	3	1,335	4,160	5,295	5,850
Bicarbonate	2	40	105	105	170
Nitrates	2	8	38	38	68

Periodic sampling of all 7 island monitoring bores for TDS provides additional data as shown in Table 10.

Table 10: Island TDS sampling

Bore ID	Sample Date	Water Quality (Assay TDS (mg/L))
LMISL-001	06/07/2019	6,331
	31/07/2019	160,727 (purged)
	14/10/2020	4,275
LMISL-002	31/07/2019	56,113
LMISL-003	31/07/2019	41,864
	14/10/2020	38,016
LMISL-009	14/10/2020	91,392
MC05	29/11/2017	10,1306
	18/01/2019	113,000
	03/03/2019	128,510
	20/06/2019	152,309
	14/10/2020	59,904
MC13	29/11/2017	63,184
	12/10/2018	32,835
	5/02/2019	39,489
	6/03/2019	42,075
	3/04/2019	41,489
	14/04/2019	89,040
	30/04/2019	40,939
	12/05/2019	61,171
	28/05/2019	39,918
	9/06/2019	84,992
	25/06/2019	39,451
	14/10/2020	24,256

A large chemistry data set exists for the on-lake monitoring bores and trenches. From 346 samples the mean salinity (TDS) of the on-lake brine resource is 214,678 mg/L.

5. Groundwater Levels

5.1 Overview

Lake Mackay hosts a dynamic groundwater system that fluctuates in response to seasonal variations and long-term weather cycles. Regular and long-term water level measurements enable characterisation of baseline lake conditions, calibration of groundwater models and evaluation of groundwater fluctuations over time in response to weather events and climate change.

Short term (<2 years) monitoring of groundwater levels in 52 historic drill holes was conducted during the 2019 wet season (March) and the 2019 dry season (September) and is detailed in Appendix B, *Long Term Groundwater Monitoring memo, Agrimin 2020*. Locations of the monitoring locations are presented in Figure 2.

A network of eleven monitoring bores equipped with data loggers have been established across the lake. Details of these bores are summarised in Table 11. The bores are installed to depths of between 9 m to 30 m in the surficial unconfined lakebed sediments.

Monitoring locations were selected based on their geographical distribution across the lake surface (Figure 2). Collectively, these locations provide data from a range of lake elevations, surficial sediment types and geomorphological features.

Figure 2: Location of Lake Monitoring Bores

5.2 Lake Bed Sediments

5.2.1 Data Logger Data

Data loggers (Table 11) were programmed to record water level measurements at either 6, 12- or 24-hour intervals. Downloads were periodically conducted, and the data processed to produce hydrographs for each location. Manual water level measurements were recorded at the time of download to enable manual off-set adjustments to the logger data if required. Barometric corrections were applied to the logger data to account for variations in atmospheric pressure. Data presented in the hydrographs has been filtered to show daily measurements only to allow for direct comparison between plots and weather records.

Hydrographs for two long term, on-lake monitoring bores are provided in figure 3 and Figure 4. These graphs provide long term water level data at bore positions closest to the landform island at Trench 13. Both graphs (MA13A & MA09) show the effect of the significant rainfall period in late December 2016 that resulted in a large inundation event on the lake and a corresponding increase in the brine groundwater levels. Periods of groundwater receding back to pre-rainfall periods is observed in both observation bores.

Table 11 Lake Bed Sediments Monitoring Bores (with data loggers)

Bore ID	Hole Depth (m)	Location Description	Record Start
MA02	16.7	Western region	2015
MA05	18.7	Western region	2016
MA09	30	Eastern region	2016
MA13-A	26	Eastern region	2015
MA13-B	6	Eastern region	2015
MC01	10.4	Western region	2019
MC05 (Island Location)	9.75	Eastern region	2018
MC13 (Island Location)	11.25	Eastern region	2017
MC37-Deep	11.25	Western region	2018
MC46-Shallow	6	Western region	2018
MC46-Deep	11.25	Western region	2018

5.3 Islands

5.3.1 Data Logger Data

MC05 (Figure 5) and MC13 (Figure 6), were both drilled through the islands and into the underlying lake bed sediments and therefore the hydrographs for these 2 monitoring points are representative of combined island and lake bed sediment brine water levels. Water levels have been measured daily since 2015.

MC05 is located on a large island in the eastern high infiltration zone of the lake. The hydrograph shows a gradual increase in groundwater levels over the 2018-2019 wet season followed by a gradual decline in the following 2020 dry season. Barometric corrections were applied to the data from April 2019 onwards. The increasing water level trend of the graph is attributed to the relatively short monitoring interval. Once several wet-dry season cycles are added to the data set it is predicted that the trend will show an overall decline, consistent with the other long-term monitoring bores.

There is a significant water level increase recorded on 03/03/2020 which coincides with a 20 mm rainfall event recorded by the pilot pond weather station. This sharp water level increase is followed by a rapid water level decline, likely a result of groundwater equalisation and dispersion following the rainfall event; however the linear trend may also be an artefact of barometric correction.

MC13 is located on a large landform island in the north eastern high infiltration zone of the lake. The hydrograph shows a gradual water level decrease over the entire monitoring period (approx 60cm over almost 3 years). There are no sharp water level spikes in the hydrograph.

The LMISL series of bores (installed in 2020), were specifically designed to drill only the island stratigraphy to the point of understanding the depth to the lake bed sediments. Every effort was made to not drill too deep into the underlying lake bed sediments, therefore representing Island hydrogeological conditions only.

LMISL001 (Figure 7) is located on the large landform island west of Trench 13. Data recorded through the 2020/2021 wet season indicates bore water levels rising approximately 50cm as a result of recharge to both lake bed sediments and island sediments.

LMISL009 (Figure 8) is an example of a small landform island with the top of the bore casing approximately 1m above the lake surface. The March 2021 rainfall event resulted in the water level rising approximately 10cm above the initial set water level reference point for the logger. Clear recharge effects are noted to corresponding periods of rainfall recorded at the Agrimin weather station located approximately 5km to the south.

5.3.2 Manual Measurements

Manual water level measurements for the island bores are presented in Table 12. Hydrographs are provided showing seasonal water level trends plotted against regional rainfall. It must be noted that across 2,500km² of lake area, isolated rainfall events occur and as such, rainfall measured at the Lake Mackay weather station does not necessarily reflect rainfall events at island monitoring points up to 60km away. The opposite is also valid, isolated rainfall events are possible at island locations that are not recorded at the weather station. Long term water level trends focus on the regional weather events (cyclonic activity).

Table 12: Island monitoring bores-manual water level measurements

Bore ID	**Date**	**SWL (mbgl)**	**SWL (mamsl)**	**Screened Interval (mbgl)**
LMISL-001	31/7/2019	3.71	363.48	0.5-6.6
	27/08/2020	4.1	363.09	
	14/10/2020	4.1	363.09	
LMISL-002	27/08/2020	Dry	Dry	0.5-4
	14/10/2020	Dry	Dry	
LMISL-003	27/08/2020	3.95	358.55	0.5-4.6
	14/10/2020	4	358.5	
LMISL-009	27/08/2020	1.04	362.14	0.5-4
	14/10/2020	1.42	361.76	
LMISL-010	14/10/2020	2.96	360.3	0.5-3.8
MC05	14/03/2019	2.73	360.12	6.75-9.75
	29/08/2019	2.88	359.97	
	28/08/2020	2.82	360.03	
	14/10/2020	2.93	359.92	
MC13	27/12/2018	2.69	360.76	2.25-11.25
	16/01/2019	2.73	360.72	
	22/01/2019	2.74	360.71	
	5/02/2019	2.76	360.69	

	20/02/2019	3.16	360.29	
	3/04/2019	3.20	360.25	
	14/04/2019	3.22	360.23	
	30/04/2019	3.23	360.22	
	12/05/2019	3.25	360.2	
	28/05/2019	3.27	360.18	
	9/06/2019	3.27	360.18	
	25/06/2019	3.29	360.16	
	16/07/2019	3.30	360.15	
	29/08/2019	3.32	360.13	
	7/10/2019	3.33	360.12	
	14/10/2020	3.54	359.91	

5.4 Summary

- Short term (<2 years) monitoring of groundwater levels in historic drill holes have recorded fluctuations in groundwater levels over a range of approximately 0.4m to 0.7m, with an average water level fluctuation of 0.3m between the 2019 wet and dry season (March to September). The average depth to water across the lake is 0.54 m bgl

- There is a strong correlation between groundwater fluctuations and seasonal variation in the monitoring bore data. The lake groundwater levels sharply increase in response to the first major rainfall event of the wet season. Sharp spikes in the hydrographs indicate a rapid rise in the groundwater level, typically associated with inundation in the immediate vicinity of the bore. These peaks decline as the water equalizes with the lake water table. As rainfall frequency decreases toward the end of the season, the lake water levels begin to recede in response to groundwater discharge via evaporation. This gradual decline in water level continues until the cycle resets at the commencement of the following wet season.

- Hydrographs for bores located on lake islands (MC13 and MC05) do not display the same sharp level increases in response to rainfall events however MC05 has shown some sharp responses to 1 rainfall event. The bores are not directly influenced by surface inundation due to their elevation above the surface of the lake.

- The long-term hydrographs show an overall declining groundwater trend in the water levels over the wet season-dry season cycles. This trend has been attributed to the below average rainfall received by the region since detailed groundwater monitoring began. The 25-year average rainfall for the region is 290.5 mm (BOM, 2020). Rainfall for the previous two years of monitoring has been significantly below average, with 169 mm received in 2018 and 30.4 mm for 2019.

- The comparison of rainfall events at the Pilot Pond weather station and/or Walungurru are guides only, the vast distance between monitoring bores and these recording stations (up to 100km) must be taken into consideration during interpretation.

5.5 Lake Hydrographs

Figure 3: MA13A Hydrograph

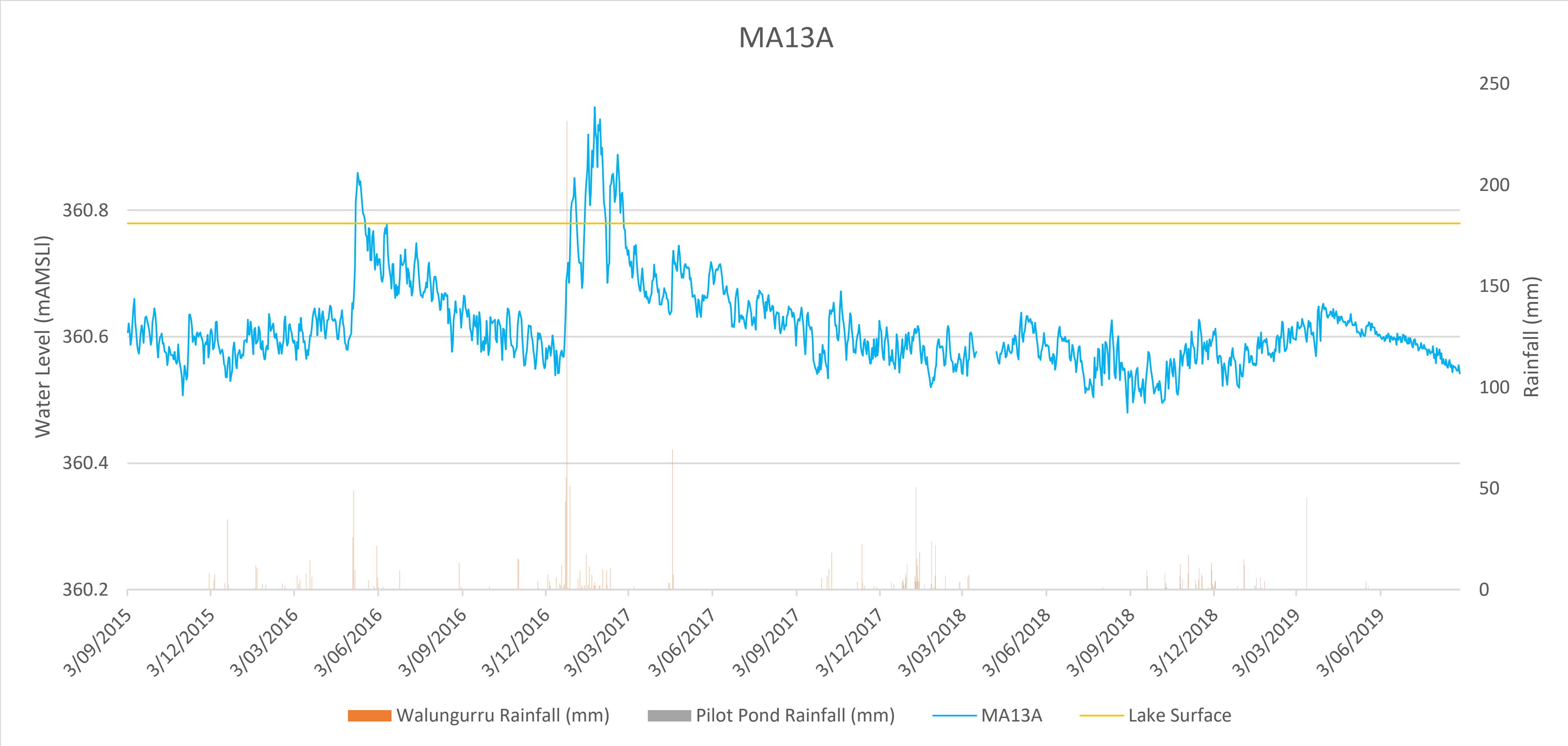
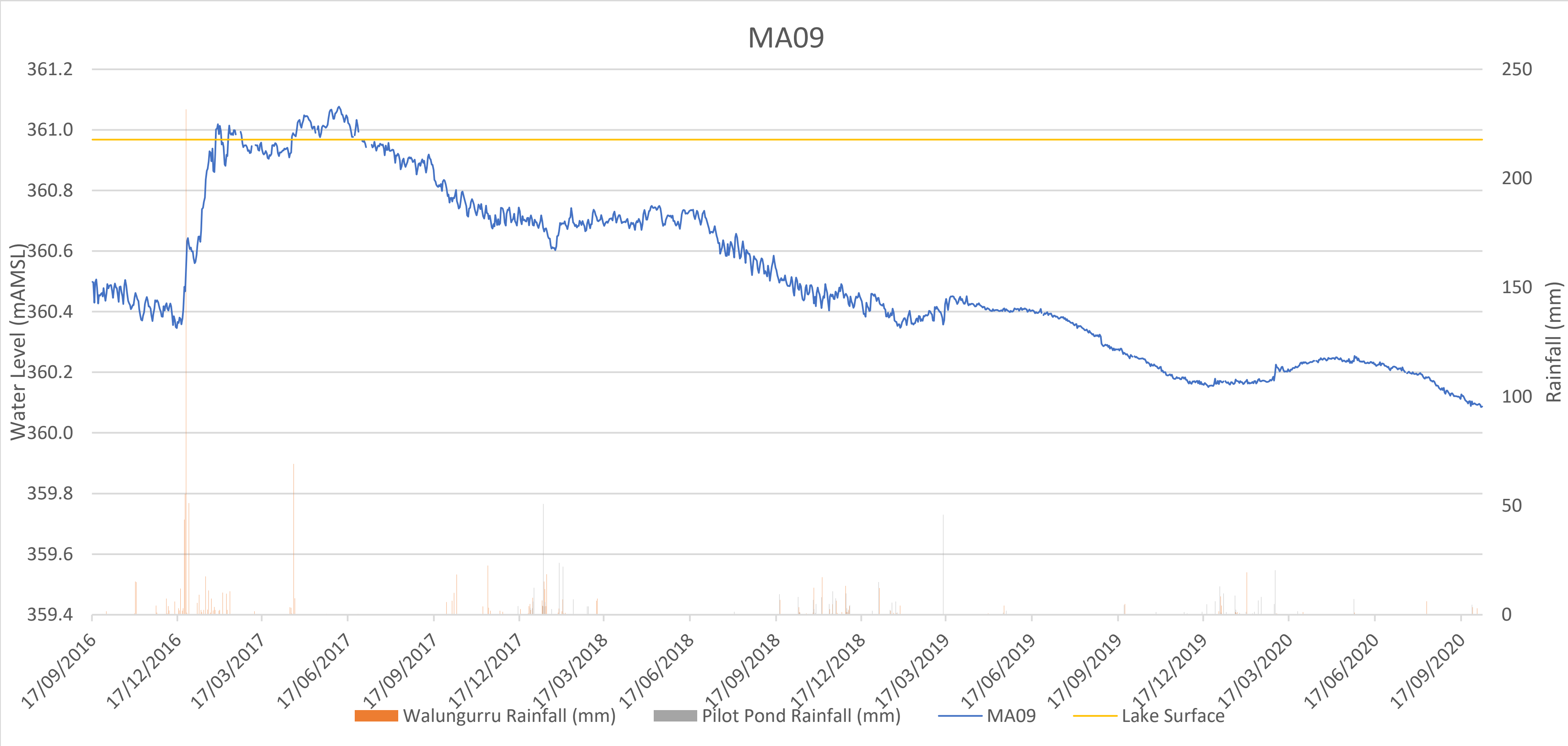
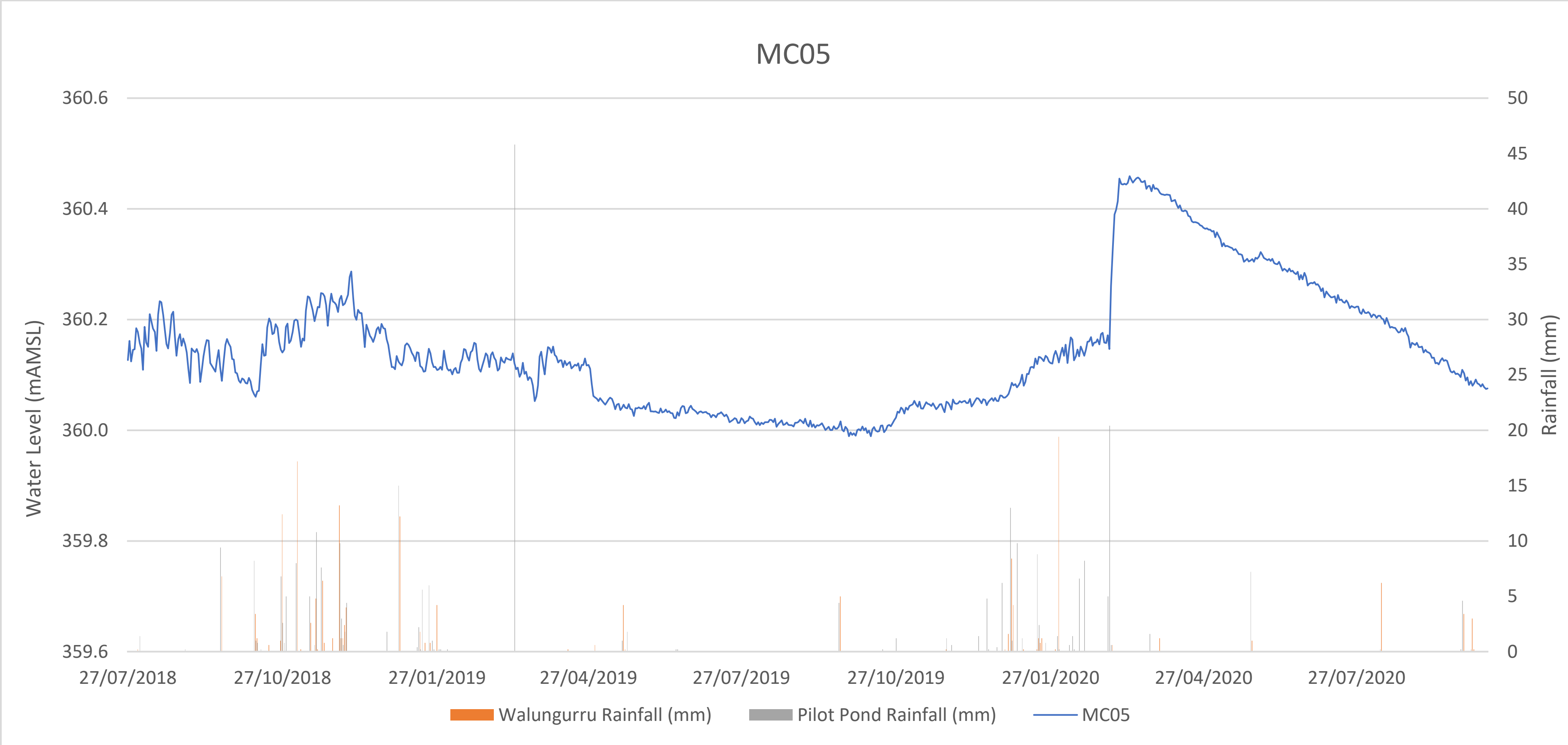


Figure 4: MA09 Hydrograph



(Barometric compensation applied from March 2019 onwards, smoothing the water level profile)

Figure 5 – MC05 Hydrograph



5.6 Island Hydrographs

Figure 6 – MC13 Hydrograph

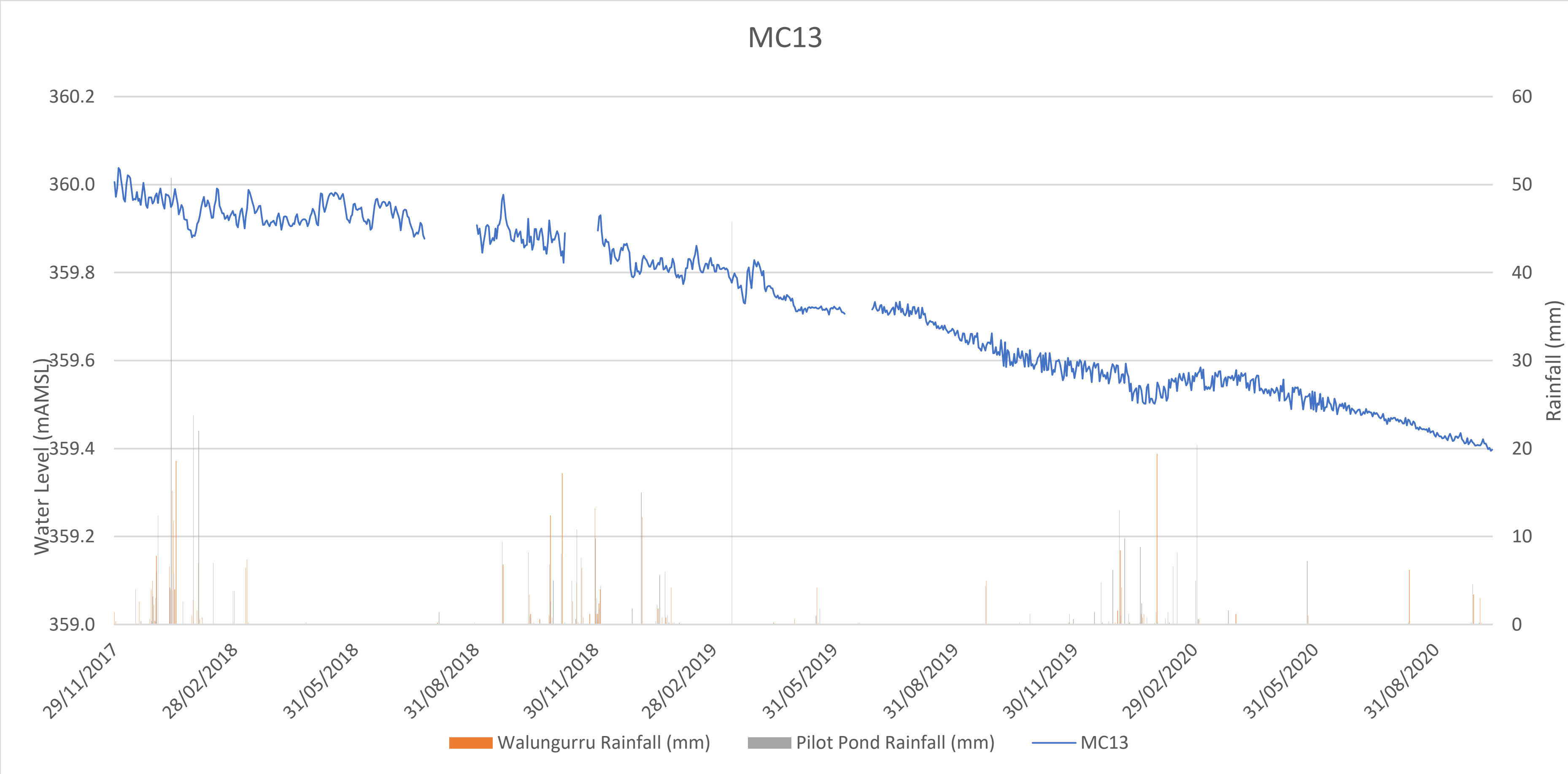


Figure 7: LMISL001 Hydrograph

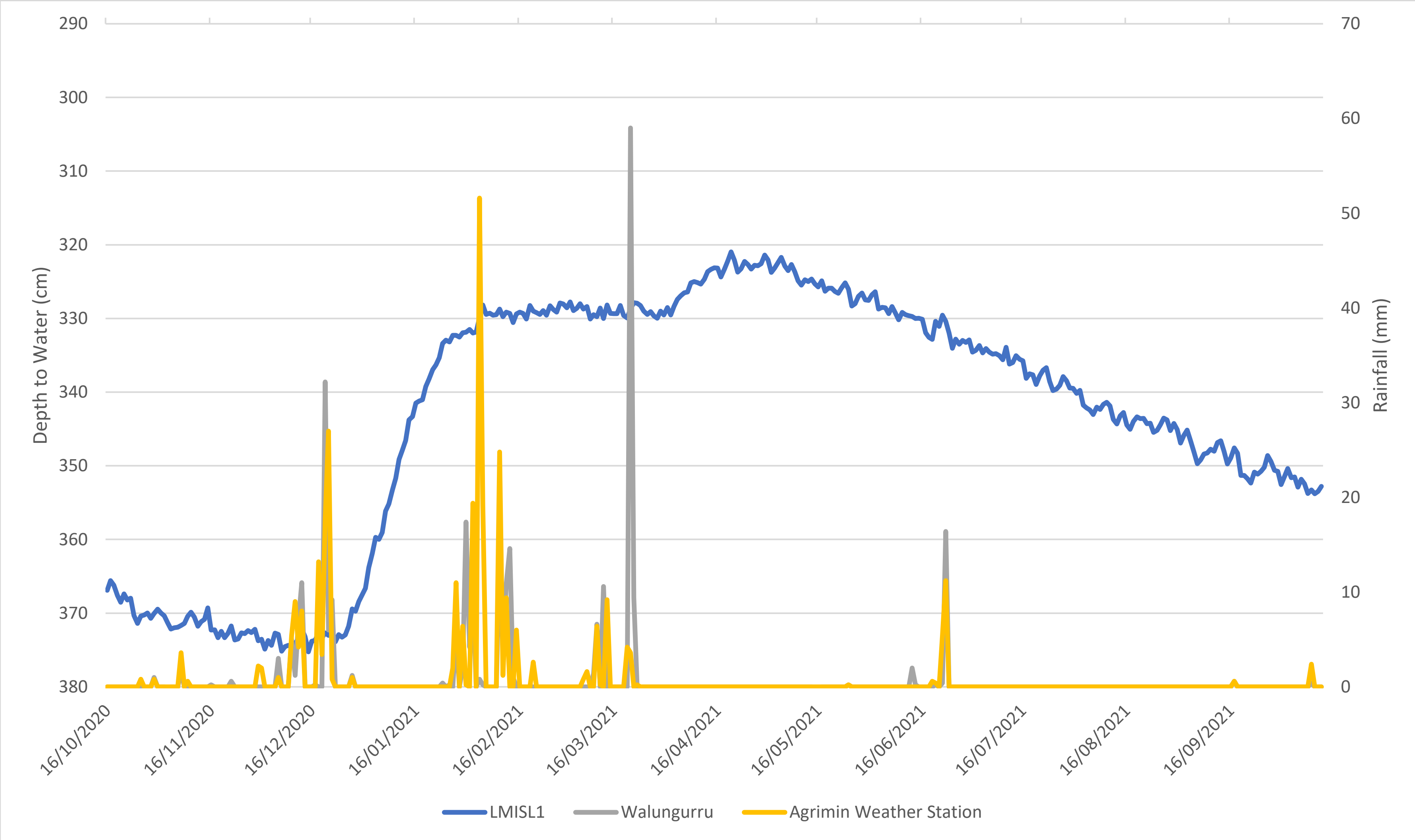
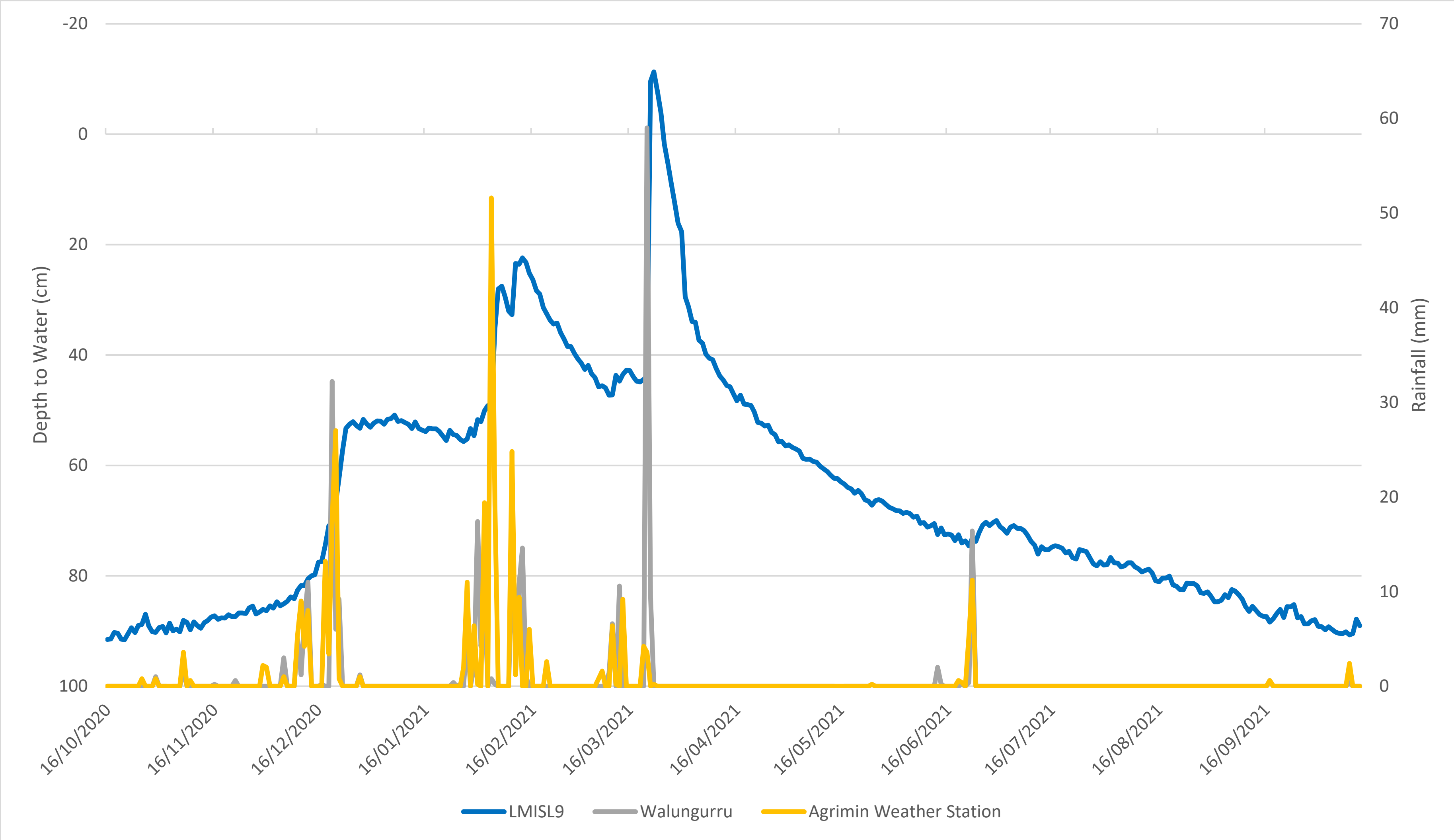


Figure 8: LMISL009



6. Islands and Lake Interface

6.1 Monitoring Points

The landform island at Trench 13 was chosen as a focal point for several hydrogeological related investigations to identify characteristics associated with lake bed sediments, the riparian zone and island surficial sands. A series of monitoring bores were installed around the trench as part of the resource and brine abstraction investigations but also along a west trending line to incorporate the riparian zone and landform island (Figure 9 & Figure 12). Most of these points were monitored during 6 months of continuous pump testing of Trench 13.

Figure 9: Position of Trench and Monitoring Bores-Landform Island

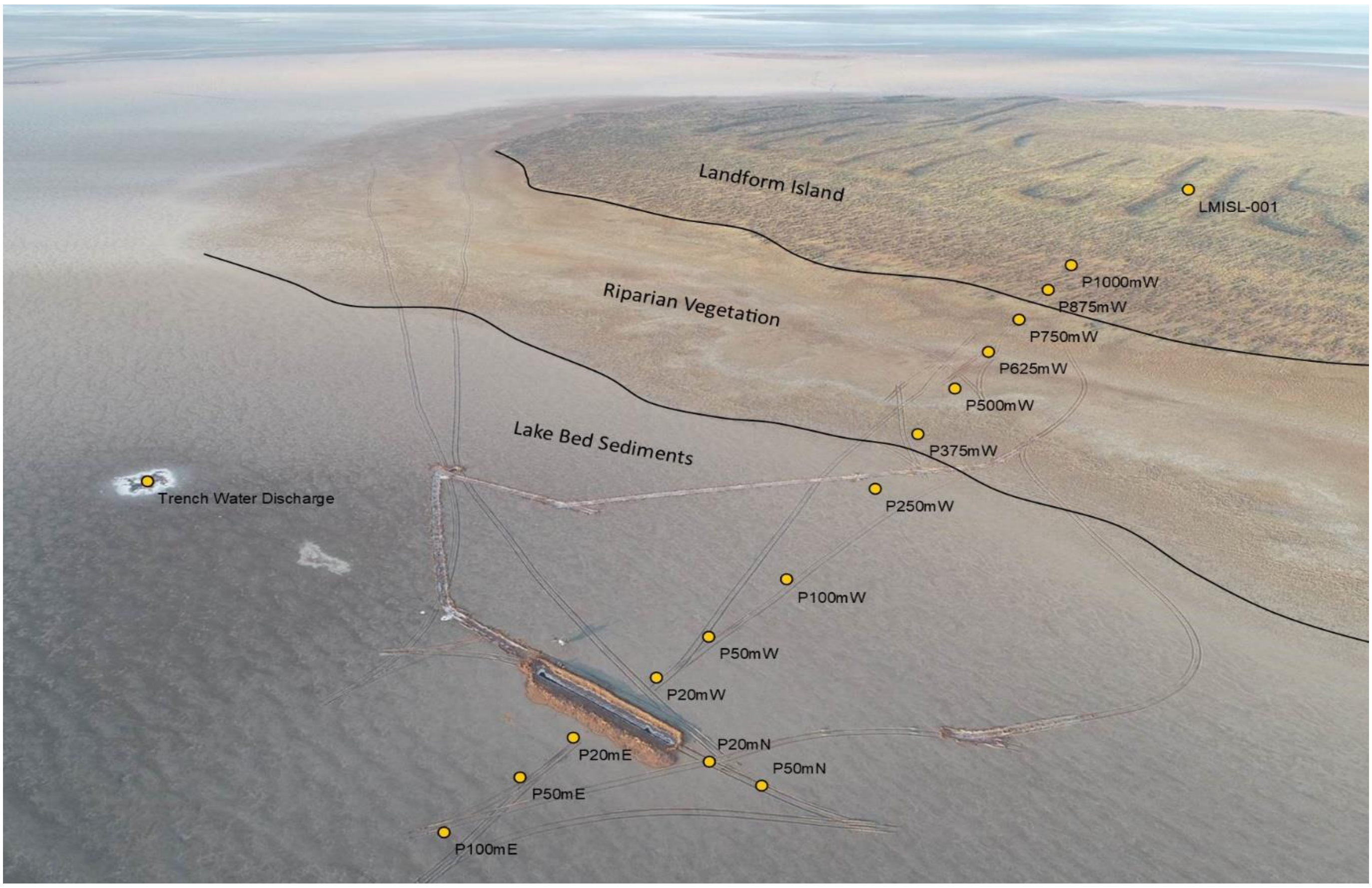


Table 13: Monitoring Bore Details-Landform Island

Monitoring Point	Zone	Depth (mbs)	Water Level (mbs) (27.12.18)	Screened Interval (mbs)	Construction Details
P20mW	Lake Bed Sediments	6	0.64	0.5-6	50mm PVC
P50mW	Lake Bed Sediments	6	0.5	0.5-6	50mm PVC
P100mW	Lake Bed Sediments	6	0.47	0.5-6	50mm PVC
P250mW	Lake Bed Sediments	6	0.6	0.5-6	50mm PVC
P500mW	Riparian Zone	6	0.73	0.5-6	50mm PVC
P625mW	Riparian Zone	6	0.94	0.5-6	50mm PVC
P750mW	Riparian Zone	6	1.56	0.5-6	50mm PVC

P875mW	Island	6	2.26	0.5-6	50mm PVC
P1000mW (MC13)	Island	11.25	2.69	2.25-11.25	50mm PVC

6.2 Groundwater Quality

A TDS profile is provided in Figure 11 for the westward transect, stretching approximately 2000m west of Trench 13. As expected, brine related TDS measurements around 200,000 mg/L were measured up to 350m west of Trench 13, reducing to between 150,000 and 120,000 mg/L through the riparian zone and into the landform island habitat where values decrease to 50,000-6,000 mg/L approximately 2000m west of Trench 13.

Figure 11: TDS Profile -Trench 13 to Landform Island

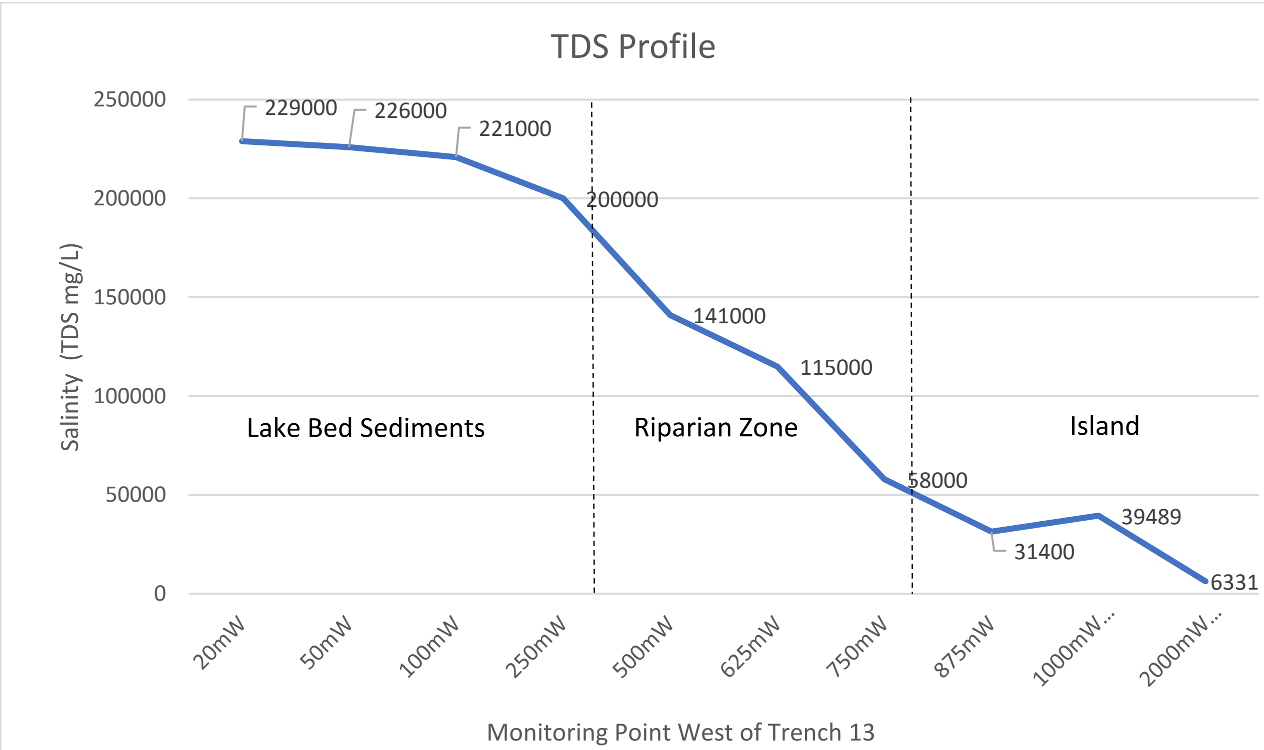
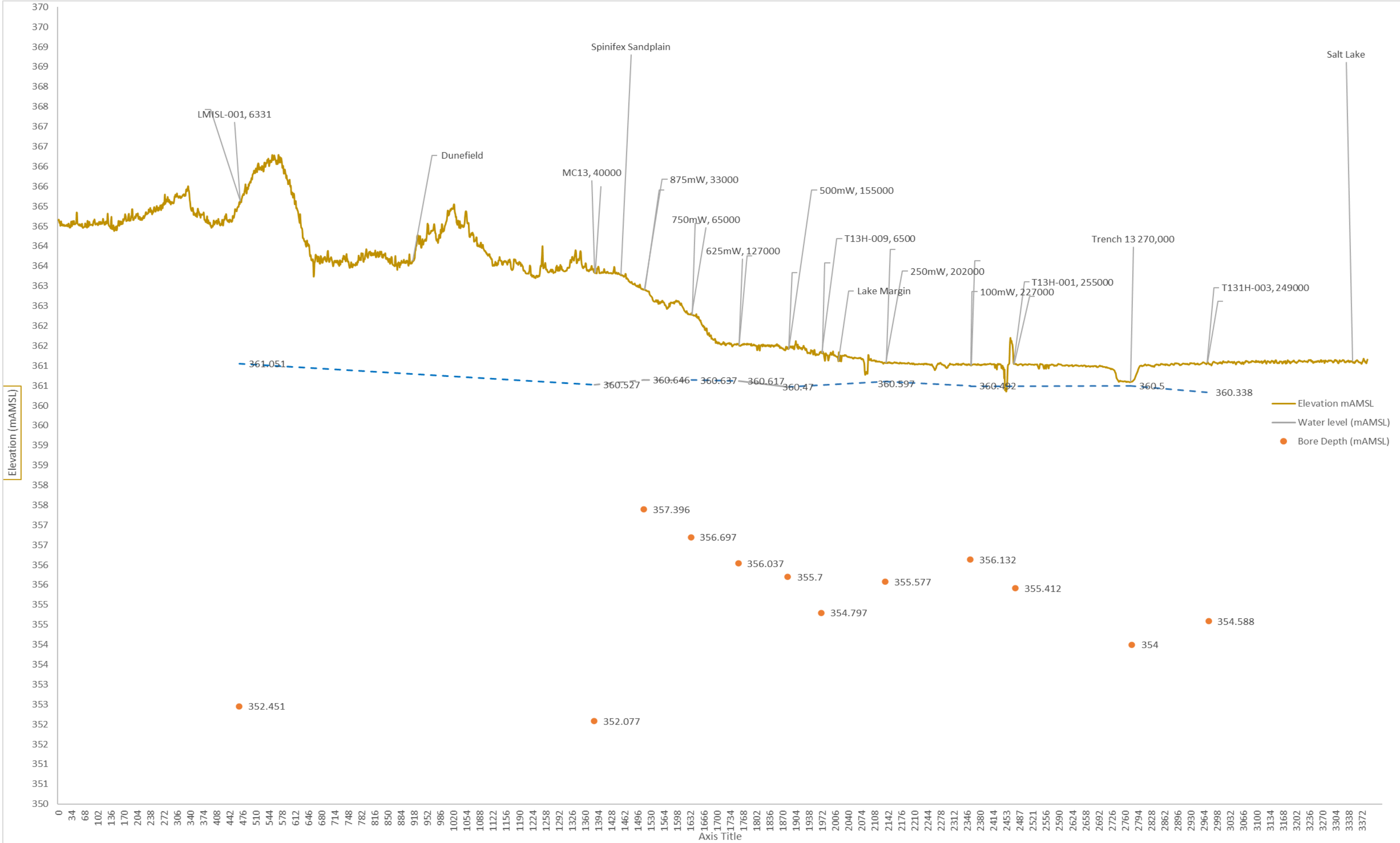


Figure 12: Section through Monitoring Bores- Trench 13



6.3 Landform Island

From Table 13 and relevant drilling information, the following interpretation of the island stratigraphy and associated hydrogeological characteristics can be made from the drilling of LMISL001.

- The top 4 meters of the drill hole consisted of sand, soft calcrete and minor clay lenses.
- The first moisture was encountered just below 3m while the first water in returned core samples was between 3.5-4m and was fresh to brackish in quality.
- The transition zone between the overlying sands, calcrete and clay, into gypsum sand and clay occurred between 4-6m.
- From 6m below surface the lithology changes into dominant clay with gypsum crystals and increased salinity (lakebed brine).
- Monitoring of the groundwater levels in the bore indicate a water level of approximately 3.7 to 4.1 meters below ground level which is reflecting the impermeable nature of the underlying clay dominant lithology.
- Water levels fluctuate according to seasonal variations in rainfall and evaporation. The presence of gypsum crystals is indicative of a fluctuating water level.

6.4 Small Island

Figure 13: Small Island West of Trench 2

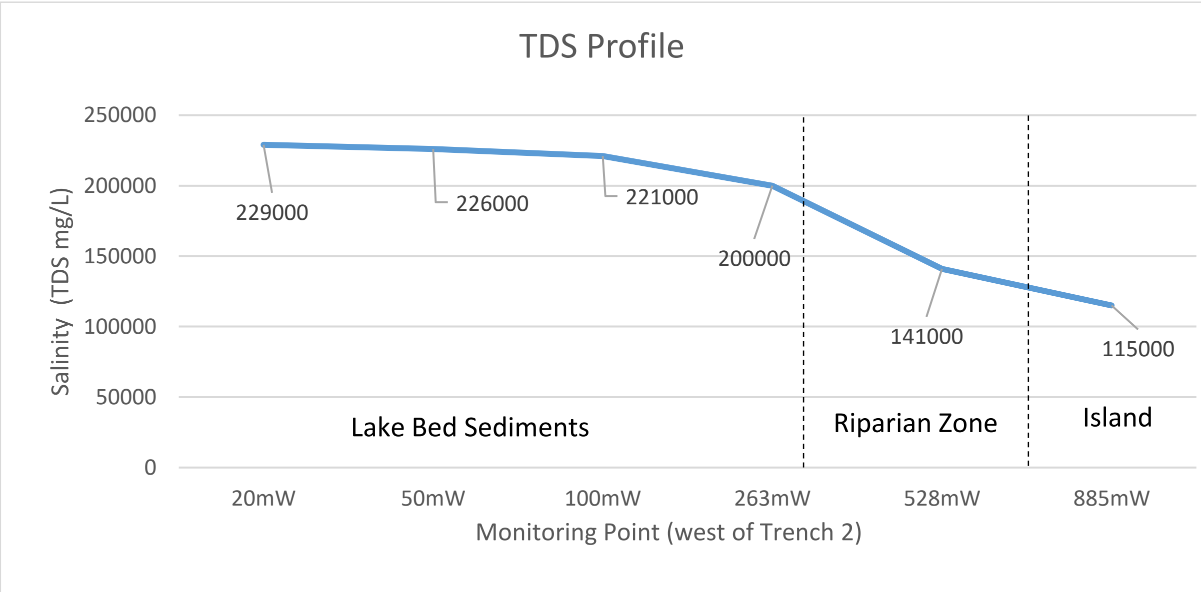
Table 14: Monitoring Bore Details-Small Island

Monitoring Point	Zone	Depth (mbs)	Water level (mbs) (15/12/18)	Screened Interval (mbs)	Construction Details
MT02A20mW	Lake Bed Sediments	6	0.76	0.5-6	50mm PVC
MT02A50mW	Lake Bed Sediments	6	0.52	0.5-6	50mm PVC
MT02A100mW	Lake Bed Sediments	6	0.36	0.5-6	50mm PVC
MT02A261mW	Lake Bed Sediments	6	0.23	0.5-6	50mm PVC
MT02A528mW	Riparian Zone	6	0.95	0.5-6	50mm PVC
MT02A855mW	Island	6	1.26	0.5-6	50mm PVC
LMISL009	Island	4	1.42	0.5-4	50mmPVC

<u>LMISL009</u>

From Table 14 and relevant drilling data the following is concluded in relation to the stratigraphy and associated hydrogeology of a small island:

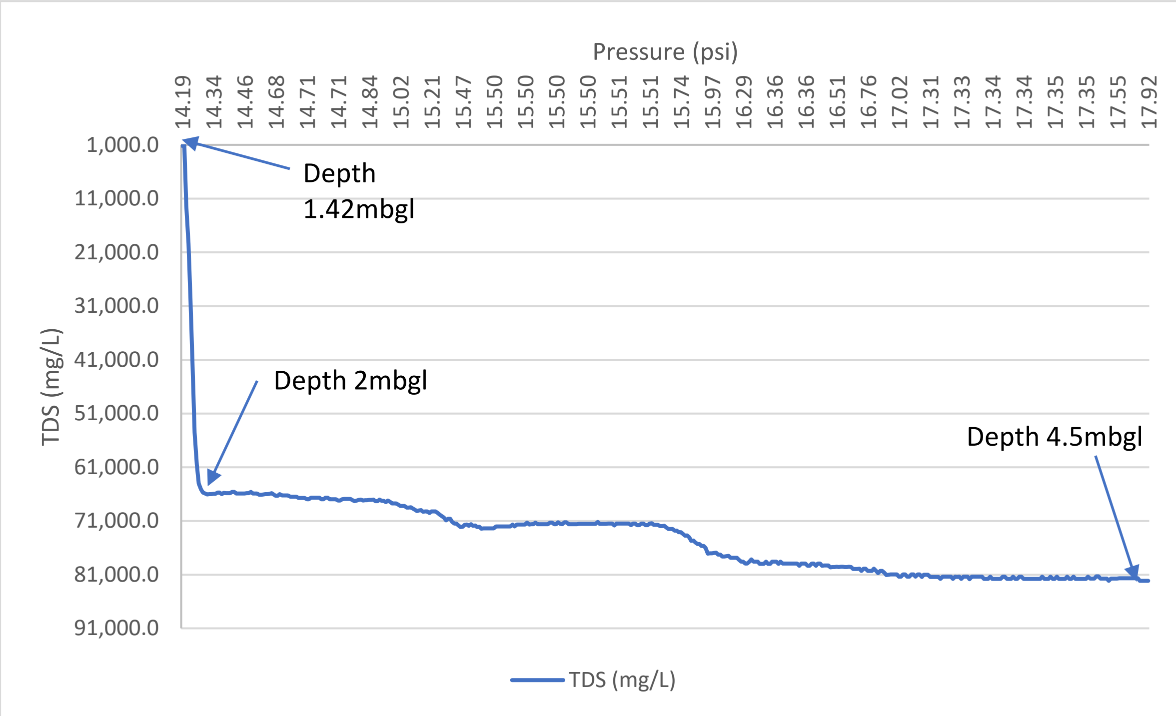
- The top 0.7 meters of the hole consisted primarily of sand and silt
- From 0.7m to 1.7m the lithology transitions into predominantly clay with some gypsum crystals
- The transition from dry aeolian type sand into muddy, silty clay occurred between 1.7m to 2.5m.
- Lake bed sediments occur below 2.5m to the bottom of the hole at 4m
- TDS measured at 2.5m below surface was approximately 90,000 mg/L
- No fresh water or less saline water was measured



The thinner sequence of aeolian sands on the smaller island results in higher TDs readings as shown in the horizontal TDS profile for the small island. Lake bed sediment brine TDS is consistent above

200,000 mg/L, dropping to 141,000 mg/L in the riparian zone and 1round 115,000 mg/L on the island.

A vertical TDS profile 0f LMISL009 indicates the presence of fresh to brackish water in the first 20-30cm of groundwater before transitioning rapidly to brine related TDS levels approximately 1.8-2m below surface.



7. Island and Lake Bed Summary

7.1 Hydrostratigraphy

- The island groundwater is unlikely to be hydraulically isolated from the lake bed sediments and there may be hydraulic continuity. This is supported by the island's lithology logs.
- The less saline groundwater appears to be a transition zone from the brine and may only be chemically differentiated by water density effects; less saline groundwater overlies the brine. Although present on the islands, this portion of groundwater is unlikely to be hydraulically independent from the brine groundwater hosted in the lakebed sediments.
- There is also potential for discrete seasonally perched groundwater aquifer systems to occur within the shallower calcrete units, which may be hydraulically distinct from the lakebed sediment units. Future drilling programs will determine this occurrence

7.2 Flow/Water Levels

- The landform island groundwater system is a vertically and laterally continuous aquifer (within island area), with a vertical saline transition (mixing) zone present.
- The lower salinity (brackish) groundwater from recent recharge, is the upper portion and the more saline (brine) is the deeper portion, where the transition zone, via diffusion occurs.
- No significant distribution of advection flow takes place in the transition zone, given the very shallow lake brine gradient. A vertical density distribution occurs in this transition zone,

likely resulting in less saline groundwater being confined to the island footprint and dependent on the lithological thickness, enabling the local water table to be greater than the typical lakebed sediment brine levels.

- These pseudo-closed systems temporarily host fresher and shallower groundwater, which is evident by the presence of gypsum crystals.

7.3 Recharge

- During significant rainfall events, recharge occurs across the island footprint, with evaporation effects reducing some recharge potential, including the abundant vegetation, through evapotranspiration.
- Rainfall that is not captured by these outputs, is percolated through the highly porous clayey sands into the less saline water table, where a noticeable increase in head levels have been recorded

8. Appendices

Appendix A - Island Drilling Memo, Agrimin, 2019

Appendix B – Long-term Groundwater Monitoring Memo, Agrimin 2020

Appendix C – Island Characterisation Memorandum, Stantec, 2020

Appendix D- Long Term Trench Pump Testing Memo, Agrimin 2020

Appendix B Integrated Groundwater Flow and Solute Transport Model (Stantec 2020)

FINAL - Integrated Groundwater Flow and Solute Transport Model – Model Development, Predictive Mine Plan Scenarios and Ore Reserve Estimate

Mackay Potash Project

Prepared for:

Agrimin Limited
2C Loch Street
Nedlands, Western Australia 6009

Prepared by:

Stantec Consulting Services Inc.
2000 South Colorado Blvd. 2-300
Denver, Colorado USA 80222

Revision - FINAL
July 13, 2020

Revision	Description	Author		Quality Check		Independent Review	
Final	Report	Reinke		Loveday		Gillian	

Prepared by ____
(signature)

Richard Reinke, P.Geo., P.Geoph.

Reviewed by __________________________________
(signature)

Derek Loveday, P.G.

Approved by __________________________________
(signature)

Greg Gillian, Q.P.

Stantec 2000 South Colorado Boulevard, Suite 2-300
Denver, Colorado 80222-7933 US

Competent Person's Consent Form

Pursuant to the requirements of ASX Listing Rules 5.6, 5.22 and 5.24 and
Clause 9 of the JORC Code 2012 Edition (Written Consent Statement)

Report name

Integrated Groundwater Flow and Solute Transport Model – Model Development, Predictive Mine Plan Scenarios, and Ore Reserve Estimate

('Report')

Agrimin Limited

Mackay Potash Project

13 July 2020

Stantec 2000 South Colorado Boulevard, Suite 2-300
Denver, Colorado 80222-7933 US

Statement

I,

Richard Frank Reinke

confirm that I am the Competent Person for the Report and:

- I have read and understood the requirements of the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code, 2012 Edition).
- I am a Competent Person as defined by the JORC Code, 2012 Edition, having more than five years' experience that is relevant to the style of mineralisation and type of deposit described in the Report, and to the activity for which I am accepting responsibility.
- I am a Professional Geoscientist of the Association of Professional Engineers and Geoscientists of Alberta.
- I am a hydrogeologist and an independent consultant to Agrimin Limited.
- I have reviewed the Report to which this Consent Statement applies.

I am a full-time employee of

Stantec Consulting Services Inc.

and have been engaged by

Agrimin Limited

to prepare the documentation for

Mackay Potash Project

on which the Report is based, for the period ended

13 July 2020

I have disclosed to the reporting company the full nature of the relationship between myself and the company, including any issue that could be perceived by investors as a conflict of interest.

I verify that the Report is based on and fairly and accurately reflects in the form and context in which it appears, the information in my supporting documentation relating to Ore Reserves.

Stantec 2000 South Colorado Boulevard, Suite 2-300
Denver, Colorado 80222-7933 US

Consent

I consent to the release of the Report and this Consent Statement by the directors of:

Agrimin Limited

June 13, 2020

Signature of Competent Person:

Date:

Association of Professional Engineers and Geoscientists of Alberta (APEGA)

#90662

Professional Membership:

Membership Number:

Katrina A Eike Parker, CO USA

Signature of Witness:

Print Witness Name and Residence:
(eg town/suburb)

EXECUTIVE SUMMARY

Stantec Consulting Services Inc. (Stantec) has been contracted by Agrimin Limited (Agrimin) to develop a definitive feasibility study level integrated numerical groundwater flow and solute transport model of Lake Mackay for Agrimin's Mackay Potash Project (MPP) in Western Australia. The MPP is a late-stage, mineral-development project. Agrimin plans to develop a mine that produces sulfate of potash (SOP) by extraction of brine from the lakebed sediments and using a solar evaporation process to precipitate potassium and sulphate rich mineral salts.

Lake Mackay encompasses an area of approximately 3,500 km^2 in Western Australia and Northern Territory of which the MPP development area encompasses approximately 2,558 km^2 in Western Australia. The lake receives direct rainfall and incoming surface water runoff from the immediate surrounding area, but there are no outlets for drainage. The hot, arid climate has seasonally evaporated the former lake over time, leaving a mineral-rich groundwater known as brine. Mineral brines are an important source of economic minerals such as salt and potash.

Exploration of the lakebed sediments has identified two main zones that host potassium-rich brines. These lakebed sediments rest unconformably atop a consolidated basement surface that defines the lower limit of the resource extent. The upper zone (UZ) extends from the lakebed surface to a vertical depth of 11m. The UZ is subdivided into an upper zone top (UZT) and upper zone bottom (UZB). The lower zone (LZ) is separated into three horizons LZ1, LZ2 and LZ3. The LZ1 and LZ2 are sedimentologically similar to the UZB. The LZ3 includes an incised paleochannel that is predominantly a sandy interval as opposed to a relatively clay rich LZ2 above. The LZ3 unit, the extents of which are defined from geophysical surveys and drill hole penetrations, extend from a depth of 150m below surface to a maximum depth of 211m below surface.

Brine will be extracted from lake sediments during the mining phase and concentrated in ponds via solar evaporation. Extraction will occur via a trench network that targets the upper zone lakebed sediments. Extracted brine will be conveyed by a system of extraction trenches and transfer canals to a series of preconcentration ponds. These ponds will concentrate the minerals in solution and begin the precipitation of unwanted salt compounds. Downstream from the preconcentration ponds, the potassium-rich concentrated brine will be precipitated in production ponds, harvested, and processed in a modern crystallization plant to produce saleable SOP and related products.

Previous studies including the PFS and a Gap Analysis recommended acquiring additional data on the distribution of hydraulic conductivity, aquifer storage properties, and aquifer recharge across the lake area and a deep drilling program to characterize the hydrogeology of paleochannel sediments and basement beneath the study area. Field and laboratory data were acquired by Agrimin during a 2018-2019 exploration program to address recommendations from the PFS and Gap Analysis. Data from these studies have been incorporated into the construction of an integrated groundwater flow and solute transport model for the DFS.

A groundwater flow and solute transport model was constructed using MODFLOW-SURFACT (Hydrogeologic, Inc. 2011), a groundwater flow and transport code based on MODFLOW the modular three-dimensional groundwater flow model developed by the United States Geological Survey (USGS) (Harbaugh and others, 2005). In addition to the standard MODFLOW packages, MODFLOW-SURFACT contains proprietary flow, transport, and solver packages which are particularly suited to modeling the complex hydrogeological flow and transport processes associated with brine production. The modeling was conducted using the pre- and post-processor Groundwater Vistas, version 6.

The active model domain considered in the groundwater flow and solute transport model includes the entirety of Lake Mackay with six model layers from the lakebed surface to top of basement. With a constant cell size of 200m x 200m, the model contains 506,209 active cells. The model was subsequently refined for detailed mine planning to more precisely simulate flow between extraction trenches on a 1km spacing. For these detailed mine planning runs, the model was refined to a constant cell size of 50m x 50m, and the domain was cut down to the active production area of approximately 2,340km^2 containing 5,617,260 active cells.

The main extraction target is 540,000 metric tonnes per annum (tpa) of sulphate of potash (SOP)-equivalent mass conveyed to the pre-concentration ponds. The annual SOP tonnage target equates to 21.6 million metric tonnes of SOP-equivalent mass delivered to the pre-concentration ponds over the 40-year mine life.

Extraction of the target ions is achieved by operating extraction trenches excavated through the UZT and into the UZB horizon to a depth of 4.5m below ground surface (BGS) while maintaining an initial pumping level of 3m BGS. Extraction trenches are represented as drain boundary conditions in the numerical model. The extraction trench network in the mine plan balances the goal of achieving the target annual mass of SOP to the pre-concentration ponds with maintaining higher brine grade to limit total flow to the ponds. To facilitate mine planning, the lake was divided into brine mining units (BMUs) based primarily on hydraulic and recharge properties but also considering potential construction logistics. BMU boundaries were defined such that most of a BMU had a similar magnitude of hydraulic conductivity. BMU's were aligned along a series of north-south trending secondary brine transfer trenches moving brine to the main brine transfer canal which will run along the southern edge of Lake Mackay to convey brine to the pre-concentration ponds.

Ore Reserves from trench production in the UZ were calculated using the outputs from the groundwater flow model. Outputs from the model were used to tabulate the annual flows and potassium concentration of the produced brine. This flow and brine grade relates to an SOP tonnage produced from the UZT over the area encompassing the Measured Mineral Resource. Using this method, the Proven Ore Reserve totals 3.75 million metric tonnes of SOP-equivalent. Probable Ore Reserve totaling 16.3 million metric tonnes of SOP-equivalent were calculated as the tonnage from the area encompassing the Indicated Mineral Resource in the UZT, UZB, and LZ1. Remaining mine plan production in the model occurs from Inferred resource horizons and is not claimed as an Ore Reserve. Total Proven and Probable Ore Reserves are 20.0 million metric tonnes of SOP-equivalent out of a total of 21.6 million tonnes of SOP produced from the mine plan model. Refer to **Tables 10, 11, and 12** showing the reserve tonnage and average produced brine grade.

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1.0 INTRODUCTION AND SITE DESCRIPTION

Stantec Consulting Services Inc. (Stantec) has been contracted by Agrimin Limited (Agrimin) to develop a definitive feasibility study (DFS) level integrated numerical groundwater flow and solute transport model of Lake Mackay for Agrimin's Mackay Potash Project (MPP) in Western Australia. The MPP is a late-stage, mineral-development project. Agrimin endeavors to develop a mine that produces sulfate of potash (SOP) by extraction of brine from the lakebed sediments and using a solar evaporation process to precipitate potassium and sulphate rich mineral salts.

If the MPP is developed, brine is planned to be extracted from lake sediments during the mining phase and concentrated in ponds via solar evaporation. Extraction from the lakebed sediments occurs via a trench network that targets the upper three metres. Extracted brine is conveyed by a system of extraction trenches and transfer canals to a series of preconcentration ponds. These ponds then serve to concentrate the minerals in solution and begin the precipitation of unwanted salt compounds. Downstream from the preconcentration ponds, the potassium-rich concentrated brine is further precipitated into production ponds where potassium salts are harvested from the production ponds and processed in a crystallization plant to produce saleable SOP and related products. The ponds and processing plant are the subject of another study.

An MPP groundwater modeling study was previously completed by Knight Piesold (KP) for the development of the Pre-Feasibility Study (PFS) in 2018 (KP, 2018). Later that year Stantec conducted a Gap Analysis (**Appendix A – Stantec Gap Analysis Report**). Recommendations from these studies included acquiring additional data on the distribution of hydraulic conductivity, aquifer storage properties, and aquifer recharge areas as bore as a deep drilling program to characterize the hydrogeology of paleochannel sediments and basement rock beneath the study area. Agrimin acquired field and laboratory data during a 2018-2019 exploration program to address recommendations from the PFS and Gap Analysis. Data from these studies have been incorporated into the construction of an integrated groundwater flow and solute transport model for the Definitive Feasibility Study (DFS).

This report provides an introduction and background site description (Section 1), and summary of the hydrogeologic setting and conceptual model (Section 2). The numerical groundwater model construction and inputs are summarized in Section 3. Explanations of the model calibration to steady state and transient pre-mining conditions are provided in Section 3. The procedures used in the development of predictive mine planning scenarios are described in Section 4. Section 4 describes the determination of an SOP mineral ore reserve, and Section 5 provides the summary and conclusions.

2.0 HYDROGEOLOGIC SETTING AND CONCEPTUAL MODEL

To characterize the hydrogeology and water budget components of the study area and translate them into a numerical model requires the development of a conceptual model. This includes examination of available published scientific works and previous studies that contain geologic, hydrogeologic, climatic, and anthropogenic information relevant to the study area hydraulics over time and translating these components into spatial and numerical inputs for the model. In some cases, additional investigations have been performed to supplement existing data and to fill data gaps to make the model more robust. The regional hydrologic setting and conceptual model for Lake Mackay has been discussed extensively in other site studies (Groundwater Exploration, 2017, Advision, 2018, KP, 2018). This section provides a brief summary of the hydrologic setting and will focus mainly on the analysis and studies of data collected since the PFS and on conceptual components and information incorporated in the numerical flow and transport model.

2.1 PHYSICAL SETTING

Lake Mackay encompasses an area of approximately 3,500 square kilometres (km^2) in Western Australia and Northern Territory of which the MPP development area encompasses approximately 2,558 km^2 in Western Australia (**Figure 1**). The active model area is defined by the geographical boundaries of Lake Mackay. The lake receives direct rainfall and incoming surface water runoff from the immediate surrounding area, but there are no outlets for drainage. The hot, arid climate of the region has seasonally evaporated the former lake over time, leaving a mineral-rich groundwater or brine. Mineral brines are important sources of economic minerals such as salt and potash.

Topography of the lakebed is relatively flat, ranging from approximately 365m above mean seal level (AMSL) at the far west end of the lake to 359.5m in the southeast corner of the lake. Lakebed topography over the proposed active mining area ranges from 362m to 359.5m AMSL. Elevations of aeolian island features across the lake range from a few centimetres above the lakebed surface to a few metres above the lakebed surface for landform islands in the eastern portion of the lake.

2.2 CONCEPTUAL MODEL SUMMARY

Lake Mackay is located in the topographic low of a regional catchment estimated to be about 87,000 km^2. The topography on Lake Mackay is generally sloping from northwest towards the southeast. The Lake contains numerous islands which consist predominantly of aeolian sand which are anchored in shallow depressions of the lakebed sediments. Lake Mackay, surrounded by higher sand dunes, is a groundwater sink or a discharge area for groundwater (KP, 2018). The lake is occasionally inundated after large precipitation events. Inundation tends to be localized, and inundated areas will change based on the current wind direction.

The occurrence and accumulation of hypersaline brine in the lakebed sediments is due to evapo-concentration through time as evaporation exceeds rainfall in the area. Groundwater levels are generally close to the surface across the lake and have a very shallow gradient. **Figure 2** shows a schematic block model of this conceptualization.

Recharge to the lake is predominately from direct rainfall and some surface runoff from the large catchment. Lake Mackay is a terminal discharge point for surrounding watershed and discharge is solely from evaporation and evapotranspiration (KP, 2018). The percentage of precipitation that recharges the shallow brine aquifer (net recharge) is expected to increase as the water table is drawn down during mining operations.

Detailed discussions of site hydrostratigraphy and groundwater levels are contained in the following sections. Construction and parameterization of the numerical model are discussed in Section 3.

2.3 SITE HYDROGEOLOGY

This section briefly summarizes the hydrostratigraphy of Lake Mackay and how this stratigraphy is represented in the resource and numerical groundwater models. A layered grid geologic and potassium resource model was constructed using the MineSight software package. Detailed discussion of the construction of the resource and geologic model are contained in **Appendix B – Stantec Resource Model Report**.

Resource Model Zones
Two main zones, an upper zone and a lower zone, have been identified that host potassium-rich brines in lakebed sediments. These lakebed sediments lie unconformably atop a consolidated basement surface that defines the lower limit of the resource. **Figure 3** contains a Resource Model Schematic Section which conceptualizes the layout of these main zones and associated subdivisions in the resource model. The following discussion summarizes the vertical extents of the zones that host the potash brine resource and the numerical model layer that correlates with each hydrostratigraphic interval.

Upper Zone
The upper zone (UZ) extends from the lakebed surface to a vertical depth of 11 metres (m) as shown in **Figure 3**. The UZ is subdivided into an upper zone top (UZT) and upper zone bottom (UZB). The UZT is represented by Layer 1 in the numerical groundwater model, and the UZB is represented by Layers 2 and 3.

Exploration records indicate the lakebed sediments are saturated below an average depth of 0.5m below lakebed surface through most of the year although the water table does vary over the wet and dry seasons. The unsaturated interval from surface to approximately 0.5m below lakebed surface, not including islands, contains potassium salts precipitated as a result of past fluctuations in brine levels. These salts may go into solution during intermittent rainfall events and are reprecipitated during intervening dry periods. All zones (horizons) below the unsaturated interval of the UZT to the basement surface are saturated with brine.

The brine-saturated portions of the UZT extend from 0.5m to 3m below lakebed surface. A 3m depth limit has been selected for the UZT (Layer 1) to represent the average depth of influence of trench pumping tests used to estimate brine production from proposed surface trenching methods. The UZB (Layers 2 and 3) is a sedimentologically similar interval to the UZT above but contains a lower sand content. The UZB extends to a depth limit of 11m below the lakebed surface. Groundwater model Layer 2 extends from 3m to 4.5m, and Layer 3 extends from 4.5m to 11m. The interface between model Layers 2 and 3 was chosen to represent the depth of trench excavation into the upper UZB to a depth of approximately 4.5m. The majority of the hydrologic and brine chemistry components used for resource estimation were sourced from test site locations located in the UZ.

Lower Zone

The lower zone (LZ) interval represents the zone between the UZ and the basement surface. The LZ is separated into three horizons LZ1, LZ2 and LZ3, as shown in **Figure 3**. These LZ horizons are represented by numerical model Layers 4, 5, and 6, respectively. The LZ1 and LZ2 are sedimentologically similar to the UZB above but with increased clay content. Separation of the LZ1 and LZ2 is based on the quantity and depth of drill hole penetration of the lakebed sediments below the UZ. The LZ3 includes an incised paleochannel that is predominantly a sandy interval as opposed to a relatively clay rich LZ2 above. The LZ3 unit, the extents of which are defined from geophysical surveys and drill hole penetrations, extend from a depth of 150m below surface to a maximum depth of 211m below surface.

2.4 GROUNDWATER FLOW AND WATER LEVELS

The shallow groundwater gradient generally follows the topography of the lake and flows from northwest to southeast. **Figures 4** and **5** show groundwater elevations for the shallow lakebed sediments from March 2019 during the wet season and August 2019 at the end of dry season, respectively. Depth to water measurements and corresponding potentiometric elevations are listed in **Table 1**. Horizontal groundwater gradients range from a high of 0.0002 metres/metre (m/m) at western edge of the lake to 0.00002 m/m in the center of the Lake and average on the order of 0.000045 m/m across the lake from northwest to southeast.

Eleven bores across the lake have been instrumented with datalogging pressure transducers over various time periods with three bores (MA02, MA13A, and MA13B) having data starting in September 2015. Hydrographs are provided in **Appendix C**. These hydrographs show yearly fluctuations in water levels over a range of approximately 0.5m to 1m between the November to April wet season and May to October dry season. Immediate water level responses to large rainfall events are observed indicating a large portion of precipitation from larger rainfall events is recharging the brine aquifer.

Figure 6 shows a representative groundwater elevation hydrograph from bore MA02 over the period from September 2015 to September 2019 plotted with the rainfall records from the Kintore Station and the Agrimin Pilot Ponds weather station. The Kintore and Pilot Ponds precipitation data indicate that 2018 and 2019 appear to be much dryer than normal years when compared with long term rainfall record from the Kintore Station. Wet season precipitation in 2018 and 2019 appears to occur in less intense rainfall events over a shorter than normal wet season. Water levels over the period from September 2015 to April 2017 show much less seasonal fluctuation than those over the period from April 2017 to September 2019. Prior to April 2017, MA02 water levels generally range from just at or below ground surface to about 40cm below ground surface. During the abnormally dry period from April 2017 to September 2019 much larger differences between wet season and dry season water levels are observed with MA02 water levels ranging from just below ground surface to approximately 70cm below ground surface during this dry period. Based on the long term rainfall record from Kintore, the 2015 and 2016 water levels appear to be more representative of water table conditions that could be expected during most of the 40 year life of mine (LoM).

A deep drilling program conducted by Agrimin from November 2019 to January 2020 encountered artesian conditions in paleochannel sediments in channels delineated using surface geophysics. Two multilevel bore completions (LMD-001 and LMD-003), and one bore completed over the entire depth interval flowed for several months with no noticeable decrease in artesian flow. Field observations during drilling and bore completion activities indicate an artesian pressure in paleochannel completions. The water level in bore LMD-003 has been measured at 2.20m above ground surface.

2.5 TRENCH PRODUCTION CONCEPTUALIZATION

A conceptual cross section showing the hydrogeologic processes and groundwater gradients involved in the production of potash brine from the Lake Mackay sediments is shown on **Figure 7.** Brine will be produced from the lakebed sediments via a network of shallow trenches excavated into the UZ and conveyed to a series of pre-concentration and production ponds to concentrate potassium salts prior to harvesting and processing in crystallization plant to produce SOP. Production trenches will fully penetrate the more permeable UZT sediments and partially penetrate the less permeable, but much thicker, UZB sediments. The trench network will be pumped down to a level at the base of the UZT. Initial drainage of the specific yield porosity in the UZT will occur in the area surrounding the trenches. As pumping continues the water levels between trenches are drawn down creating hydraulic gradients which cause brine to flow horizontally toward the trenches in the UZT and upper UZB, radially upward in the UZB to the trenches, and vertically from the UZT to the UZB, from the lower UZB to the upper UZB, and from the LZ1 to the UZB.

In addition to these flow processes, brine will also move via the mass transport processes of advection, dispersion, and mass transfer. Advection is the process by which mass moves along with flowing groundwater. Dispersion is the process of mixing that occurs along an advective flow front caused by the tortuous paths that individual mass particles travel on a microscale. Dual-domain mass transfer is typically thought of as representing the process of diffusion from immobile porosity to mobile porosity in contaminant transport problems. In the case of brine production from the trench network at Lake Mackay, dual-domain mass transfer represents the processes of diffusion of higher concentration capillary, or non-specific yield brine, to more dilute brine flowing in the mobile aquifer pore space, and also, the mixing brines of differing concentration as fresh recharge water and dilute brine in the specific yield, or mobile, porosity come in direct contact with capillary brine. Conceptualization of these mass transport processes is shown in **Figure 8**.

3.0 GROUNDWATER MODEL CONSTRUCTION

3.1 NUMERICAL CODE

Groundwater flow and solute transport were simulated using MODFLOW-SURFACT (Hydrogeologic, Inc. 2011), a groundwater flow and transport code based on MODFLOW the modular three-dimensional groundwater flow model developed by the United States Geological Survey (USGS) (Harbaugh and others, 2005). In addition to the standard MODFLOW packages, MODFLOW-SURFACT contains proprietary flow, transport, and solver packages that are particularly suited to modeling the complex hydrogeological flow and transport processes associated with brine production. The modeling was conducted using the pre- and post-processor Groundwater Vistas, version 6.

3.2 MODEL HORIZONTAL AND VERTICAL DOMAIN

The active model domain includes approximately 3,375km^2 encompassing the majority of Lake Mackay (**Figure 1)** with six layers from the lakebed surface to top of basement. With a constant cell size of 200m x 200m, the model contains 506,209 active cells. In order to more precisely simulate flow between trenches on a 1km spacing for detailed mine planning runs, the model was refined to a constant cell size of 50m x 50m, and the domain was cut down to the active production area of approximately 2,340km^2 containing 5,617,260 active cells.

The model consists of 6 layers of varying thickness representing the different hydrostratigraphic units and extends from the lakebed surface to top of basement. Basement elevations beneath Lake Mackay range from 174.9m AMSL in paleochannels in the south to approximately 271m AMSL. The model layers that correspond to the hydrostratigraphic units in the resource model are discussed in more detail in Section 2.3.

3.3 BOUNDARIES

Model boundary conditions include no-flow, constant head, general head, and drains as shown on **Figure 9**. General head boundaries were used to simulate flow between lakebed sediments and alluvium along the model perimeter, and no-flow boundaries are assigned along the lake perimeter. Constant head boundaries are assigned in layer 6 where paleochannels enter the model domain.

A general head boundary was applied at the outer perimeter of Lake Mackay in layers one through five to account for flow between the lakebed aquifer sediments and surrounding alluvial/colluvial sediments. Heads were assigned to these boundary conditions based on the September 2019 dry season potentiometric surface and boundary conductance was assigned based on dimensions of the cell and the hydraulic conductivity of the adjacent active model area. Interaction between lakebed sediments and the surrounding alluvial/colluvial sediments is a very small percentage of the overall water balance as discussed below. No-flow boundaries are assigned to cells outside the Lake Mackay perimeter.

A constant head boundary condition was assigned in layer six along the lake perimeter where paleochannels are interpreted to enter the active model domain. A constant head of 362.5m AMSL was assigned to these boundary conditions which is on the order of 1m above the average lakebed elevation based on observations at artesian bores completed in the paleochannel sediments.

Drain boundary conditions were used to simulate trench production in the mine planning model. Drain conductance was assigned based on model cell dimensions, hydraulic conductivity in the surrounding aquifer, and trench design specification dimensions in individual model cells using the standard MODFLOW boundary condition conductance approach (Harbauch, 2005). Drain elevations in operating brine mining units (BMUs) were assigned to be three metres below ground level to represent the pumping level in the trench network during initial brine production. Starting in year 3 of the mine plan the drain elevation representing the trench network pumping level was adjusted in operating BMUs to balance the brine flow and potassium grade required to meet the annual SOP mass target. The trench network pumping level is gradually increased from 3m BGS beginning in mine year 3 to 1.7m BGS in mine year 20 during which time individual BMUs in the mine plan model are brought online by setting the drain elevation to the appropriate pumping level or flow from individual BMUs are turned off by setting the pumping level above the lake surface. This pumping level is then gradually increased back to 3m BGS over the period from mine year 23 to mine year 33 where it remains over the remainder of the LoM. Mine planning and BMU sequencing is discussed in Section 4.2.

3.4 MODEL HYDRAULIC PARAMETERS

Hydraulic Conductivity
A comprehensive trench pumping test program was conducted to assess hydraulic conductivity and specific yield of the upper zone (model layers 1, 2, and 3). Trenches were constructed at 22 locations distributed over the production area. Two locations were abandoned during construction due to ground conditions or absence of brine inflow. The trenches were generally 100 m long, 6 m wide at the surface, 1 m wide at the base, and 6 m deep. Individual trench construction was field modified to adjust to site conditions. Seventeen trench pumping tests were conducted, and three locations were not pumped due to limited brine inflow. The details of the trench testing program and modeling analysis of the trench pumping and recovery data are described in **Appendix D – Trench Test Analysis Report**.

Hydraulic conductivity was distributed across model layers one, two, and, three (representing the UZT and UZB) based on detailed analyses of the trench pumping tests at 17 locations distributed relatively evenly across the lake and from nuclear magnetic resonance (NMR) borehole logging data collected at the two detailed infill drilling sites (T02A and T13).

The transmissivity (T = bulk hydraulic conductivity x thickness) at each trench location was determined over the saturated interval from 0.5m to 6m BGS (representing the interval intercepted by each trench) by calibrating a local scale groundwater model to drawdown and recovery observations recorded at monitoring wells during the trench tests. Hydraulic conductivity was also measured with a downhole NMR tool at 0.25 metre increments to depths up to 5.5m at two detailed infill drilling test sites, T13 and T02A. Data from eleven infill drilling locations at each site were analyzed to determine a statistical ratio of UZT hydraulic conductivity to UZB hydraulic conductivity at each site. The average of the T13 and T02A ratios

(K_{UZB} = 0.26 x K_{UZT}) was applied, and the hydraulic conductivity was calculated for model layer 1 representing the UZT and model Layers 2 and 3 representing the UZB based on the following equations:

$T = K_{UZT} \times b_{UZT} + K_{UZB} \times b_{UZB}$ (determined from trench test analysis),

$K_{UZB}/K_{UZT} = 0.26$ (determined from statistical analysis of NMR log data),

where,

T = transmissivity,

K_{UZT} = hydraulic conductivity of the UZT,

K_{UZB} = hydraulic conductivity of the UZB,

b_{UZT} = saturated thickness of the UZT (=2.5m), and

b_{UZB} = thickness of the UZB intercepted by the trench (=3m).

The hydraulic conductivity of the UZT and UZB was then distributed across the model domain using a natural neighbor interpolation scheme with some control points added to reflect observed transitions in surficial geology on the lakebed (i.e. sand and clay content).

The mean hydraulic conductivity in the UZT is approximately 9 metres per day (m/d). Hydraulic conductivity generally increases from west to east and ranges from approximately 0.8 m/d in a few isolated areas to over 200 m/d in a zone between some of the major aeolian islands in the east portion of the production area. This high hydraulic conductivity zone loosely corresponds to the main north-south surface water drainage on the lakebed surface. The hydraulic conductivity distribution in the UZT is shown on **Figure 10**.

Vertical hydraulic conductivity in the UZT and UZB is set to 1/100 of the horizontal hydraulic conductivity. Vertical air permeability measurements from the PFS and vertical hydraulic conductivity measurements from column test laboratory analyses conducted as part of the recharge studies described below generally support a ratio of vertical to horizontal hydraulic conductivity (vertical anisotropy) in this range.

LZ1 (Layer 4) and LZ2 (Layer 5) horizontal hydraulic conductivity was set to 0.1 m/d with vertical hydraulic conductivity set to 0.0001 m/d based on the much higher clay content in these intervals. Model Layer 6 (LZ3) represents coarse paleochannel sediments on top of basement formations. Layer 6 thickness corresponds to paleochannel thickness as determined in the resource model from drilling and geophysical data. In areas outside delineated paleochannels, a minimum thickness of 0.05m is used to preserve layer continuity. The paleochannel sediments encountered during the deep drilling program are coarse sand with limited clay content, as such the horizontal hydraulic conductivity of Layer 6 was set to 10m/d and the vertical conductivity is set to 1 m/d, or one-tenth of the horizontal hydraulic conductivity in this layer.

Hydraulic parameters and corresponding numerical model layers for each hydrostratigraphic unit are summarized in **Table 2**.

Aquifer Storage Parameters
Total porosity and specific yield were imported from the resource model. A detailed description of the determination and distribution of these parameters is found in the resource model description, attached in **Appendix B – Stantec Resource Model Report**. Total porosity of various hydrostratigraphic layers was determined from lab analysis and borehole geophysics (NMR) conducted by Agrimin in 2019 as described in **Appendix B**. An average total porosity of 0.46 was applied to the UZT in model Layer 1, and an average total porosity of 0.42 was applied to layers representing the UZB and LZ horizons.

Specific yield for the various lithologic layers was determined from the analyses of trench pumping tests, water level changes recorded during rainfall events of known duration and magnitude at the specific trench test locations (described in **Appendix D – Trench Test Analysis Report),** borehole geophysics (NMR) measurements collected at 22 T02A and T13 infill drilling locations, and from core samples collected at 20 recharge sampling locations (described in **Appendix E – Recharge and Evaporation Analysis Technical Memo)**. Fifty-four core samples from various depth intervals at these locations were sent to the DB Stephens & Associates Soils Laboratory in Albuquerque, New Mexico, USA for analysis of Relative Brine Release Capacity (RBRC) (Stormont, et.al. 2011) . Based on the results from these various lines on analysis, three specific yield zones in the UZT were identified and are shown in **Figure 11**. Specific yield in the UZT ranges from 0.06 to 0.14. An average specific yield of 0.05 was applied to the UZB and LZ1, 0.04 to the LZ2, and 0.12 to the paleochannel sediments in the LZ3. It should be noted that the mining method of brine production with extraction trenches will only dewater the upper 3m of lakebed sediments in the UZT. Therefore, specific yield drainage below the 3m does not occur in the current mine plan simulation, and the simulated brine production is not sensitive to the specific yield of the UZB and LZ.

A specific storage of $1x10^{-3}$/m was assigned to all layers which is representative of the unconsolidated nature of the UZ and LZ sediments.

3.5 RECHARGE AND EVAPOTRANSPIRATION

Previous modeling studies have shown net recharge to be a significant factor in long term brine production (KP, 2018). Recharge sources include direct infiltration from precipitation, and infiltration of runoff (ultimately derived from precipitation). Given the lack of vegetation, evaporation is assumed to be the principal component of ET.

A detailed field sampling and laboratory program was conducted during 2019 to characterize the percentage of precipitation that recharges the shallow brine aquifer versus the percentage that is lost to evaporation. Field tests and sampling conducted at 20 locations across the lake included infiltrometer testing to assess the rate of rainfall infiltration collocated with core samples collected for lab analysis of soil hydraulic parameters, chemical leaching parameters, and in-situ soil moisture conditions. At two of these locations (T02A and T13) detailed infill drilling and sampling of 11 locations at each site was conducted to assess the variation in these parameters on a more local scale. In addition, closed lysimeter tests were conduction at each infill drilling site to assess evaporation at depth in the unsaturated interval. **Appendix E – Recharge and Evaporation Analysis Technical Memo** describes analysis of these recharge and evaporation studies, and the laboratory methodologies and results are described in **Appendix F – Soils Lab Results Technical Memo**. The infill drilling programs and other data including lithology, brine resource data, and geophysical logging data collected from the infill drill holes are described in **Appendix B – Stantec Resource Model Report**.

Evaporation and recharge versus water table depth were determined from detailed unsaturated flow modeling with the HYDRUS 1D unsaturated model code. Multi-step outflow tests were conducted on unsaturated zone core samples collected at the locations described above. These tests were conducted using Tempe cells, and inverse modeling was performed to fit modeled fluxes to the observed fluxes recorded during the Tempe cell tests. The HYDRUS models were calibrated to the various field and lab measurements.

The results from this field testing, laboratory analysis, and HYDRUS modeling program show that the percentage of mean annual precipitation that recharges the brine aquifer will increase as the water table is drawn down during mining. These results were used to develop curves of segmented ET and recharge versus water table depth for input into the MODFLOW-SURFACT groundwater flow and transport model. The segmented ET and recharge implementation in the model is able to simulate increased recharge as various areas, or brine mining units (BMUs), are drawdown down at different stages during the mine plan simulation.

Four recharge and ET zones were used as determined from these recharge studies (**Figure 12**). Recharge as a percentage of mean annual precipitation ranges from 43% in the western recharge zone to 13% in the eastern recharge zone.

3.6 TRANSPORT PROCESSES AND PARAMETERS

With the very small groundwater gradients and the conceptual model assumption of Lake Mackay as a terminal evaporative discharge area, it is assumed that the lake is currently in a steady state condition over the time scales of this study. Under these conditions and time scales brine is not moving over appreciable distances; therefore, transport processes were not implemented in the pre-mining model.

Transport processes were implemented for predictive mine plan modeling to represent advection, mechanical dispersion, diffusion and dual-domain mass transport of potassium. As stresses and groundwater gradients are introduced to the aquifer system from pumping the extraction trench network, concentration gradients are introduced as precipitation recharges and dilutes the brine aquifer in areas where groundwater levels are drawn down during pumping of the extraction network.

Consideration was given to using the density- and viscosity-dependent flow and transport formulation in MODFOW-SURFACT. However, lab density and viscosity measurements from brine samples collected from Lake Mackay suggest that over the range of brine concentrations expected during the 40-year life of mine that the differences in brine density and viscosity will not be significant enough to justify the added complexity and numerical effort to implement these processes in the mine planning model.

Transport parameters are discussed in the following sections.

Initial Brine Concentration

Initial brine potassium concentrations in the various hydrostratigraphic units were imported from the resource model. Construction of the resource and geologic models is described in **Appendix B – Stantec Resource Model Report**. The main brine production interval will be the UZT. Trenches will intercept the upper UZB, however trench pumping levels will be up to 3m below ground surface, or the base of the UZT.

Initial potassium concentration in the UZT (Layer 1) varies from less than 200 mg/l beneath some of the major islands (which may contain a lens of brackish water due to higher net recharge at these locations) to over 6,000 mg/l in a few isolated areas. A map of Layer 1 initial potassium concentration is shown on **Figure 13**. The average potassium concentration of the brine in Layer 1 over the production area is 3,475 mg/l. Initial potassium concentration in the UZB (Layers 2 and 3) varies from less than 200 mg/l beneath some of the major islands to 5,000 mg/l in a few isolated areas. The average potassium concentration of the brine in Layers 2 and 3 over the production area is 3,302 mg/l. A map of UZB potassium concentration can be found in resource model description in **Appendix B**.

Initial potassium concentration in the LZ1 (Layer 4) varies from 2,735 mg/l to 4,687 mg/l. The average potassium concentration of the brine in Layer 4 over the production area is 3,414 mg/l. Initial potassium concentration in the LZ2 (Layer 5) varies from 2,650 mg/l to 4,014 mg/l. The average potassium concentration of the brine in Layer 5 over the production area is 3,343 mg/l. Map of LZ1 and LZ2 potassium concentration can be found in **Appendix B**. Layer 6 initial potassium concentration is 1,910 mg/l based on brine collected from a bore completed over the paleochannel interval.

Dispersivity

Longitudinal dispersivity is a parameter that is dependent on the scale of both distance and time of the application. A typical approximation when applying this parameter is to set the longitudinal dispersivity to one-tenth of the characteristic length, or flow distance. Longitudinal dispersivity was set to 50 m which is one-tenth of the half-distance between extraction trenches in the mine plan network. Transverse dispersivity was set to one-fifth of longitudinal dispersivity, or 10 m, and vertical dispersivity was set to one-tenth of transverse dispersivity, or 1 m.

Diffusion Coefficient

The diffusion coefficient was set to the open-water K^+ diffusion coefficient, 1.28×10^{-5} cm^2/s (Li and Gregory, 1974).

Dual-domain Mass Transfer Coefficient

The dual-domain mass transfer formulation in MODFLOW-SURFACT was used to represent mass transport between the drainable, or specific yield, porosity, and the non-drainable, or capillary, porosity. After initial drainage of the UZT specific yield during trench production, areal recharge water will percolate through the unsaturated zone to replenish the brine removed in the drainable porosity mixing with precipitated salts and capillary brine. Given the relatively coarse and unconsolidated nature of the lakebed sediments, the non-drainable porosity is mainly due to capillary forces within interconnected pore space and due to immobile porosity in non-interconnected pore space; thus, the mass transfer component is assumed to be mixing limited rather than diffusion limited. A mass transfer coefficient (MTC) of 0.01/d was used. Although no site-specific lab or field testing was performed to determine the mass transfer coefficient, the value chosen for the Lake Mackay model compares with lab and field testing results conducted by the project team for a similar potash brine production project (Novopro Projects Inc. and Norwest Corporation, 2018).

Mobile Fraction

The dual-domain mass transfer formulation in MODFLOW-SURFACT uses the concept of mobile fraction along with the MTC to calculate mass transfer between the two mass transport domains. The mobile fraction is defined as the ratio of the mobile porosity to the total porosity. In the Lake Mackay modeling study it is assumed that the mobile porosity is equivalent to the specific yield, and the immobile porosity is equivalent to the non-drainable, or capillary, porosity. In this case, the mobile fraction in each model cell is set equal to the specific yield divided by the total porosity.

3.7 MODEL CALIBRATION

3.7.1 Steady State Calibration

A steady state condition was simulated by running the pre-mining model in transient mode for a long enough time period such that the change in aquifer storage between stress periods in the overall model water balance was less than 0.002% of the total water inflows and outflows indicating a steady state condition was reached.

The pre-mining model was calibrated to water levels measured during September 2019 at 58 bores distributed across Lake Mackay. **Figure 14** shows the locations of these calibration targets with posted calibration residuals, or the difference between simulated and observed water levels. Steady-state calibration residuals are also shown in **Table 3.** Calibration residuals range from -0.17m to 0.9m. The average residual is 0.39m with a root mean square error (RMSE) of 0.46m. A common metric for evaluating a model calibration is the normalized RMSE (nRMSE) which is the RMSE divided by the range in the measured heads. The range in measured heads is 2.37m; thus, the nRMSE is approximately 0.19. This is a reasonable nRMSE value given the low range in measured heads due to the very low hydraulic gradient across Lake Mackay. A scatter plot of modeled versus measured heads in shown in **Figure 15**. The final calibrated model potentiometric surface for the UZT is shown in **Figure 16**.

As seen in **Figure 15** the model underpredicts the September 2019 water levels by about 30 to 40cm while simulating the general shallow groundwater gradient correctly. Several methods were tried to raise the modeled water levels to match the observed water levels including increasing recharge, lowering the ET rate, and increasing the constant head representing the paleochannel head in Layer 6. Given the amount of detailed field and laboratory work and analysis done during the recharge studies, it was decided to not change these parameters to raise the modeled water levels to better match the observed water levels. The calibration could also be improved by increasing the constant head representing the artesian conditions in the paleochannels in model Layer 6; however, this requires and unrealistic artesian head on the order of 8 to 10 meters above ground level which then would contribute about 20% to the overall water steady-state water balance. In the end, it was decided to proceed with the model calibration described in the previous paragraph. This lower steady state water level likely represents a conservative initial condition for the mine planning simulations.

During the calibration process the sensitivity of the results to changes in various boundary conditions and hydraulic parameters was evaluated. The steady-state model calibration was found to be most sensitive to net recharge and relatively insensitive to the hydraulic conductivity of the UZT due to the flat hydraulic gradient across the Lake.

The steady state water balance from the calibrated steady state model is shown in **Table 4**. As might be expected the main components of the steady state water balance are areal recharge and evapotranspiration. Interaction between the lakebed aquifer and surrounding alluvium and colluvium, as represented by the general head boundaries along the model perimeter, is a very small percentage of the overall water balance. Similarly, inflow and upward flow from the deep paleochannel system in the LZ3 as represented by the constant head boundaries where paleochannels enter the model domain in Layer 6 are also a very small percentage of the overall water balance.

3.7.2 Transient Calibration

The scope and size of the Lake Mackay groundwater model precludes a transient calibration to the relatively small-scale stresses in relation to the overall model domain and grid size from trench pumping tests conducted at numerous locations over the lake area. Transient calibrations to these tests were conducted using local scale models, and the results from these local scale model calibrations were used to distribute hydraulic conductivity and specific yield in the UZT for the lake-wide model. These models and results are discussed in **Appendix D – Trench Test Analysis Report**.

A transient calibration of the pre-mining lake-wide model was performed using monthly rainfall records from the Kintore weather station as transient stresses on the model. Monthly recharge stress periods were developed over the period from September 2015 to October 2019. Modeled head changes (drawdowns) were compared with hydrographs from bores instrumented with recording pressure transducers over various time intervals with the transient simulation period. Given the large distances between bores on Lake Mackay (up to over 65km) and the fact that the Kintore station is approximately 60 km distant, short term high intensity rainfall events that occur at some locations on the Lake may not occur over the entire model domain or at every monitored location, and thus, not all bores respond to each precipitation event. However, given this caveat, in general, the modeled heads respond in very similar fashion and magnitude to the measured hydrographs. Calibration hydrographs for all transient calibration targets are included in **Appendix G**.

4.0 PREDICTIVE MINE PLANNING AND ORE RESERVES DETERMINATION

4.1 PREDICTIVE SIMULATIONS

Mathematical models can only approximate physical and chemical processes, despite their high degree of precision. A major cause of uncertainty in these types of models is the discrepancy between the coverage of measurements needed to understand subsurface conditions and the coverage of measurements generally made under the constraints of limited time and budget (Rojstaczer, 1994). The spatial scale and complex physical and chemical environment at Lake Mackay present some specific challenges and limitations. Although a significant amount of field data has been collected over the past several years to help develop a conceptual basin model, Lake Mackay covers a geographic area of approximately 3,500 km^2. This vast spatial scale necessitates interpolation of field data over distances of hundreds to thousands of metres. Thus, various degrees of uncertainty exist in the distribution of hydraulic and transport properties across the lake. These uncertainties have been taken into consideration to help inform the estimation of Proven and Probable Ore Reserves.

Given these assumptions and limitations, numerical groundwater models should be considered insight tools and qualitative predictors of future conditions. Therefore, important planning decisions that are informed by output from this model should be made with an understanding of the uncertainty in, and sensitivity to, model input parameters and consider other site data, professional judgment and inclusion of safety factors.

4.1.1 Mine Planning Assumptions

The mine planning simulations were conducted to gain insight into an extraction trench layout that may be needed to achieve produced flow and potassium (K^+) concentration to meet yearly SOP equivalent mass targets during future mining operations. The following subsections describe these targets and the basic infrastructure assumptions inherent in the forecast simulations. Mine plan transport simulations were run with the assumption that potassium is the limiting brine constituent for SOP production and that sufficient sulphate is present in the brine. As such, only the mass transport and production of K^+ was modeled in the mine plan simulations.

4.1.1.1 Brine Extraction Targets

The main extraction target equates to 540,000 metric tonnes per annum of SOP equivalent mass (242,272 metric tonnes of K^+) conveyed to the pre-concentration ponds (multiply K^+ concentration or mass by 2.2285 to convert from K^+ to SOP-equivalent terms). The annual SOP tonnage target equates to 21.6 million metric tonnes of SOP-equivalent mass delivered to the pre-concentration ponds over the 40-year life of mine (LoM).

4.1.1.2 Trenches

Extraction of the target ions is achieved by operating extraction trenches excavated through the UZT and into the UZB horizon. The trenches are assumed to be 4.5m deep with an effective width of 3m, to facilitate flow from the surrounding UZ aquifers. Brine extraction levels are assumed to be 3m below ground level, or the base of the UZT. Extraction trenches are represented as drain boundary conditions as discussed previously.

4.2 MINE PLAN

4.2.1 Sequencing of Mining Operations

The extraction trench network in the mine plan balances the goal of achieving the target annual mass of SOP to the pre-concentration ponds with maintaining higher brine grade to limit total flow to the ponds. To facilitate mine planning, the lake was divided into brine mining units (BMUs) based primarily on hydraulic and recharge properties but also considering potential construction logistics. BMU boundaries were defined such that most of a BMU had a similar magnitude of hydraulic conductivity. BMU's were aligned along a series of N-S trending secondary brine transfer trenches moving brine to the main brine transfer canal which will run along the southern edge of Lake Mackay to convey brine to the pre-concentration ponds in the southwest portion of the Lake. The boundaries of the 17 BMUs are shown in **Figure 17**.

No specific brine grade target was used. The sequencing of BMUs proceeded to try to achieve as high a K^+ concentration and correspondingly low brine flow as possible to maintain a constant SOP mass production of 540,000 tonnes per annum (tpa). Initial brine extraction from a BMU is at the initial average K^+ concentration adjacent to the extraction trenches within the BMU during the period when mobile-phase brine is extracted. The K^+ concentration of the extracted brine decreases over time, as the drainable porosity in the BMU is mined out and replaced by freshwater recharge from infiltration of precipitation. This creates a concentration gradient between the native brine in the non-drainable porosity (capillary brine) and the relatively fresher recharged porosity. Mass transfer of K^+ mass from the non-drainable porosity into the drainable porosity occurs due to this concentration gradient. The process of mass transfer, or mixing of the capillary and non-capillary brine, allows for production of K+ from the non-drainable fraction over the duration of the mine plan.

As K^+ concentrations extracted at individual BMUs are diluted due to recharge, subsequent higher grade BMUs are brought online to balance the flow and brine grade needed to maintain a constant mass of SOP feed to the evaporation ponds. Mining commences with production from BMUs along the southern lake boundary (BMUs -6, -7, -9, -12, -15, and -17) adjacent to the main brine transfer canal. As these initial BMUs begin to deplete the mine plan progress to the north. BMUs -2, -3, -5, and -14 are brought on line between years 2 and 5, and the remaining BMUs (-1, -4, 8, -11, -13, and 16) are brought on line between years 7 and 18. The BMU sequencing schedule for the final mine plan is shown on **Table 5**. This sequencing of the BMUs allows for capacity to accelerate the mine plan in the event of drought during the first 10 to 15 years of mining. The potential effects of drought on mining is discussed in Section 4.4.

In addition to staging the construction of BMUs from south to north, the pumping level in the trench network is also varied to optimize brine grade and flow volume while maintaining the annual SOP mass production target of 540,000 tpa. As mentioned in Section 3.5, the percentage of mean annual precipitation that recharges the brine aquifer increases as the water table is drawdown in individual BMUs during mining. This additional recharge helps to maintain continuous brine flow to the trench network and helps to convey precipitated salts and non-drainable capillary brine in the unsaturated interval to the water table. However, the additional recharge will also gradually dilute the overall produced brine grade over time. To mitigate some of this dilution and optimize produced brine grade and flow volume, the pumping level in the trench network rises from 3 meters below ground level in mine year 3 to 1.7m below ground level in mine year 20. The trench pumping level is maintained at 1.7m below ground level through mine year 22, gradually decreases to 3m in mine year 33, and is maintained at this level to the end of mining after year 40. **Table 6** lists the annual pumping level in the trench network over the 40 year LoM.

In addition to optimizing brine grade and flow volume, the increase brine pumping level allows for potential mitigation of reduced brine flow during drought periods. Between mine years 10 and 30 additional drawdown capacity greater than 0.5m above the base pumping level of 3m below ground surface would be available to increase brine flow during a potential drought. As mentioned previously, the potential effects of drought on mining is discussed in Section 4.4.

The following section describes the implementation of this mine planning process into the numerical groundwater model.

4.2.2 Forecast Modeling Approach

To conduct the mine plan simulations and fulfill the modeling objectives, the calibrated pre-mining model needed to be modified to represent the extraction trench network. Following is a description of how the pre-mining model was modified.

4.2.2.1 Grid Refinement and Model Domain Reduction

To increase the resolution of the mine plan flow and transport predictions the 200m x 200m grid spacing used in the pre-mining model was refined to 50m x 50m, and the areal domain for the mine planning model was reduced to cover the production area in the Western Australia portion of Lake Mackay (**Figure 18**). Model layering was maintained as described previously.

A general head boundary condition was added along the east and north boundaries of the refined model to represent flow between the refined model and the portion of the lakebed aquifer outside the reduced model domain. This boundary condition was assigned a head from the pre-mining calibrated model and a conductivity of the UZT at each general head boundary cell along the east and west boundary.

4.2.2.2 Boundary Conditions Representing Trenches

Extraction trenches were simulated using a drain boundary-condition package. The drain package is a one-way, head-dependent boundary condition at which groundwater can only exit the model domain. This package requires input of a drain water elevation (i.e., stage), drain-bed thickness, drain lengths and widths, and a drain-bed hydraulic conductivity (K_{trench}) value that governs the resistance to water exchange between the drain (i.e., the trench) and the surrounding brine aquifer. The drain package allows for input of the actual dimensions of the feature being represented. This is important because the dimensions of the extraction trenches will be less than the dimensions of the 50m by 50m model cells. Allowing the user to incorporate the dimensions of the trenches in the boundary condition facilitates an appropriate hydraulic conductance to be computed to constrain the water exchange between the trench and the surrounding brine aquifer based on the actual construction of the extraction trenches. The model determines the volumetric rate of brine that is extracted based on the stage assigned in the boundary condition, the heads in surrounding model cells, the hydraulic conductance of the boundary condition, and the aquifer hydraulic properties.

All drain boundaries were assigned to Model Layers 1 and 2, representing the UZT and the upper portion of the UZB. The initial drain stage was assigned a value equal to 3m below the lakebed surface (base of the UZT) at each drain boundary cell. This target drain stage represents the initial water level that will be maintained within the extraction trench during operation. As the mine plan progresses the pumping level maintained in the trench network is raised and then lower, and the drain boundary stage is adjusted accordingly.

The assigned trench geometries remain constant during the mine planning simulations. Thus, trenches are assumed to remain stable during mining operations. The drain-bed thickness was assumed to be 1 metre for all drain cells. The K_{trench} was set equal to the hydraulic conductivity value of the model cell in which the drain boundary was assigned. The length and width of the drain boundaries were set to 50 meters, which is the nominal length dimension of the model cells, and to 3 metres, respectively. Selected reaches of extraction trenches were assigned drain stages at elevations higher than the lakebed surface to deactivate them according to the mine plan, and at various levels from 3 metres to 1.7 metres below the lakebed surface to activate or reactivate them, or to balance overall brine flow and grade during mining, simulating the operations of the BMUs over the LoM. BMU scheduling and pumping level flow adjustments are discussed in the following section.

4.2.3 Forecast Modeling Results

4.2.3.1 Model Forecasts

The final results of the mine plan simulations are shown in **Figure 19, Figure 20,** and **Figure 21**.

Figure 19 shows the simulated annual average rate of brine extraction flow and the associated annual average K^+ concentration. The simulated flow rate steadily increases from approximately 2.5 m^3/s to approximately 3.3 m^3/s in mine year 20 at which time the flow rate remains relatively constant between the range from 3.2 to 3.4 m^3/s over the remainder of the mine plan simulation. Simulated brine grade gradually decreases from approximately 3,282 mg/l to 2,163 mg/l at the end of the 40-year LoM. It should be noted that the simulated mine plan over produces SOP over the majority of the simulation period.

Actual mine operation will be limited to the target annual SOP production which will lessen brine dilution over the 40-year LoM.

Figure 20 shows the simulated annual SOP-equivalent mass in units of million metric tonnes delivered to the pre-concentration ponds. Simulated SOP production remains above the 540,00 tpa target level up to mine year 34 after which simulated SOP production is slightly below target. Mining operations will limit production to the target levels. The results of the mine plan simulation indicated that sufficient SOP reserve exists to maintain target production over the LoM. This is discussed in more detail in Section 4.5.

Figure 21 shows the simulated cumulative extracted SOP-equivalent mass extracted from Lake Mackay, over the 40-year LoM. As seen in this figure, simulated cumulative SOP production remains above target levels over the entire simulation indicating that sufficient production capacity exists to maintain target annual SOP production over the entire LoM.

It should be noted that the forecast cumulative SOP mass of 23 million metric tonnes represents what the trench build-out and mine plan schedule is capable of producing over the 40-year LoM simulation. Simulated brine grade and flow rates and annual SOP production fluctuate around the target values over the LoM; however, as part of mine operations and development efforts during future implementation phases, these fluctuations will be balanced to meet the target SOP mass production to meet the pre-concentration pond requirements. **Figure 22** shows predicted annual and cumulative SOP-equivalent mass after flow weighted average balancing of the simulated production. The resultant flow weighted average brine grade gradually decreases from approximately 3,282 mg/l at the start of production to approximately 2,562 mg/l at the of the LoM with average grade of approximately 2,817 mg/l. Production balancing was accomplished arithmetically while maintaining the mass balance produced from the mine plan simulation.

Yearly extraction trench requirements in kilometres of trench length are included in the BMU buildout schedule in **Table 7**. Under full build-out conditions total extraction trench construction equates to 1,973 kilometres of trenches.

The total mass balance error at the end of the simulation is -0.027% which is well within commonly accepted model mass balance error percentages for numerical groundwater models. The cumulative water balance at the end of the 40-year LoM simulation is shown in **Table 8**.

Comparisons of the forecast extraction-trench flows and their associated modeled lengths indicate maximum annual BMU flows per km of extraction trench ranging from approximately 1.4 l/s/km to 3.9 l/s/km of extraction trench at BMU01 and BMU09, respectively, with an average of 2.6 l/s/km.

4.3 PARAMETER SENSITIVITY

A sensitivity analysis was conducted on selected model input parameters to assess which parameters have the most influence on the predicted mine plan SOP production. The model input parameters included in the sensitivity analysis are hydraulic conductivity, specific yield (Sy), specific storage (Ss), net recharge as a percentage of mean annual precipitation, dispersivity, and the dual-domain mass transfer coefficient (MTC). This set of parameters represents a logical group of parameters that would typically be included in such a flow and mass transport modeling analysis.

The sensitivity analysis was performed by varying a single parameter and running the mine plan model. Four sensitivity simulations were run for each parameter for a total of 24 sensitivity simulations. **Table 9** lists the factors used to adjust the sensitivity parameter values. Professional judgement and prior experience were used in selecting the sensitivity factors. It should be noted that the range of these parameters does imply any degree of uncertainty in the parameters. An uncertainty analysis would require stochastic simulations to quantify the probability of a particular model prediction. In fact, the parameters with the most influence on the predicted mine plan SOP production (hydraulic conductivity and net recharge) have been studied extensively as discussed in prior sections of this report.

Figure 23 shows the predicted annual SOP production (Mt) for all 24 sensitivity simulations over the 40-year mine life. Similarly, **Figure 24** shows the predicted cumulative SOP production for all 24 sensitivity simulations. Of the parameters investigated, annual and cumulative SOP production is most sensitive to hydraulic conductivity and recharge, somewhat sensitive to dispersivity, and insensitive to MTC, Sy, and Ss. As shown in the figures, a 10-fold increase in hydraulic conductivity results in annual and cumulative SOP production that is approximately double that from the base mine plan run, while a 10-fold decrease in hydraulic conductivity results in annual and cumulative SOP production that is on the order of one-third of the SOP production from the base mine plan run.

Figures 23 and **24** also show that increase of the percentage of precipitation that recharges the brine aquifer by 100% results in an approximately 50% increase in annual SOP production for the first 15 years of the mine plan. This increase in SOP production steadily decreases over the remaining mine plan simulation with annual SOP production in year 40 approximately 15% higher than the base mine plan run. Cumulative SOP production at the end of the 40-year LoM simulation is increased by approximately 32% with a 100% increase in net recharge. The figures show that reducing the percentage of precipitation that recharges the brine aquifer by 50% reduces SOP production for the first 15 years of the mine plan by approximately 50%. This percent reduction in annual SOP production when compared to the base run decreases over the remaining 25 years of mining to approximately 33% in year 40. Cumulative SOP production at the end of the 40-year LoM simulation is reduced by approximately 37% with a 50% reduction in net recharge. The change in sensitivity to net recharge between the first 15 years of the mine plan simulation and last 25 years is due to the way in which the mine plan generally progresses from east to west across Lake Mackay encountering zones of varying net recharge.

As noted above, SOP production from the mine plan simulation is slightly sensitive to dispersivity and insensitive to specific yield, specific storage, and MTC over the ranges of these parameters tested. As noted previously, dispersion is dependent on the scale of time and distance. Hence, the sensitivity to this parameter becomes more pronounced as the mine plan progress. However, the effect of doubling or reducing this parameter by half is still relatively small (+/- approximately 5-6% at the end of the 40-year simulation). Some sensitivity to specific yield can be seen when drainage of the specific yield occurs in the first few years of production. As the drainable brine is depleted and the system becomes dominated recharge and mass transfer, the sensitivity to specific yield is reduced. Given the assumption that dual-domain mass transfer is dominated by the relatively fast process of the mixing of brine in the drainable and capillary porosity fractions rather than being limited by the slow process of diffusion, SOP production from the mine plan simulation is not sensitive to the MTC over the ranges assessed.

Note that hydraulic conductivity of the UZT production interval and recharge as percentage of mean annual precipitation have been extensively investigated and analyzed as demonstrated in the Trench Test Analysis Report in **Appendix D** and the Recharge Analysis Technical Memo in **Appendix E**. The sensitivity analysis was conducted to demonstrate the relative influence of various parameters on the simulated mine plan production, and the range over which parameters are investigated does not imply any degree of uncertainty in these parameters.

4.4 DROUGHT SENSITIVITY SCENARIO

A scenario was run to examine the sensitivity of the mine plan production to a theoretical drought condition. Precipitation data from the Kintore Airport over the period from 1993 to 2019 was analyzed to determine a drought condition with some likelihood of occurrence during the 40-year life of mine. Mean annual precipitation at Kintore is 320mm. A three-year drought condition was chosen based on the longest duration between 50mm rainfall events in the Kintore rainfall record. Annual precipitation during this three-year period was 139mm.

To evaluate the potential effect of this theoretical drought on brine production, the mine plan model was run with recharge reduced to 0.4334 of normal (=139mm/320mm) for mine years 21, 22, and 23 and returning to normal thereafter. This represents a period shortly after the entire trench network has been constructed. Prior to this period capacity exists to mitigate the effects of drought by altering the mine plan by bringing additional trenches on line.

Figure 25 shows annual and cumulative SOP production for the drought scenario mine plan simulation. SOP production drops below the 540,000 tpa target level to 360,000 tpa in mine year 21, reaches a low of 240,000 tpa in mine year 22, and begins to recover when the drought ends after mine year 23. Recovery to pre-drought production occurs over two years with mine year 24 production at 460,000 tpa and mine year 25 production back above the target level. Note that cumulative SOP production remains above target levels during the entire simulation.

Capacity exists in the mine plan construction and operating schedule to mitigate potential drought conditions. Depending on when a drought occurs during the life of mine, mitigation options include:

- Accelerate trench construction to bring addition production capacity on line. This option is available to varying degrees up to mine year 18 at which time all BMUs are constructed.
- Restart production in BMUs that have been turned off due to diluted grade. This option is available to varying degrees after mine year 21 after which time some BMUs in the mine plan schedule are turned off.

- Increase trench production by lowering the pumping level. Trenches will be constructed to a nominal depth of 4.5m below ground surface with pumping levels varying from 3m to 1.7m below ground surface over the duration of the mine plan. Trenches could also be deepened to allow additional production capacity.

Note that the results of this simulation have not been balanced to the 540,000 tpa target level prior to the drought period. Balancing of the simulation results to the annual target level may give some indication of the level of production capacity available to mitigate the effects of drought.

4.5 POTASSIUM RESERVE ESTIMATE

The numerical mine plan model described in Section 4.4 was revised to directly account for brine production from each brine resource category in each production interval to determine the quantity of potassium and SOP Reserves produced over the 40-year simulation period. A multi-species mass transport simulation was run with five separate chemical species representing the following:

- UZT measured potassium resource,
- UZT indicated potassium resource,
- UZB indicated potassium resource,
- LZ1 indicated potassium resource, and
- UZ and LZ inferred resource.

This simulation directly tracks mass from each resource category listed above as brine flows within and between model layers and is produced by the trench network.

The UZT resource includes precipitated potassium salts in the unsaturated zone. These precipitated salts are classified as an indicated resource although they occur over the UZT measured footprint. The produced precipitated salt resource over the measured resource footprint was moved to indicated UZT production outside of the model simulation. The average ratio of precipitated to dissolved UZT potassium from the resource model was determined over the operating BMUs in each simulation year. This ratio was then applied to the measured UZT resource produced each year to account for the appropriate tonnage of produced precipitated UZT resource. Column testing of unsaturated zone core samples used to quantify the UZT precipitated salt resource is referenced in Section 3.5 Recharge and Evapotranspiration and is described in **Appendix F – Soils Lab Results Technical Memo.** Salt decay curves representing the amount of precipitated salt that is dissolved as precipitation percolates through the unsaturated zone and recharges the brine aquifer versus the number of unsaturated zone pore volumes flushed where calculated for each recharge zone. These curves were used to determine the maximum amount of UZT precipitated resource that could be produced over the LoM

Only in-place Measured plus Indicated Mineral Resources were used determine the Proven and Probable Ore Reserves. Modifying factors in the construction of the mine plan to determine these reserves include buffer zones around the major landform islands to mitigate drawdown beneath these environmentally sensitive areas and cultural zones where no trench construction is permitted. Available Ore Reserves are defined as the quantities of potassium and associated SOP contained in brine that is technically extractable from the Lake and delivered to the first solar evaporation pond. These values were determined using the numerical model outputs from the mine plan simulation described above and categorized by level of assurance into Proven and Probable Ore Reserves of K^+ and equivalent SOP tonnages as summarized in **Table 10, Table 11** and **Table 12**.

Proven and Probable Ore Reserves of K+ and equivalent SOP tonnages for each category are summarized in **Table 10** in addition to average produced brine grade and total brine produced over the LoM simulation. Proven Ore Reserves from trench production in the UZT (model Layer 1) were calculated as the SOP tonnage produced from the each UZT model cell in the Measured Mineral Resource minus the mass of precipitated salts in the UZT unsaturated zone (0-5m, BGS) in each UZT model cell in the Measured Mineral Resource. **Proven Ore Reserves total 3.75 million metric tonnes of SOP**.

Table 10 Total Reserves

Proven		Probable		Total		Average Grade	Produced Brine
K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	mg/l K^+	Gl
1.7	3.75	7.3	16.3	9.0	20.0	2,817	3,456

As described above the portion of UZT resource associated with precipitated salts in the unsaturated zone has been assigned an Indicated Resource category, and production from this resource is assigned as a Probable Ore Reserve. Although the extraction level in the production trenches is set to the base of the UZT or 3 m below the lakebed surface hydraulic gradients created during trench extraction induce flow from UZB and LZ horizons below the UZT over the 40-year LoM. Resource below the UZT is classified in the Indicated or Inferred Resource category. Produced resource from model Layers 2, 3, and 4 in each model cell within the Indicated Mineral Resource in the UZB and LZ1 is categorized as Probable Ore Reserve. **Probable Ore Reserve totals 16.3 million metric tonnes of SOP**.

Remaining mine plan production occurs from Inferred resource horizons and is not claimed as an Ore Reserve. **Total Proven and Probable Ore Reserves are 20.0 million metric tonnes of SOP** out of a total of 21.6 million tonnes of SOP produced from the mine plan model.

Table 11 lists the Proven and Probable Ore Reserves in each hydrostratigraphic unit. All of the proven SOP reserve (3.75 Mt) is produced from the UZT resource zone. Total SOP reserve produced from the UZT resource zone 5.3 Mt. No Proven Reserve is produced from the UZB or LZ resource zones. Probable SOP Reserve produced from the UZB is 10.6 Mt, and Probable SOP Reserve produced from the LZ1 resource zone is 4.1 Mt.

Table 11 Total Reserves by Resource Zone

Resource Zone	Proven plus Probable					
	Proven		Probable		Total	
	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)
UZT	1.7	3.75	0.7	1.6	2.4	5.3
UZB	-	-	4.8	10.6	4.8	10.6
LZ1	-	-	1.8	4.1	1.8	4.1
LZ2	-	-	-	-	-	-
LZ3	-	-	-	-	-	-
Total	**1.7**	**3.75**	**7.3**	**16.3**	**9.0**	**20.0**

Table 12 lists the annual Proven and Probable Reserve production, production fromInferred Mineral Resource, average produced brine grade, and produced brine volume. **Figure 26** contains a plot of annual production by reserve category. Produced brine grade after balancing the mine plan simulation output to the annual SOP production target of 540,000 tpa decays over the LoM as recharge from precipitation dilutes the in-situ brine as the water table is drawn down during extraction in the BMUs. Average brine grade produced during the first year of mining is 3,282 mg/l of K^+. The produced brine grade gradually decays to 2,562 mg/l of K^+ at the end of 40-year LoM. Average produced brine grade over the LoM is 2,817 mg/l K^+. As the brine grade declines over the LoM, annual brine production increases to meet the annual mass target of 540,000 tonnes of SOP. Initial annual brine production is 73.8 gigaliters (GL) increasing to 94.6 GL in mine year 40. Total brine produced over the 40-year LoM is 3,456 GL.

The annual proportion of Proven and Probable Ore Reserve against production from the Inferred Mineral Resource varies during the 40-year LoM. The proportion of Proven Reserve produced is higher at the start of the mine plan and gradually decreases over the LoM while the proportion of Probable Reserve increases over the LoM. The small amount of production from the Inferred Mineral Resource shown in Table 12 is not claimed as a reserve. The annual amount of total SOP production from the Inferred Mineral Resource is approximately 7% and never exceeds 11% of the total annual SOP production

Table 12 Annual Reserves and Brine Production

Mine Year	Proven		Probable		Total		Inferred Production		Average Grade	Produced Brine
	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	mg/l K^+	GL
1	0.08	0.18	0.16	0.35	0.24	0.53	0.01	0.01	3,282	73.8
2	0.06	0.13	0.17	0.38	0.23	0.52	0.01	0.02	3,225	75.1
3	0.05	0.12	0.18	0.40	0.23	0.52	0.01	0.02	3,173	76.4
4	0.05	0.10	0.18	0.41	0.23	0.51	0.01	0.03	3,130	77.4
5	0.05	0.11	0.18	0.40	0.23	0.51	0.01	0.03	3,096	78.3
6	0.04	0.10	0.19	0.41	0.23	0.51	0.01	0.03	3,062	79.1
7	0.05	0.11	0.18	0.40	0.23	0.51	0.01	0.03	3,037	79.8
8	0.04	0.10	0.18	0.41	0.23	0.51	0.01	0.03	3,008	80.6
9	0.05	0.11	0.18	0.40	0.23	0.51	0.01	0.03	2,986	81.2
10	0.04	0.10	0.18	0.41	0.23	0.51	0.01	0.03	2,961	81.8
11	0.05	0.10	0.18	0.41	0.23	0.51	0.01	0.03	2,937	82.5
12	0.04	0.10	0.19	0.41	0.23	0.51	0.01	0.03	2,912	83.2
13	0.05	0.11	0.18	0.41	0.23	0.51	0.01	0.03	2,896	83.7
14	0.05	0.10	0.18	0.40	0.23	0.51	0.02	0.03	2,879	84.2
15	0.04	0.10	0.18	0.41	0.23	0.51	0.02	0.03	2,860	84.7
16	0.05	0.11	0.18	0.40	0.23	0.51	0.02	0.03	2,845	85.2
17	0.04	0.10	0.18	0.41	0.23	0.50	0.02	0.04	2,829	85.7
18	0.05	0.11	0.18	0.40	0.23	0.51	0.02	0.03	2,816	86.0
19	0.04	0.10	0.18	0.41	0.23	0.50	0.02	0.04	2,800	86.5
20	0.04	0.10	0.18	0.41	0.23	0.50	0.02	0.04	2,784	87.0

Table 12 Annual Reserves and Brine Production (cont.)

Mine Year	Proven		Probable		Total		Inferred Production		Average Grade	Produced Brine
21	0.04	0.09	0.18	0.41	0.23	0.50	0.02	0.04	2,767	87.6
22	0.04	0.09	0.18	0.41	0.22	0.50	0.02	0.04	2,752	88.1
23	0.04	0.09	0.18	0.41	0.22	0.50	0.02	0.04	2,736	88.6
24	0.04	0.09	0.18	0.41	0.22	0.49	0.02	0.05	2,723	89.0
25	0.04	0.09	0.18	0.41	0.22	0.50	0.02	0.04	2,711	89.4
26	0.04	0.09	0.18	0.41	0.22	0.49	0.02	0.05	2,701	89.7
27	0.04	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,691	90.0
28	0.04	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,681	90.4
29	0.04	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,670	90.8
30	0.04	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,660	91.1
31	0.03	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,650	91.4
32	0.04	0.08	0.19	0.42	0.22	0.49	0.02	0.05	2,641	91.8
33	0.03	0.08	0.19	0.42	0.22	0.49	0.02	0.05	2,632	92.1
34	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,622	92.4
35	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,613	92.7
36	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,603	93.1
37	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,593	93.4
38	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,583	93.8
39	0.03	0.07	0.19	0.42	0.22	0.48	0.02	0.06	2,572	94.2
40	0.03	0.07	0.19	0.42	0.22	0.48	0.03	0.06	2,562	94.6
Total	**1.7**	**3.75**	**7.3**	**16.3**	**9.0**	**20.0**	**0.7**	**1.6**	**2,817**	**3,456**

5.0 SUMMARY AND CONCLUSIONS

The forecast simulations indicate that the proposed mine plan, with the noted configuration and modeling assumptions, could meet the brine-extraction target of 540,000 metric tonnes of SOP per annum for a 40-year mine life. According to the model, this may require operation of 1,973 kilometres of extraction trenches and canals at various times during the mine plan. Mine plan simulation or predictive modeling indicates that there is a decrease in annual average K^+ concentration due to dilution of the mobile-phase brine as areal recharge from precipitation is recharged into the UZT. It is anticipated that the brine grade will decline approximately 20% over the LoM from an initial grade of approximately 3,282 mg/l K^+ to 2,562 mg/l K^+ at the end of the 40-year mine plan. Average predicted brine grade over this period is 2,817 mg/l K^+. **Proven Ore Reserves total 3.75 million metric tonnes of SOP. Probable Ore Reserve totals 16.3**

million metric tonnes of SOP. **Total Proven and Probable Ore Reserves are 20.0 million metric tonnes of SOP** out of a total of 21.6 million tonnes of SOP produced from the mine plan model. The Ore Reserve figures reported in this technical report will support the annual SOP production profile over the life of the Project.

The DFS has demonstrated that the Project is economically viable. As a result of the favorable economic results presented in the DFS and the technical viability demonstrated in this report, in-place Measured plus Indicated Mineral Resources have been upgraded to Proven and Probable Ore Reserves. Numerical groundwater flow and transport models have been developed that integrate hydrogeologic information collected over the last several years to improve the understanding of the groundwater flow and transport components of the conceptual model of the Lake Mackay aquifer system. This integrated groundwater flow and transport model provided a numerical framework to support the development of the mine plan. The mine plan consists of a conceptual design layout and sequencing of UZ trenches required to achieve SOP-production targets during a 40-year mine life.

The accuracy of Mineral Resource and Ore estimates is, in part, a function of the quality and quantity of available data and of engineering and geological interpretation and judgment. Elements of the study that form the basis of the Ore Reserve estimation include sampling and analytical methodology, the hydrostratigraphic resource model construction and understanding of brine and sediment properties and variability, and the construction and calibration of the integrated groundwater flow and mass transport numerical models. These tasks were performed in succession, with standard validation and calibration exercises performed throughout each stage, culminating in the integrated numerical models from which the Ore Reserve estimations have been sourced. This has led to a reasonable level of confidence that Lake Mackay will be able to produce the quantities and grade of brine presented as Proven and Probable Ore Reserves in this Report.

Given the data available at the time this Competent Persons Report was prepared, the estimates presented herein are considered reasonable. However, they should be accepted with the understanding that additional data and analysis available subsequent to the date of the estimates may necessitate revision. These revisions may be material. There is no guarantee that all or any part of the estimated Mineral Resources or Ore Reserves will be recoverable.

6.0 REFERENCES

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TABLES

Table 1. Water Level Measurements, March 2019 and August 2019

Boring	X	Y	Depth mbgs	Screen Top mbgs	Screen Bot mbgs	Ground Elevation amsl	SWL Mar2019 mbgs	WLE Mar2019 amsl	SWL Sep2019 mbgs	WLE Aug2019 amsl
MC01	464954	7510017	10.40	1.40	10.40	361.50	0.24	361.26	0.81	360.69
MC02	470016	7510019	9.75	0.75	9.75	360.73	0.45	360.28	0.67	360.06
MC03	493409	7509502	9.75	0.75	9.75	361.11	0.31	360.80	0.51	360.60
MC04	493786	7510003	9.75	0.75	9.75	362.98	0.815	362.16	0.965	362.01
MC05	494088	7510168	9.75	6.75	9.75	360.86	2.735	358.12	2.88	357.98
MC06	499845	7510004	11.25	2.25	11.25	360.83	0.18	360.65	0.63	360.20
MC07	495020	7515084	11.25	10.25	11.25	361.08	0.37	360.71	0.64	360.44
MC08	491436	7519245	11.25	2.25	11.25	361.03	0.545	360.48	1.04	359.99
MC09	492704	7524188	11.25	2.25	11.25	361.16	0.655	360.50	0.85	360.31
MC10	490123	7529868	11.25	2.25	11.25	361.14	0.655	360.48	0.805	360.33
MC11	490717	7529886	7.50	ND	ND	361.03	-	-	0.86	360.17
MC12	496021	7529993	11.25	5.25	11.25	363.35	-	-	3.06	360.29
MC13	494917	7530028	11.25	2.25	11.25	360.99	-	-	0.69	360.30
MC16	497412	7529995	7.50	ND	ND	361.16	0.6	360.56	-	-
MC18	495004	7535000	7.50	1.50	3.50	361.11	0.385	360.73	0.6	360.51
MC19	495002	7539595	11.25	ND	ND	361.12	0.735	360.39	0.81	360.31
MC21	498098	7535007	11.25	8.25	11.25	361.04	0.39	360.65	0.63	360.41
MC24	479943	7529996	11.25	2.00	1.00	361.00	0.275	360.72	0.67	360.33
MC25	485777	7524188	11.25		11.25	360.98	0.25	360.73	1.11	359.87
MC28	484971	7515062	11.25	8.25	11.25	360.82	0.11	360.71	0.31	360.51
MC32	470014	7520051	11.25	8.25	11.25	361.98	0.295	361.68	0.58	361.40
MC37	455015	7524980	11.25	5.25	11.25	362.12	0.28	361.84	1.14	360.98
MC38	449994	7519984	11.25	5.25	11.25	361.76	0.19	361.57	0.77	360.99
MC40	464570	7514535	11.25	5.25	11.25	361.84	0.275	361.56	0.595	361.24
MC42	439990	7510029	11.25	2.25	11.25	362.90	0.265	362.64	0.58	362.32
MC43	435003	7509993	11.25	2.25	11.25	362.02	0.23	361.79	0.865	361.15
MC44	441561	7506993	11.25	2.25	11.25	361.84	0.285	361.55	0.645	361.19
MC46	445769	7506084	15.65	12.65	15.65	361.84	0.205	361.63	0.2	361.64
MC47	445769	7506084	2.25	0.75	2.25	361.53	0.275	361.25	0.645	360.88
MC50	455013	7509984	11.25	2.25	11.25	361.11	0.32	360.79	0.655	360.45
MC51	457166	7498787	11.25	2.25	11.25	360.79	0.275	360.51	0.57	360.22
MC53	479978	7510044	11.25	2.25	11.25	360.65	0.305	360.34	0.635	360.01
MC55	489983	7505010	11.25	2.25	11.25	360.24	0.58	359.66	0.865	359.38
MC56	482373	7495002	11.25	8.25	11.25	360.96	0.345	360.61	0.49	360.47
MC57	485876	7491918	11.25	8.25	11.25	361.80	0.35	361.45	0.55	361.25

Table 1 (cont.). Water Level Measurements, March 2019 and August 2019

Boring	X	Y	Depth mbgs	Screen Top mbgs	Screen Bot mbgs	Ground Elevation amsl	SWL Mar2019 mbgs	WLE Mar2019 amsl	SWL Sep2019 mbgs	WLE Aug2019 amsl
MA01	440018	7505016	24.00	3.00	24.00	361.98	0.185	361.79	0.09	361.89
MA02	450003	7504992	16.70	0.35	15.35	362.34	0.325	362.01	0.655	361.68
MA03	449969	7514950	19.00	1.30	16.30	361.56	0.22	361.34	0.49	361.07
MA04	450003	7524996	24.00	0.00	5.48	361.19	0.2	360.99	0.46	360.73
MA05	460003	7514992	18.70	3.52	18.52	361.08	0.295	360.79	0.6	360.48
MA06	470022	7515008	22.50	1.52	19.52	360.70	0.25	360.45	0.5	360.20
MA07	479996	7514981	27.00	1.65	25.65	360.97	0.39	360.58	0.54	360.43
MA08	490050	7515074	30.00	3.00	30.00	361.11	0.24	360.87	0.62	360.49
MA09	499801	7515003	30.00	3.00	30.00	360.99	0.6	360.39	0.735	360.25
MA10	495031	7519985	29.00	1.30	28.30	361.11	0.69	360.42	0.9	360.21
MA11	499807	7524974	30.00	3.00	27.00	360.81	0.425	360.39	0.57	360.24
MA12	495000	7539595	27.00	3.00	30.00	361.17	0.735	360.44	0.81	360.36
MA13	490028	7534995	26.00	7.50	25.50	361.27	0.03	361.24	0.19	361.08
MA14	485014	7539617	20.00	2.00	17.00	361.42	0.145	361.27	0.66	360.76
MA15	480001	7534993	25.00	0.00	11.00	360.94	0.23	360.71	0.655	360.29
MA16	475005	7529997	27.00	ND	ND	360.67	0.17	360.50	0.67	360.00
MA17	485007	7528035	30.00	ND	ND	360.92	0.17	360.75	0.42	360.50
MA18	489998	7525007	26.80	ND	ND	360.86	-0.175	361.03	0.57	360.29
MA19	494995	7509521	27.00	0.00	10.00	361.11	0.42	360.69	0.73	360.38
MA20	484997	7510000	21.50	ND	ND	361.21	0.27	360.94	0.44	360.77
MA21	474508	7509959	22.00	ND	ND	361.47	0.215	361.25	0.415	361.05
MA22	474993	7519995	28.00	0.30	24.30	361.71	0.245	361.47	0.555	361.16
MA23	464982	7520024	24.00	ND	ND	362.00	0.3	361.70	-	-
MA25	454987	7520000	26.50	ND	ND	360.64	0.4	360.24	0.66	359.98
MA26	444989	7510006	22.50	ND	ND	361.25	0.32	360.93	-	-
MA27	482410	7495004	25.00	ND	ND	361.36	0.29	361.07	0.44	360.92

Table 2. Summary of Hydrostratigraphic Units and Hydraulic Properties

Hydro-stratigraphic Interval	Model Layer	Hydraulic Conductivity (m/d)	Kh:Kv	Sy	Ss (1/m)
UZT	1	0.8 - 264.8	100:1	0.06 - 0.14	$1x10^{-3}$
UZB	2	0.13 - 43.9	100:1	0.05	$1x10^{-3}$
UZB	3	0.13 - 43.9	100:1	0.05	$1x10^{-3}$
LZ1	4	0.1	100:1	0.05	$1x10^{-3}$
LZ2	5	0.1	100:1	0.04	$1x10^{-3}$
LZ3	6	10	10:1	0.12	$1x10^{-3}$

Table 3. Steady State Calibration Targets and Residuals

Name	X	Y	Water Level Elevation (m,asl)		Residual (m)
			Target	Modeled	
MA15-01	440018	7505016	361.99	361.26	0.73
MA15-02	450003	7504992	361.14	360.90	0.24
MA15-03	449969	7514950	361.50	361.06	0.44
MA15-04	450003	7524996	361.88	361.44	0.44
MA15-05	460003	7514992	360.96	360.52	0.44
MA15-06	470022	7515008	360.71	360.12	0.59
MA15-07	479996	7514981	360.57	360.04	0.53
MA15-08	490050	7515074	360.08	359.70	0.38
MA15-09	499801	7515003	360.24	359.86	0.38
MA15-10	495031	7519985	360.36	359.99	0.37
MA15-11	499807	7524974	360.43	359.80	0.63
MA15-12	495000	7539595	360.30	359.75	0.55
MA15-13	490028	7534995	360.63	359.73	0.90
MA15-14	485014	7539617	360.54	360.13	0.41
MA15-15	480001	7534993	360.61	360.18	0.42
MA15-16	475005	7529997	360.74	360.34	0.40
MA15-17	485007	7528035	360.53	359.93	0.60
MA15-18	489998	7525007	360.08	359.67	0.41
MA15-19	494995	7509521	360.21	359.99	0.22
MA15-20	484997	7510000	360.41	359.88	0.53
MA15-21	474508	7509959	360.71	360.09	0.62
MA15-22	474993	7519995	360.78	360.26	0.51
MA15-25	454987	7520000	361.15	360.81	0.34
MA15-27	482410	7495004	360.19	359.98	0.21

Table 3 (cont.). Steady State Calibration Targets and Residuals

Name	X	Y	Water Level Elevation (m,asl)		Residual (m)
			Target	Modeled	
MC16-01	464954	7510017	360.44	360.16	0.28
MC16-02	470016	7510019	361.12	360.26	0.86
MC16-03	493409	7509502	360.21	359.61	0.60
MC16-04	493786	7510003	360.51	359.73	0.78
MC16-05	494088	7510168	360.09	359.94	0.15
MC16-06	499845	7510004	360.24	359.99	0.25
MC16-07	495020	7515084	360.15	359.73	0.42
MC16-08	491436	7519245	360.03	359.80	0.23
MC16-09	492704	7524188	360.18	359.86	0.32
MC16-10	490123	7529868	360.35	360.00	0.34
MC16-12	496021	7529993	360.16	359.86	0.30
MC16-13	494917	7530028	360.29	360.11	0.18
MC16-14	496221	7529995	360.24	359.79	0.45
MC16-18	495004	7535000	360.50	359.76	0.74
MC16-19	495002	7539595	360.30	359.75	0.55
MC16-21	498098	7535005	360.68	359.90	0.78
MC16-24	479943	7529996	360.49	360.10	0.39
MC16-25	485777	7524188	359.87	359.94	-0.07
MC16-28	480002	7519998	360.69	359.96	0.73
MC16-32	470014	7520051	360.70	360.19	0.51
MC16-37	455015	7524980	360.84	361.01	-0.17
MC16-38	449994	7519984	361.36	361.18	0.18
MC16-40	464570	7514535	360.74	360.31	0.42
MC16-42	439990	7510029	361.81	361.58	0.23
MC16-43	435003	7509993	362.04	362.04	0.00
MC16-44	441561	7506993	361.38	361.23	0.15
MC16-46	445769	7506084	361.64	361.02	0.62
MC16-47	445769	7506084	361.20	360.85	0.35
MC16-50	455013	7509984	360.89	360.64	0.25
MC16-51	457166	7498787	360.96	360.78	0.18
MC16-53	479978	7510044	360.28	359.95	0.32
MC16-55	489983	7505010	359.86	359.89	-0.03
MC16-56	482373	7495002	360.15	359.98	0.17
MC16-57	485876	7491918	359.67	359.79	-0.12

Table 4 Steady State Model Water Balance

Process	IN (m^3/d)	OUT (m^3/d)
Storage	12	15
Recharge	865,253	-
ET	-	899,838
General Head Boundary	7,462	5,734
Constant Head Boundary	32,862	-
Total	905,589	905,588
Percent error	0.00015%	

Table 5. Mine Plan - BMU Schedule

BMU	Start Year	Stop Year
1	10	40
2	2	40
3	1.8	31
4	12	40
5	4	40
6	1	25
7	1	40
8	6	40
9	1	21
10	13	40
11	8	40
12	1.3	23
13	15	40
14	2.1	40
15	1	24
16	17	40
17	1.5	29

Table 6. Mine Plan – Pumping Level Adjustments

Mine Year	Number of Operating BMUs	Trench Pumping Level (m, bgs)	Adjustment from Base Pumping Level (m)
1	4	3	0
2	7	3	0
3	9	2.9	0.1
4	9	2.9	0.1
5	10	2.8	0.2
6	10	2.85	0.15
7	11	2.65	0.35
8	11	2.7	0.3
9	12	2.57	0.43
10	12	2.55	0.45
11	13	2.4	0.6
12	13	2.45	0.55
13	14	2.3	0.7
14	15	2.1	0.9
15	15	2.05	0.95
16	16	2.05	0.95
17	16	1.8	1.2
18	17	1.8	1.2
19	17	1.8	1.2
20	17	1.7	1.3

Mine Year	Number of Operating BMUs	Trench Pumping Level (m, bgs)	Adjustment from Base Pumping Level (m)
21	16	1.7	1.3
22	16	1.7	1.3
23	15	1.8	1.2
24	14	1.85	1.15
25	13	2.3	0.7
26	13	2.4	0.6
27	13	2.4	0.6
28	13	2.5	0.5
29	12	2.5	0.5
30	12	2.6	0.4
31	11	2.7	0.3
32	11	2.9	0.1
33	11	3	0
34	11	3	0
35	11	3	0
36	11	3	0
37	11	3	0
38	11	3	0
39	11	3	0
40	11	3	0

Table 7 BMU Buildout Schedule

Mine Year	BMUs Starting Operation	New Trench Requirement (km)
1	6, 7, 9, 15	367.8
1.3	12	141.9
1.5	17	103.1
1.8	3	100.6
2	2	84.0
2.1	14	120.2
4	5	98.7
6	8	149.3
8	11	144.1
10	1	106.3
12	4	174.7
13	10	90.6
15	13	127.0
17	16	165.1

Table 8 Mine Plan Model Cumulative LoM Water Balance

Process	IN (m3)	OUT (m3)
Storage	18,1444,064	69,617,048
Recharge	10,287,511,552	-
ET	-	6,273,071,616
General Head Boundary	1,389	3,636
Constant Head Boundary	31,958,386	28,544
Drain Boundary	-	4,161,074,688
Total	10,500,915,391	10,503,795,532
Percent error	-0.027%	

Table 9 Mine Plan Model Sensitivity Runs

Parameter/Process	Sensitivity Multiplier			
K_h and K_v	0.1	0.2	5	10
Sy	0.67	0.8	1.25	1.5
Net annual recharge	0.5	0.67	1.5	2
MTC	0.1	0.2	5	10
α (longitudinal, transverse, and vertical)	0.5	0.67	1.5	2
Storativity	0.1	0.2	5	10

Table 10 Total Reserves

Proven		Probable		Total		Average Grade	Produced Brine
K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	mg/l K^+	Gl
1.7	**3.75**	**7.3**	**16.3**	**9.0**	**20.0**	**2,817**	**3,456**

Table 11 Total Reserves by Resource Zone

Resource Zone	Proven plus Probable					
	Proven		Probable		Total	
	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)
UZT	1.7	3.75	0.7	1.6	2.4	5.3
UZB	-	-	4.8	10.6	4.8	10.6
LZ1	-	-	1.8	4.1	1.8	4.1
LZ2	-	-	-	-	-	-
LZ3	-	-	-	-	-	-
Total	**1.7**	**3.75**	**7.3**	**16.3**	**9.0**	**20.0**

Table 12 Annual Reserves and Brine Production

Mine Year	Proven		Probable		Total		Inferred Production		Average Grade	Produced Brine
	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	K (Mt)	SOP (Mt)	mg/l K^+	GL
1	0.08	0.18	0.16	0.35	0.24	0.53	0.01	0.01	3,282	73.8
2	0.06	0.13	0.17	0.38	0.23	0.52	0.01	0.02	3,225	75.1
3	0.05	0.12	0.18	0.40	0.23	0.52	0.01	0.02	3,173	76.4
4	0.05	0.10	0.18	0.41	0.23	0.51	0.01	0.03	3,130	77.4
5	0.05	0.11	0.18	0.40	0.23	0.51	0.01	0.03	3,096	78.3
6	0.04	0.10	0.19	0.41	0.23	0.51	0.01	0.03	3,062	79.1
7	0.05	0.11	0.18	0.40	0.23	0.51	0.01	0.03	3,037	79.8
8	0.04	0.10	0.18	0.41	0.23	0.51	0.01	0.03	3,008	80.6
9	0.05	0.11	0.18	0.40	0.23	0.51	0.01	0.03	2,986	81.2
10	0.04	0.10	0.18	0.41	0.23	0.51	0.01	0.03	2,961	81.8
11	0.05	0.10	0.18	0.41	0.23	0.51	0.01	0.03	2,937	82.5
12	0.04	0.10	0.19	0.41	0.23	0.51	0.01	0.03	2,912	83.2
13	0.05	0.11	0.18	0.41	0.23	0.51	0.01	0.03	2,896	83.7
14	0.05	0.10	0.18	0.40	0.23	0.51	0.02	0.03	2,879	84.2
15	0.04	0.10	0.18	0.41	0.23	0.51	0.02	0.03	2,860	84.7
16	0.05	0.11	0.18	0.40	0.23	0.51	0.02	0.03	2,845	85.2
17	0.04	0.10	0.18	0.41	0.23	0.50	0.02	0.04	2,829	85.7
18	0.05	0.11	0.18	0.40	0.23	0.51	0.02	0.03	2,816	86.0
19	0.04	0.10	0.18	0.41	0.23	0.50	0.02	0.04	2,800	86.5
20	0.04	0.10	0.18	0.41	0.23	0.50	0.02	0.04	2,784	87.0

Table 12 (cont.) Annual Reserves and Brine Production

Mine Year	Proven		Probable		Total		Inferred Production		Average Grade	Produced Brine
21	0.04	0.09	0.18	0.41	0.23	0.50	0.02	0.04	2,767	87.6
22	0.04	0.09	0.18	0.41	0.22	0.50	0.02	0.04	2,752	88.1
23	0.04	0.09	0.18	0.41	0.22	0.50	0.02	0.04	2,736	88.6
24	0.04	0.09	0.18	0.41	0.22	0.49	0.02	0.05	2,723	89.0
25	0.04	0.09	0.18	0.41	0.22	0.50	0.02	0.04	2,711	89.4
26	0.04	0.09	0.18	0.41	0.22	0.49	0.02	0.05	2,701	89.7
27	0.04	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,691	90.0
28	0.04	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,681	90.4
29	0.04	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,670	90.8
30	0.04	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,660	91.1
31	0.03	0.08	0.18	0.41	0.22	0.49	0.02	0.05	2,650	91.4
32	0.04	0.08	0.19	0.42	0.22	0.49	0.02	0.05	2,641	91.8
33	0.03	0.08	0.19	0.42	0.22	0.49	0.02	0.05	2,632	92.1
34	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,622	92.4
35	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,613	92.7
36	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,603	93.1
37	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,593	93.4
38	0.03	0.07	0.19	0.42	0.22	0.49	0.02	0.05	2,583	93.8
39	0.03	0.07	0.19	0.42	0.22	0.48	0.02	0.06	2,572	94.2
40	0.03	0.07	0.19	0.42	0.22	0.48	0.03	0.06	2,562	94.6
Total	**1.7**	**3.75**	**7.3**	**16.3**	**9.0**	**20.0**	**0.7**	**1.6**	**2,817**	**3,456**

FIGURES

Figure 1. Lake Mackay Location Map

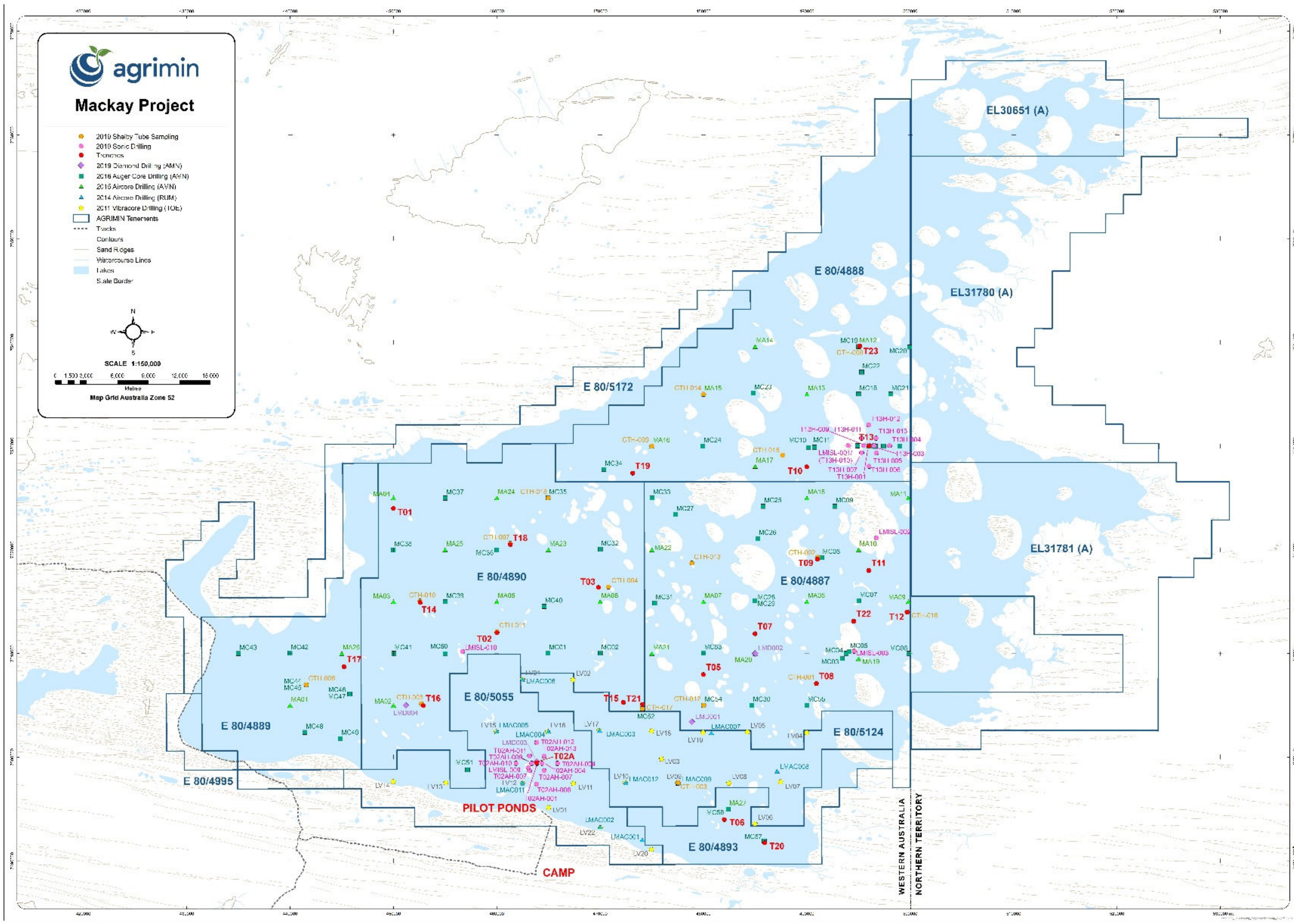


Figure 2. Conceptual Hydrogeologic Model

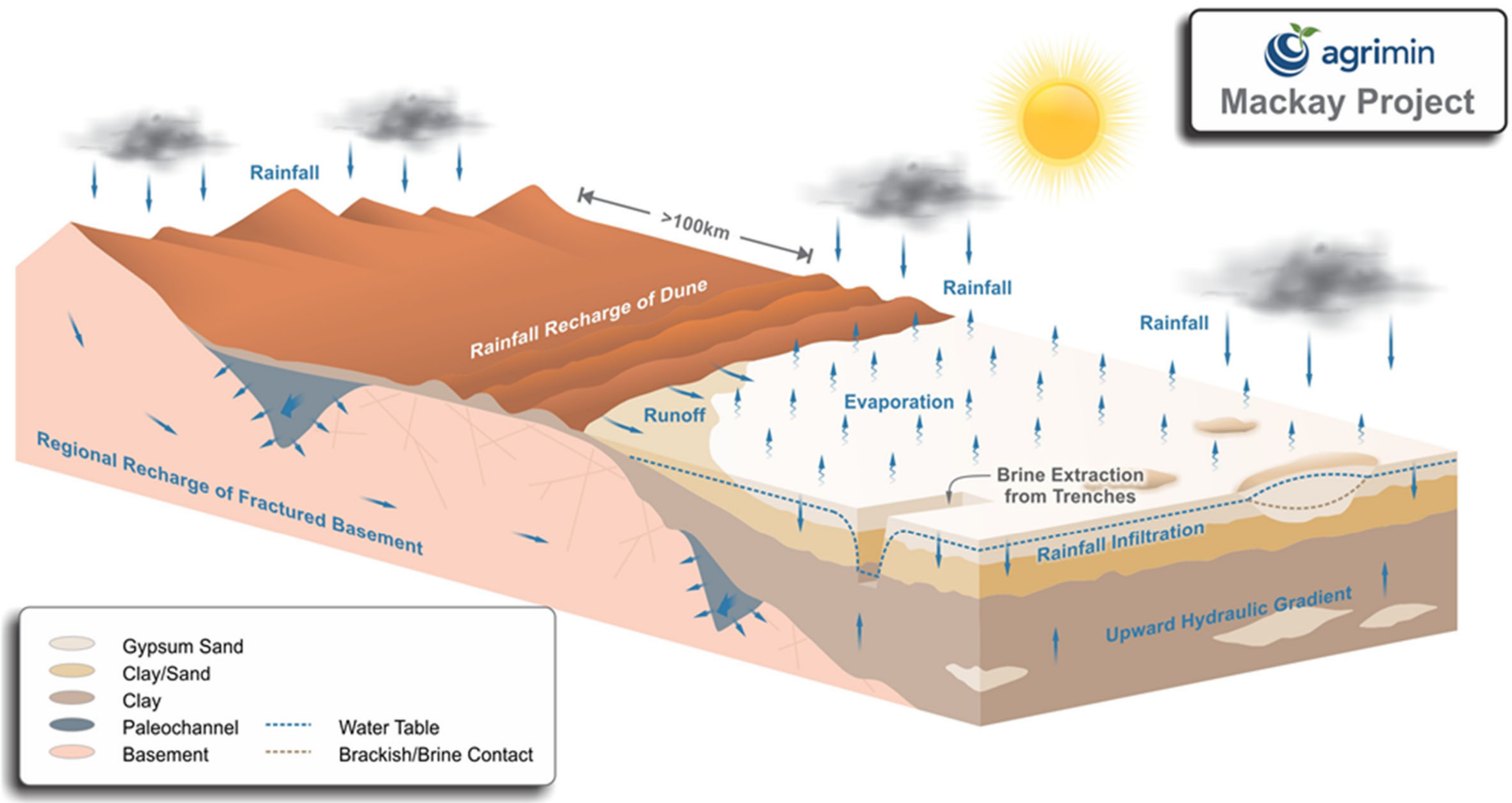


Figure 3 Resource Model Schematic Cross Section

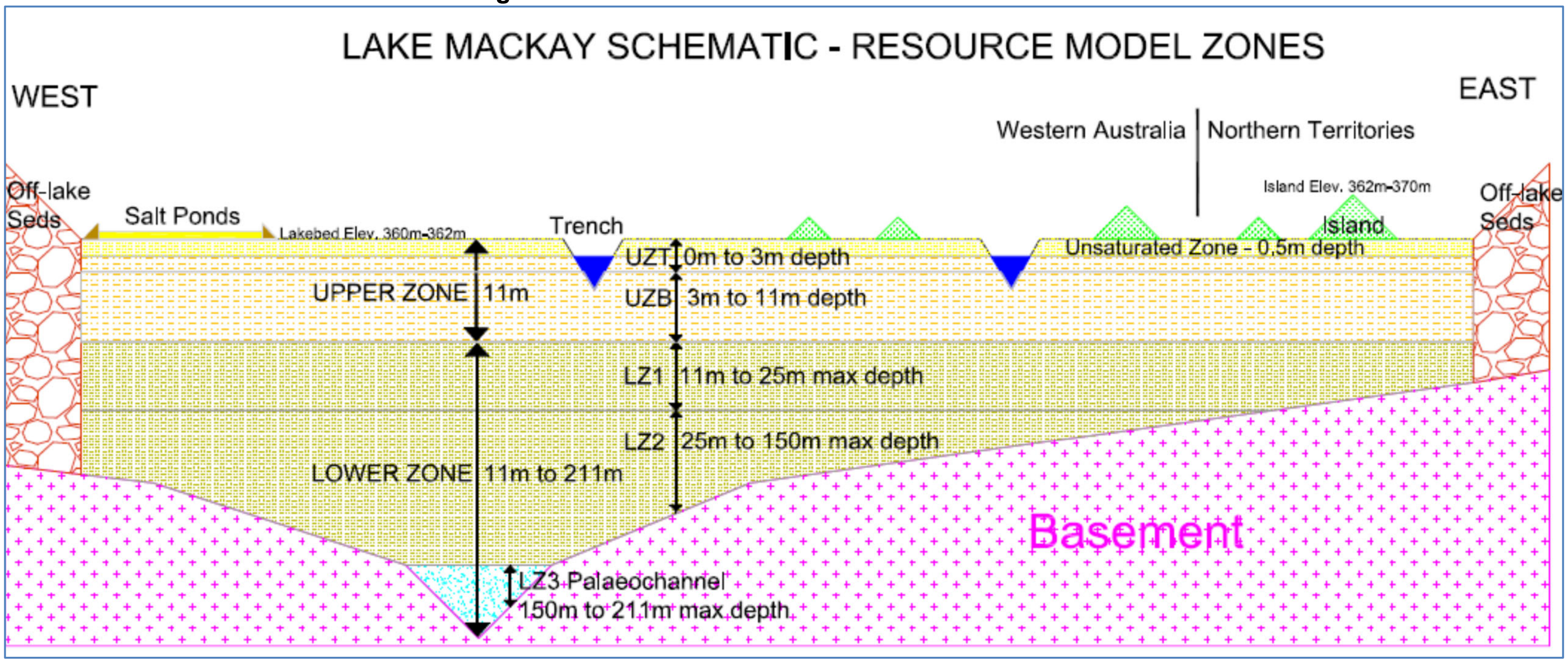


Figure 4 Lake Mackay Potentiometric Surface Map (March 2019)

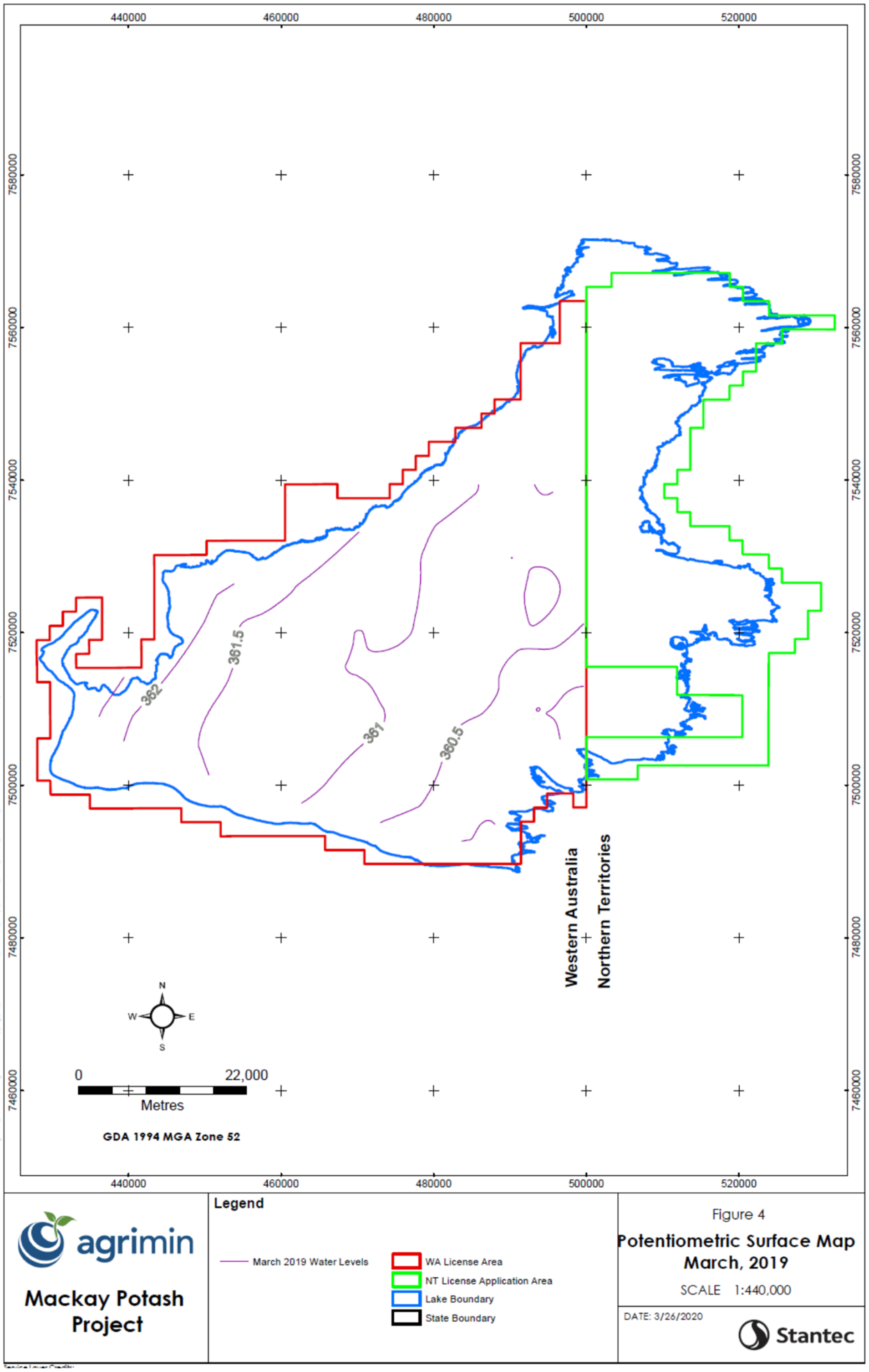


Figure 5 Lake Mackay Potentiometric Surface Map (August 2019)

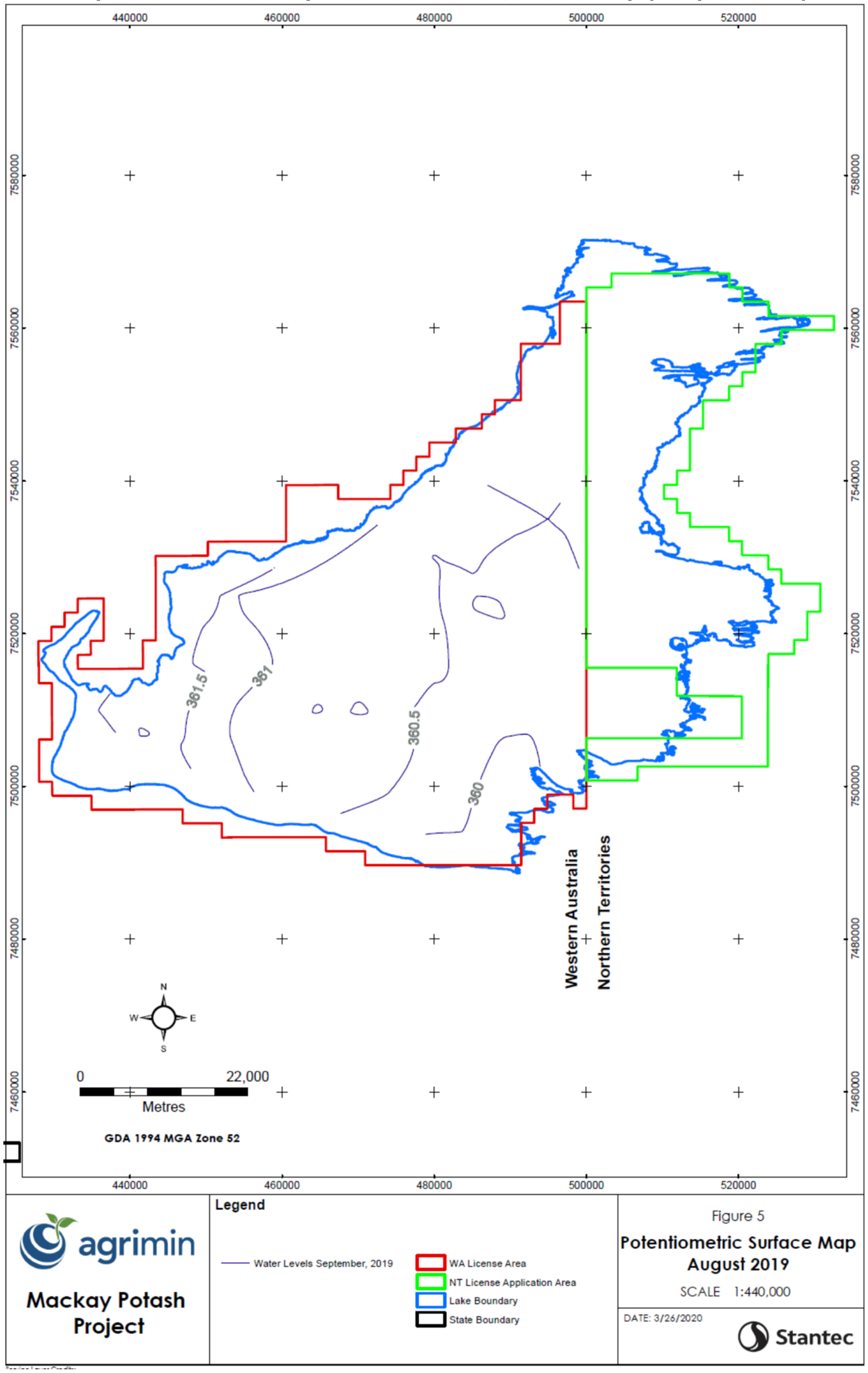


Figure 6 MA02 – Long Term Water Levels vs Precipitation

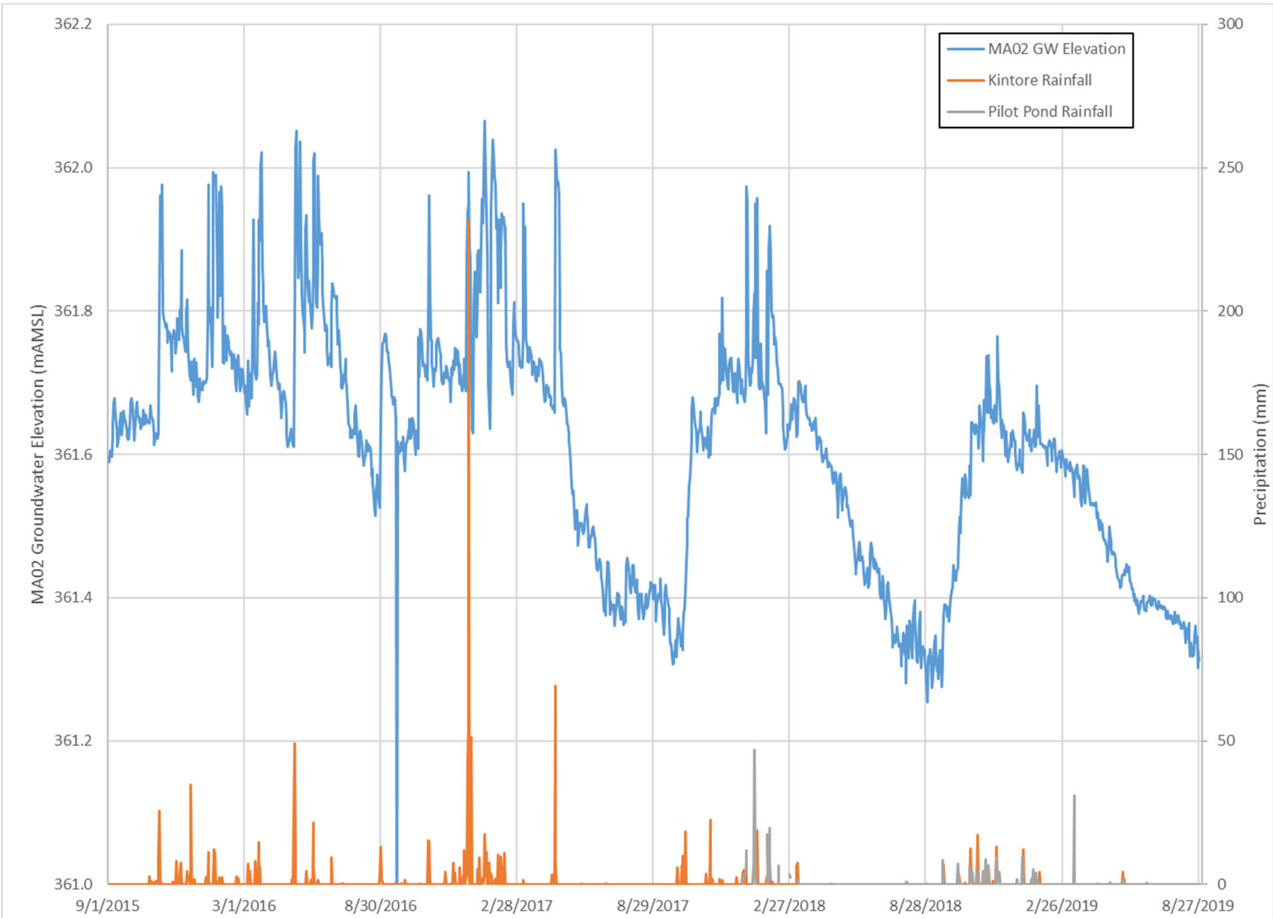


Figure 7 Trench Production Conceptual Cross Section

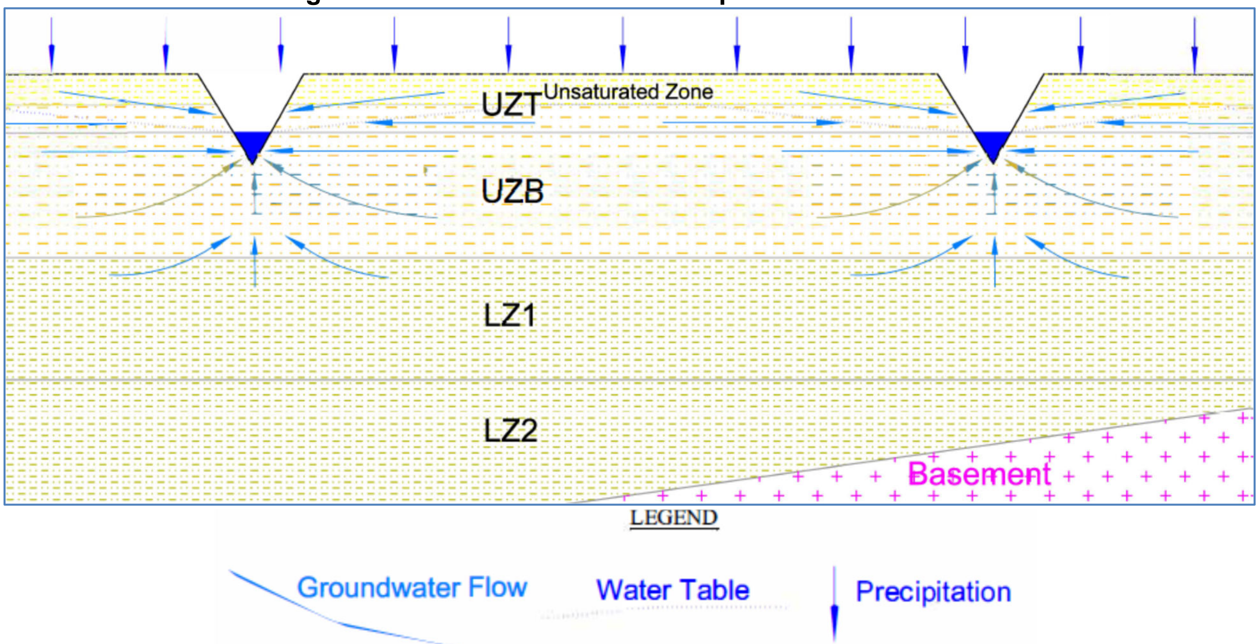


Figure 8 Trench Production Mass Transport Processes

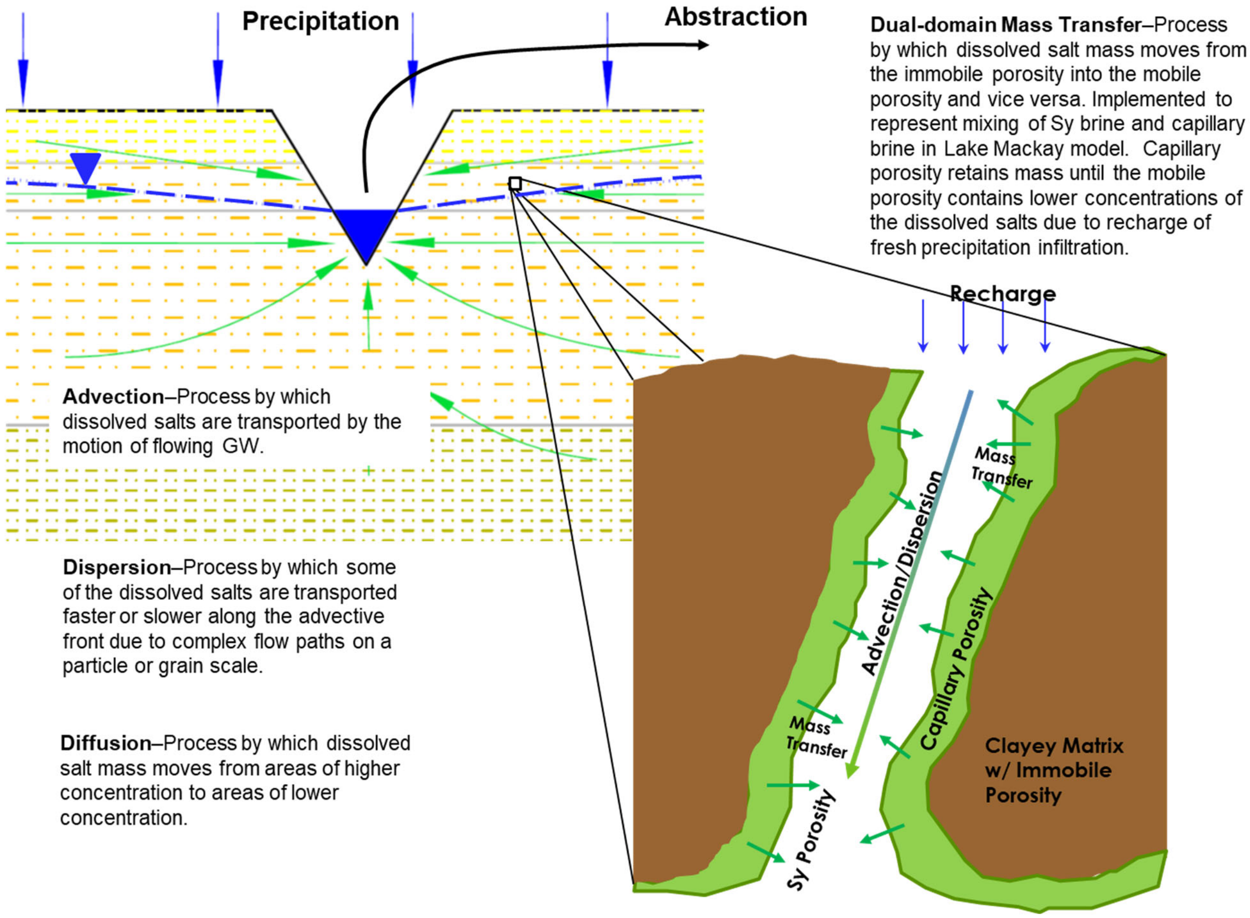


Figure 9 Model Boundary Conditions

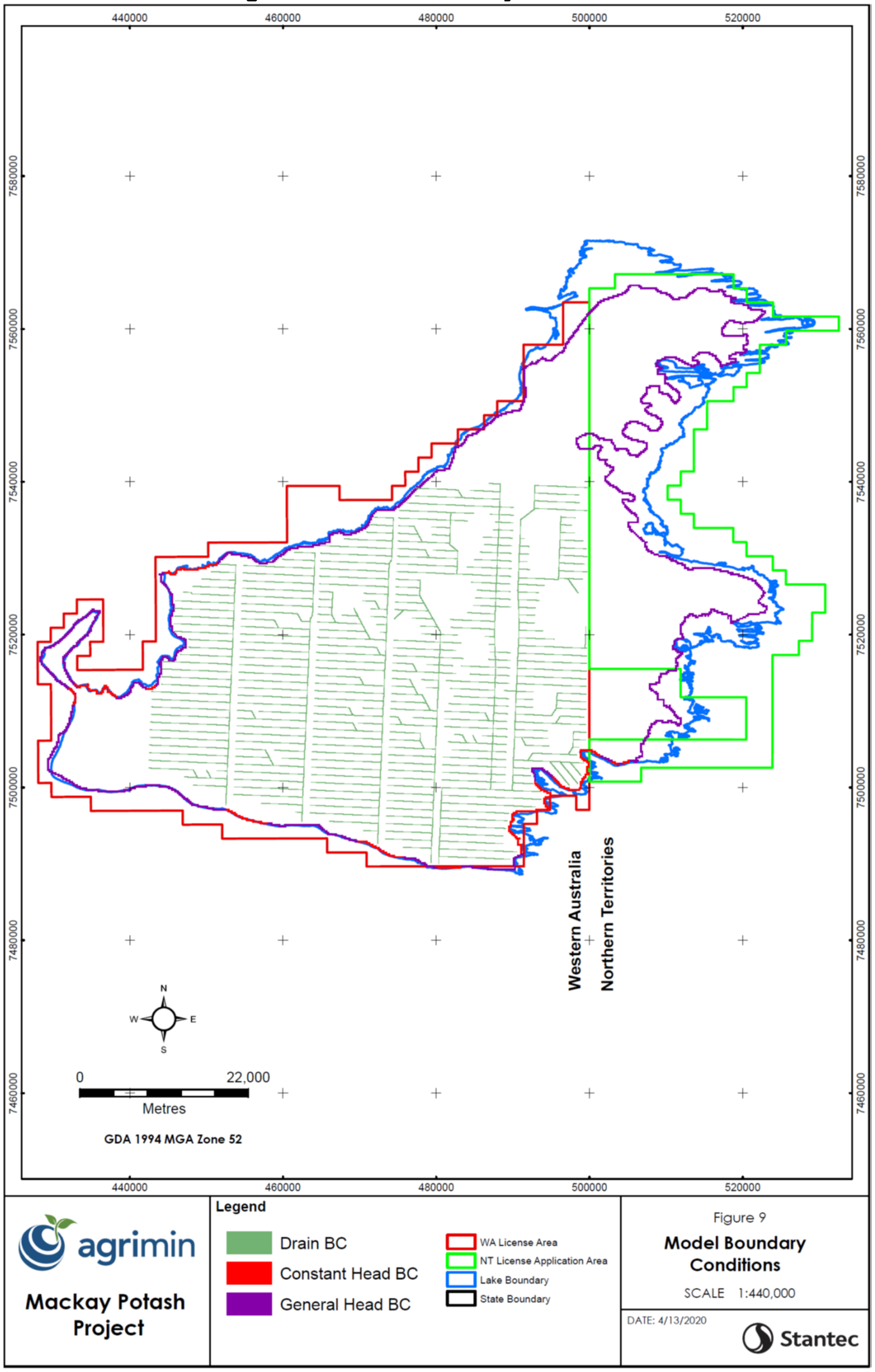


Figure 10 UZT Hydraulic Conductivity Distribution

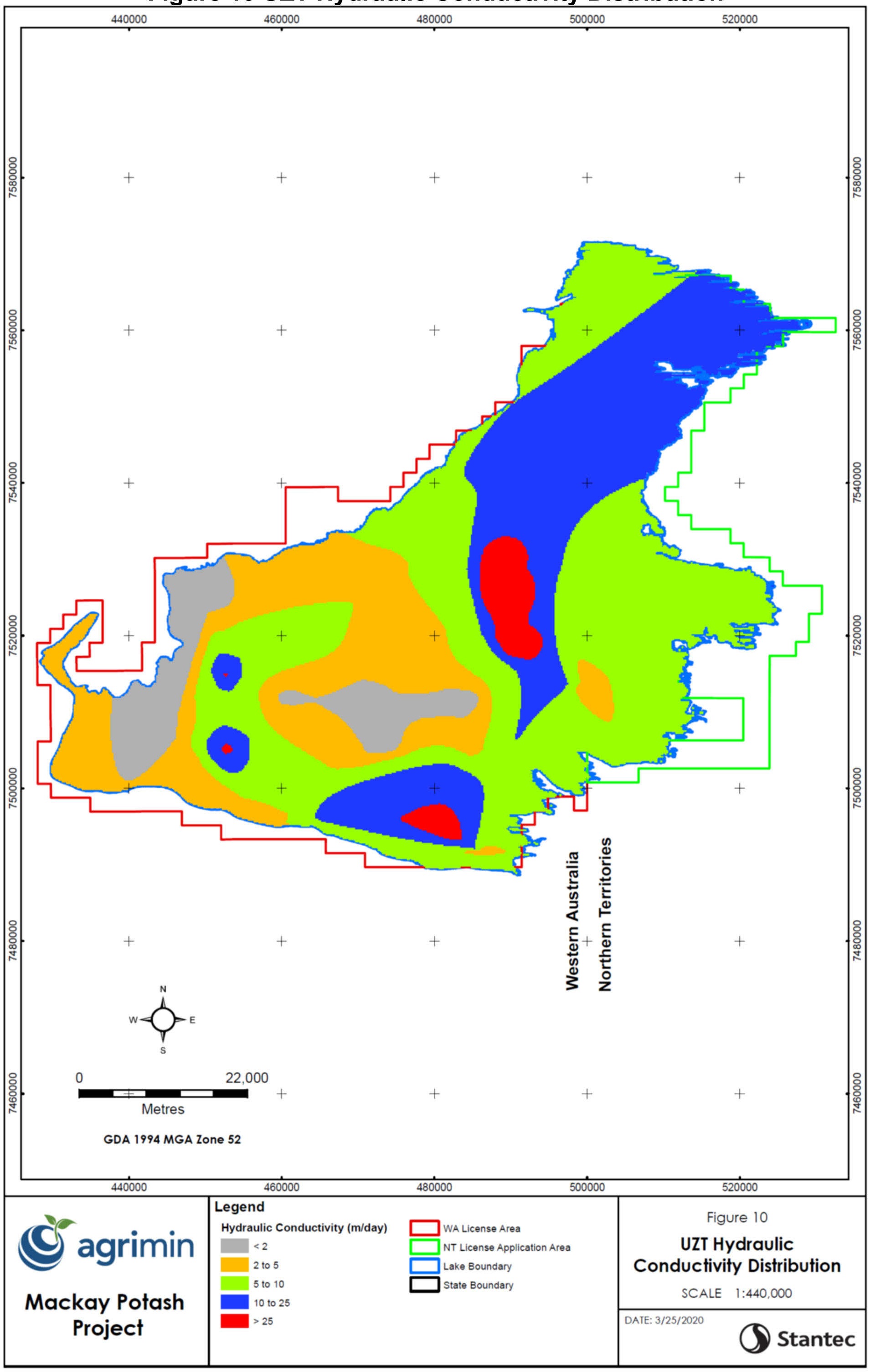


Figure 11 UZT Specific Yield Zones

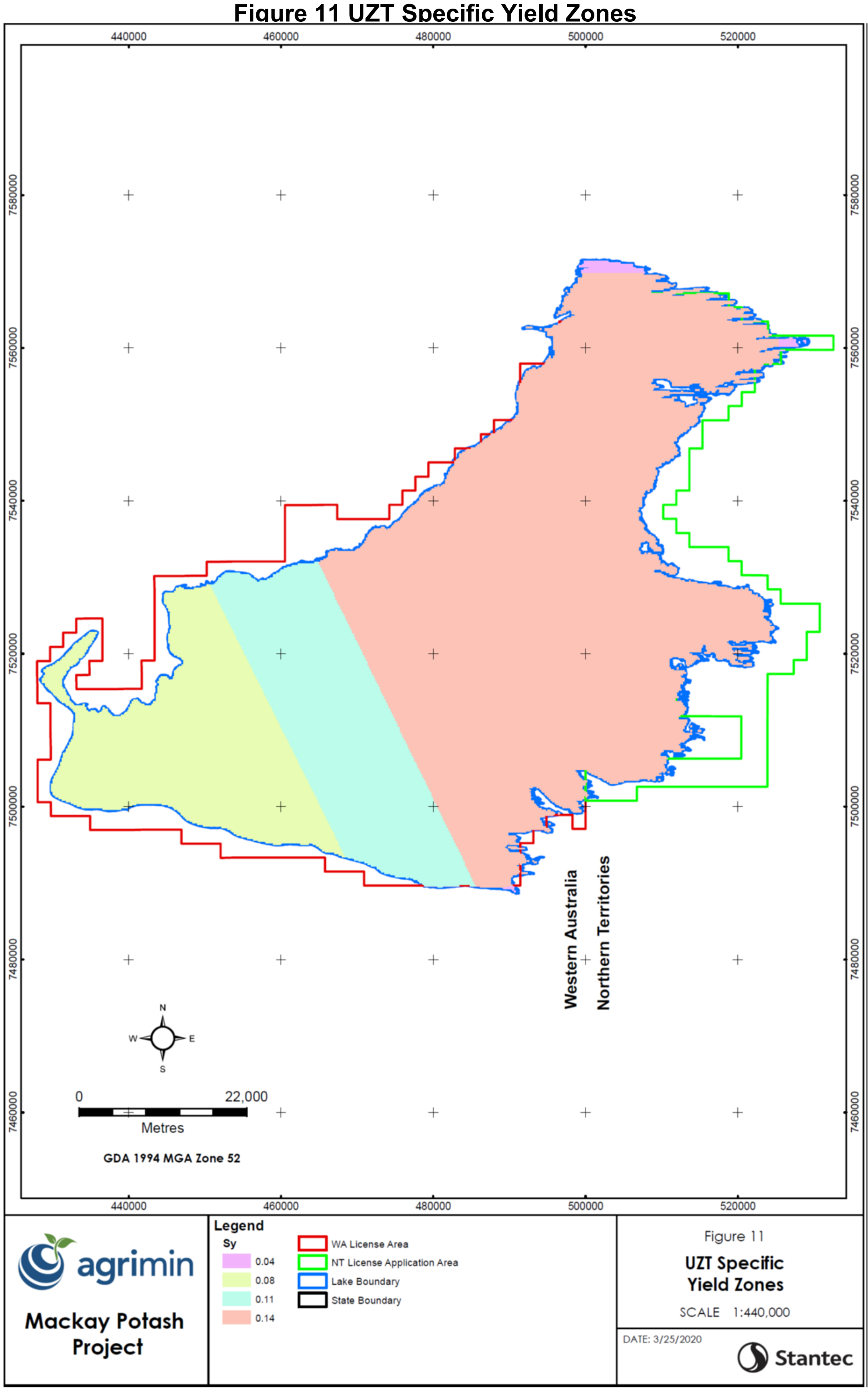


Figure 12 Recharge and ET Zones

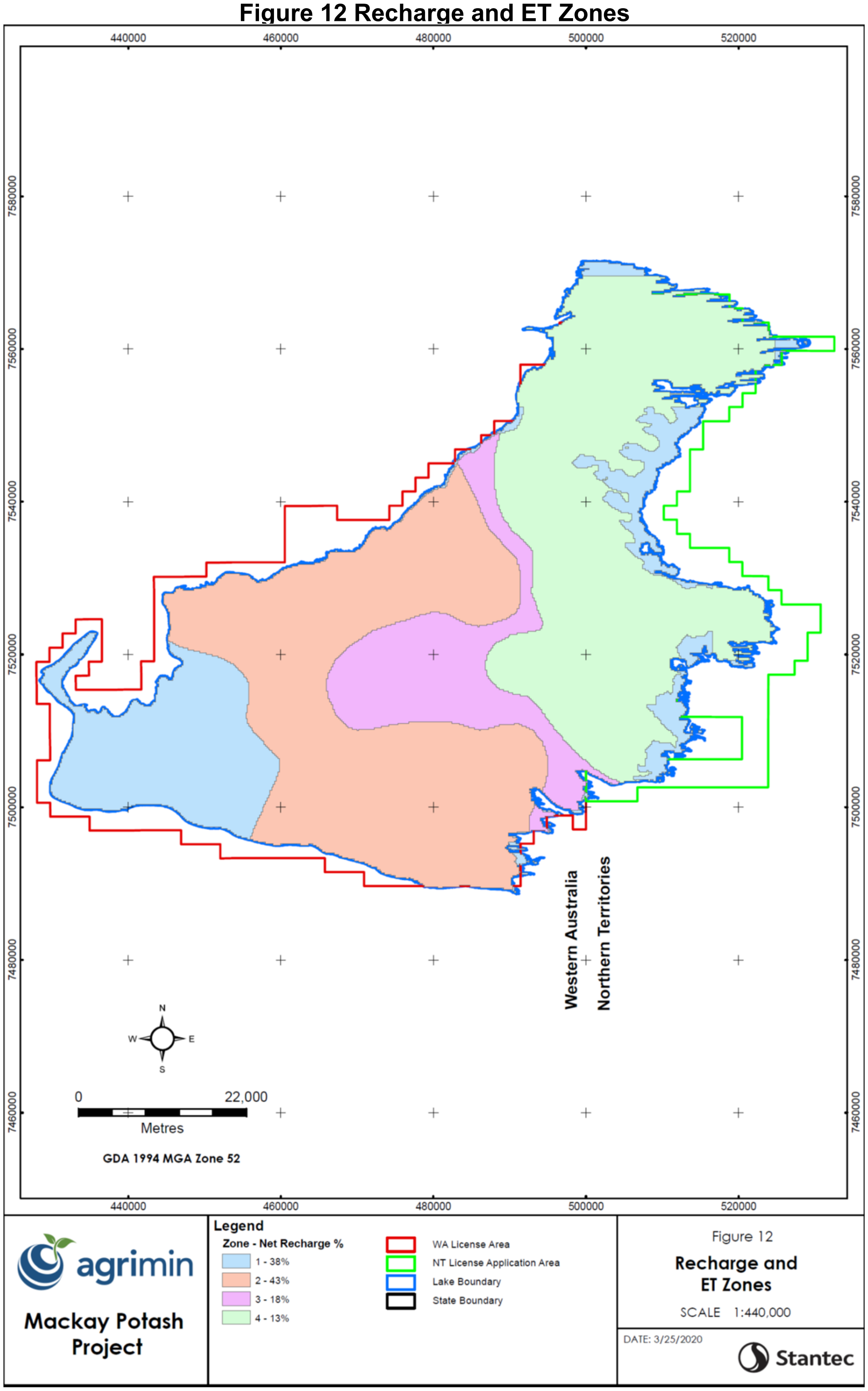


Figure 13 UZT Potassium Concentration

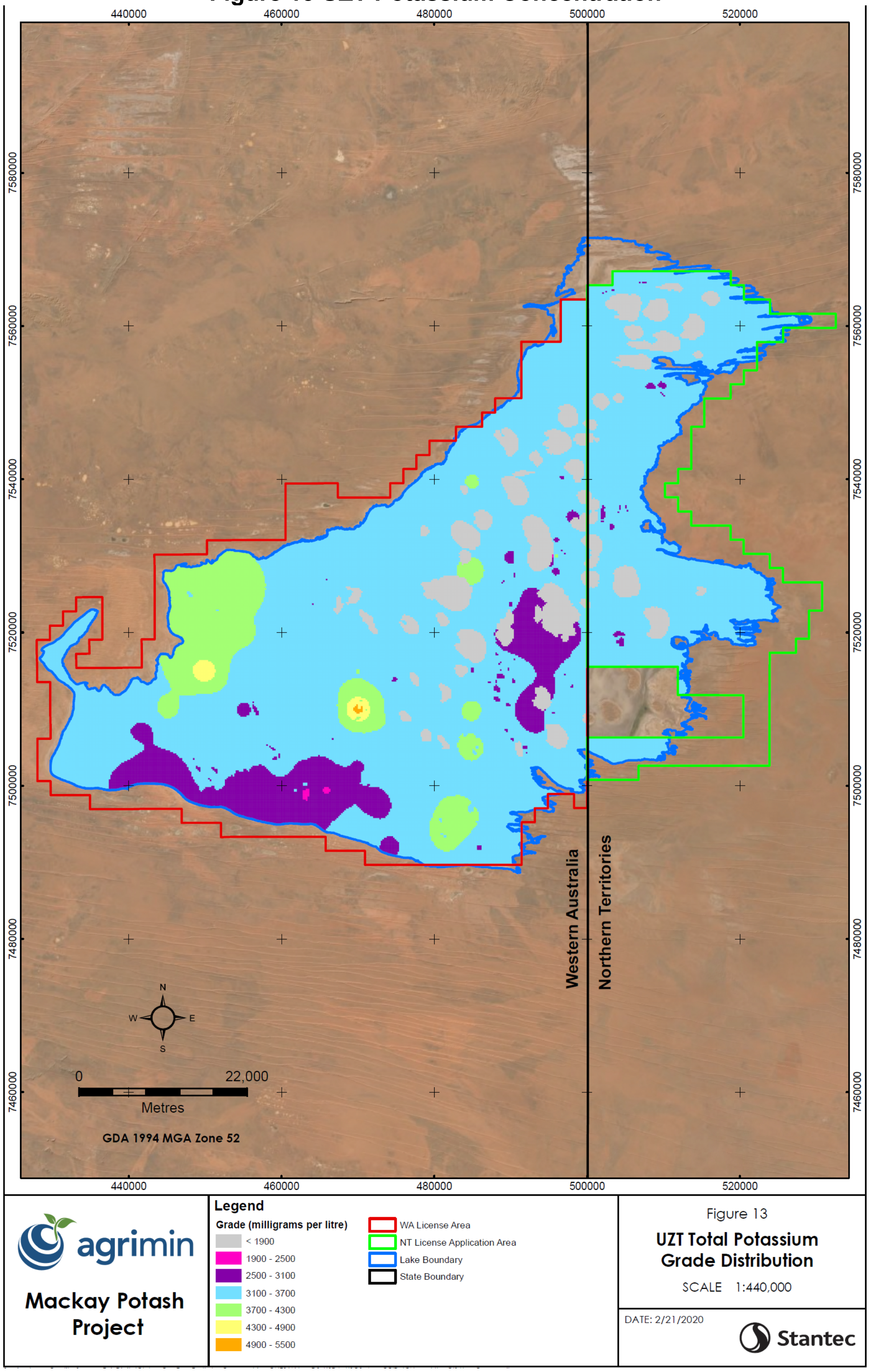


Figure 14 Lake Mackay Head Calibration Targets Map

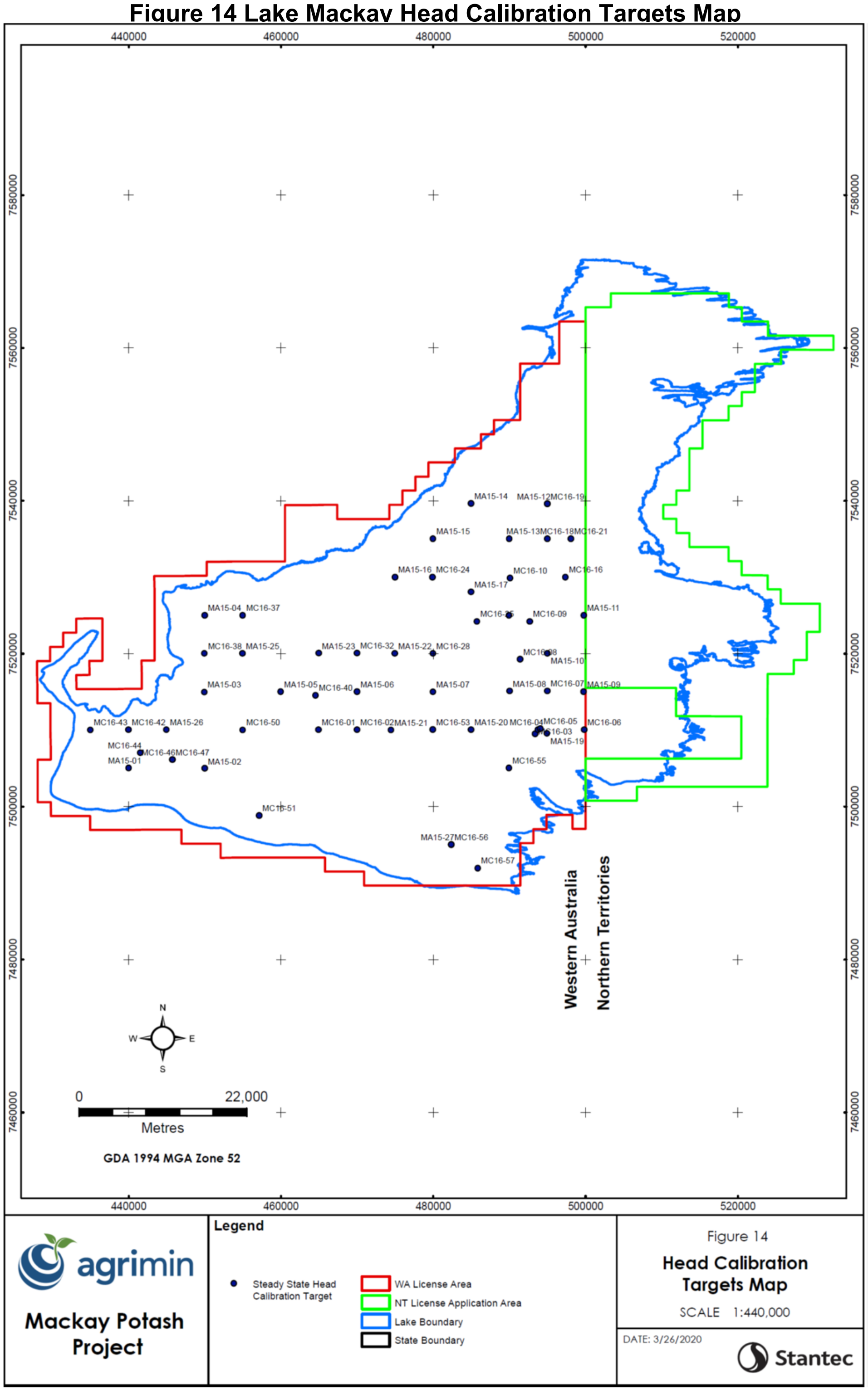


Figure 15 Steady State Model Calibration Plot

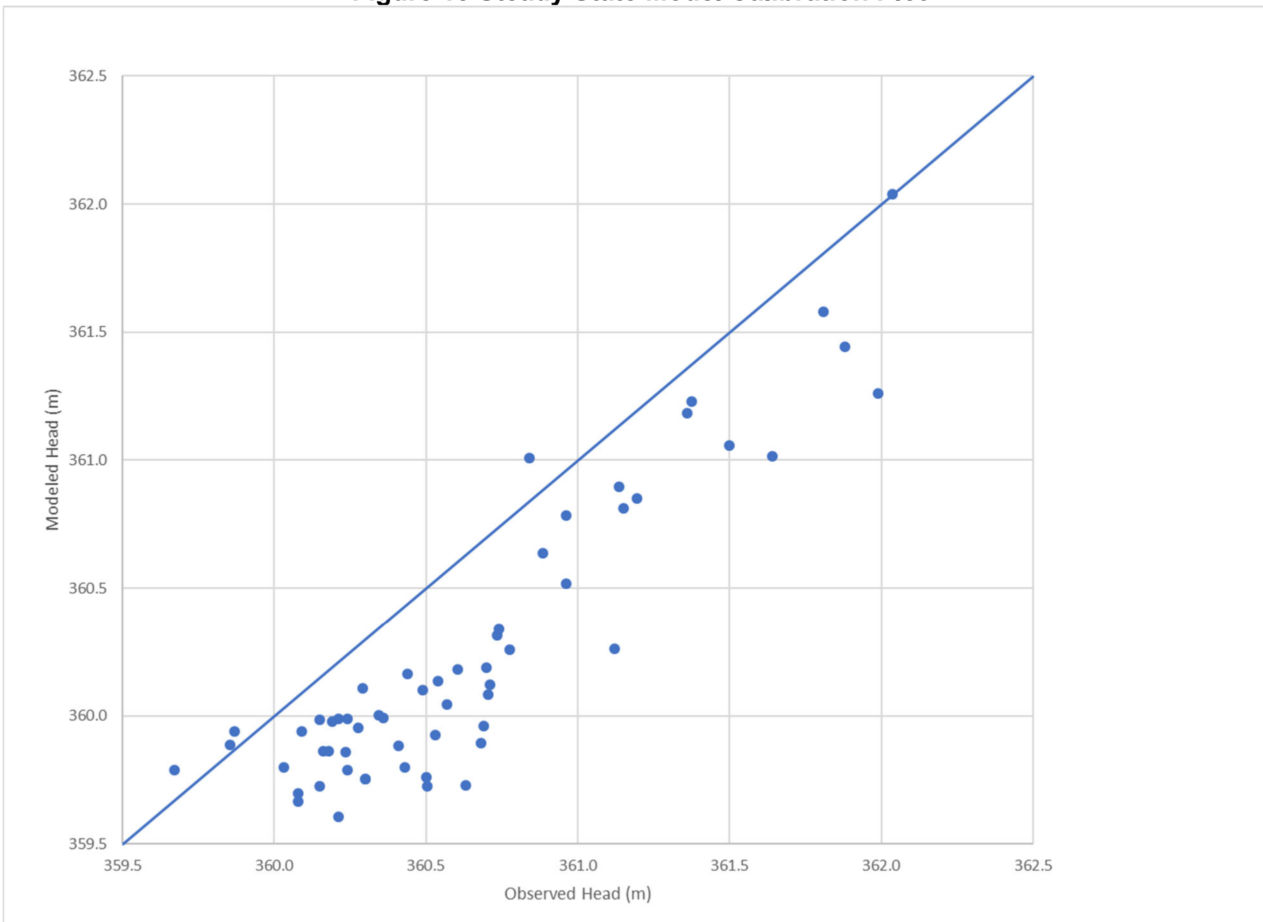


Figure 16 Simulated Potentiometric Surface

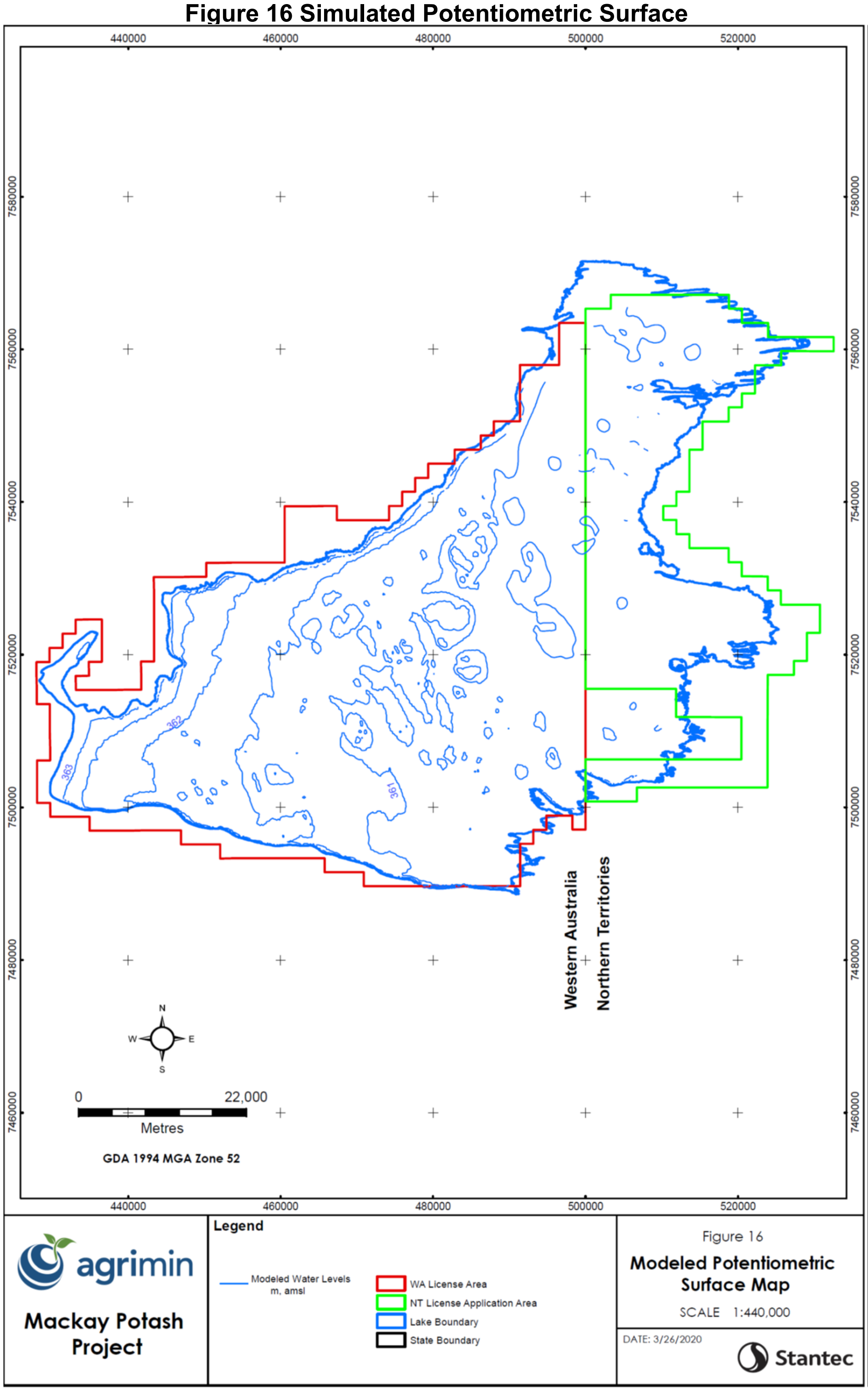


Figure 17 Lake Mackay Brine Mining Units (BMUs)

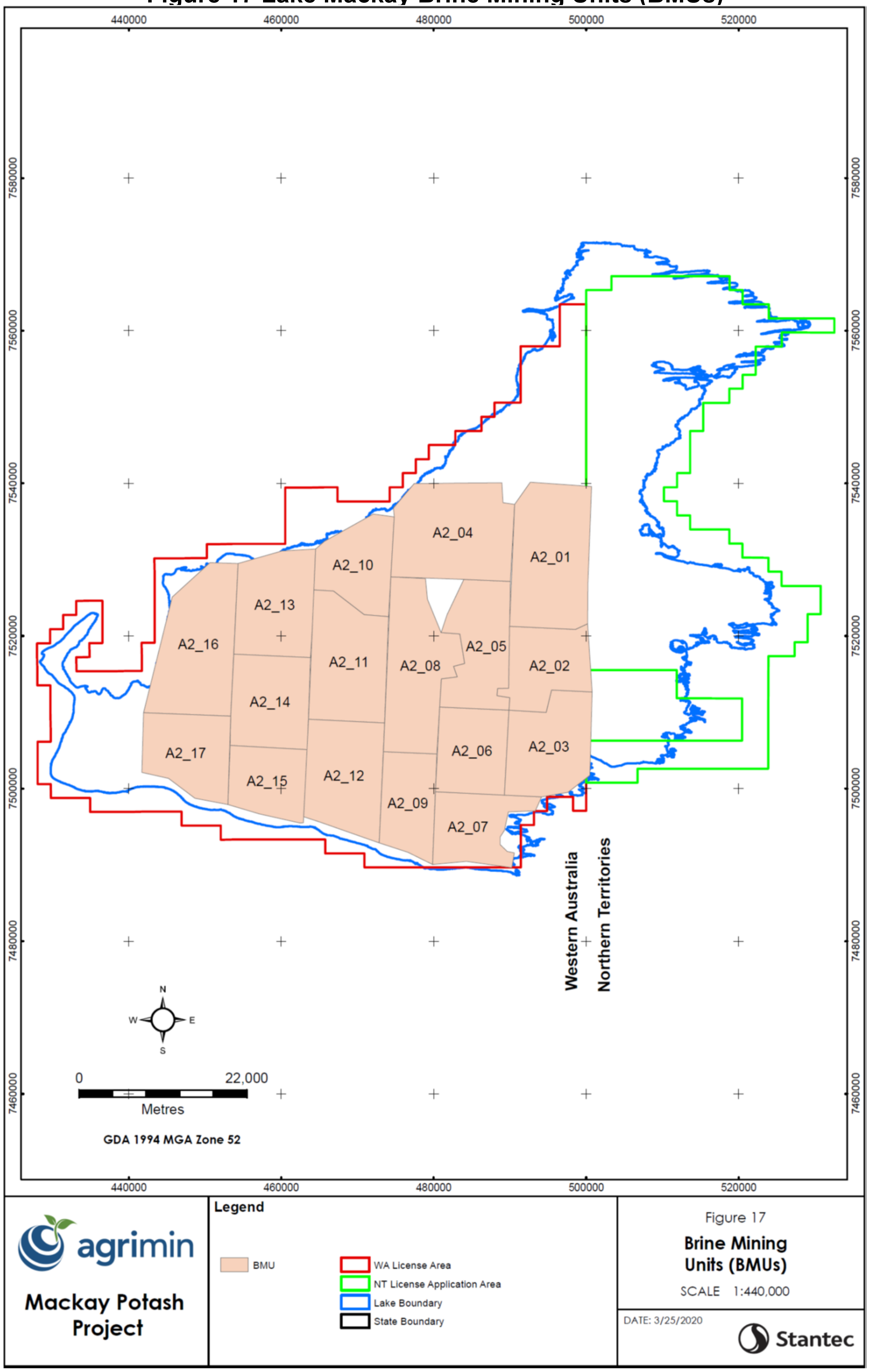


Figure 18 Predictive Model Domain

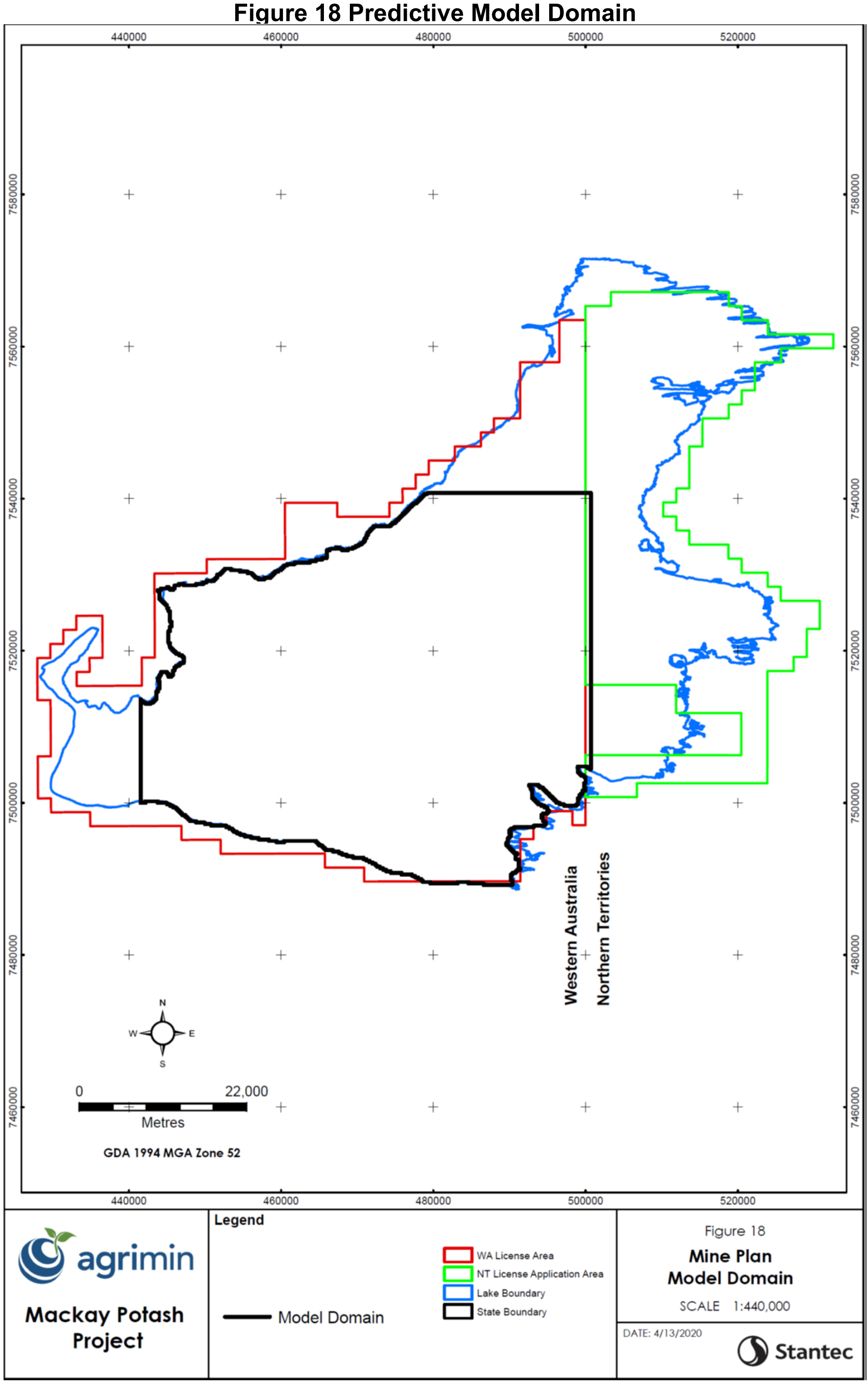


Figure 19 Mine Plan Simulation Results – Annual SOP Production

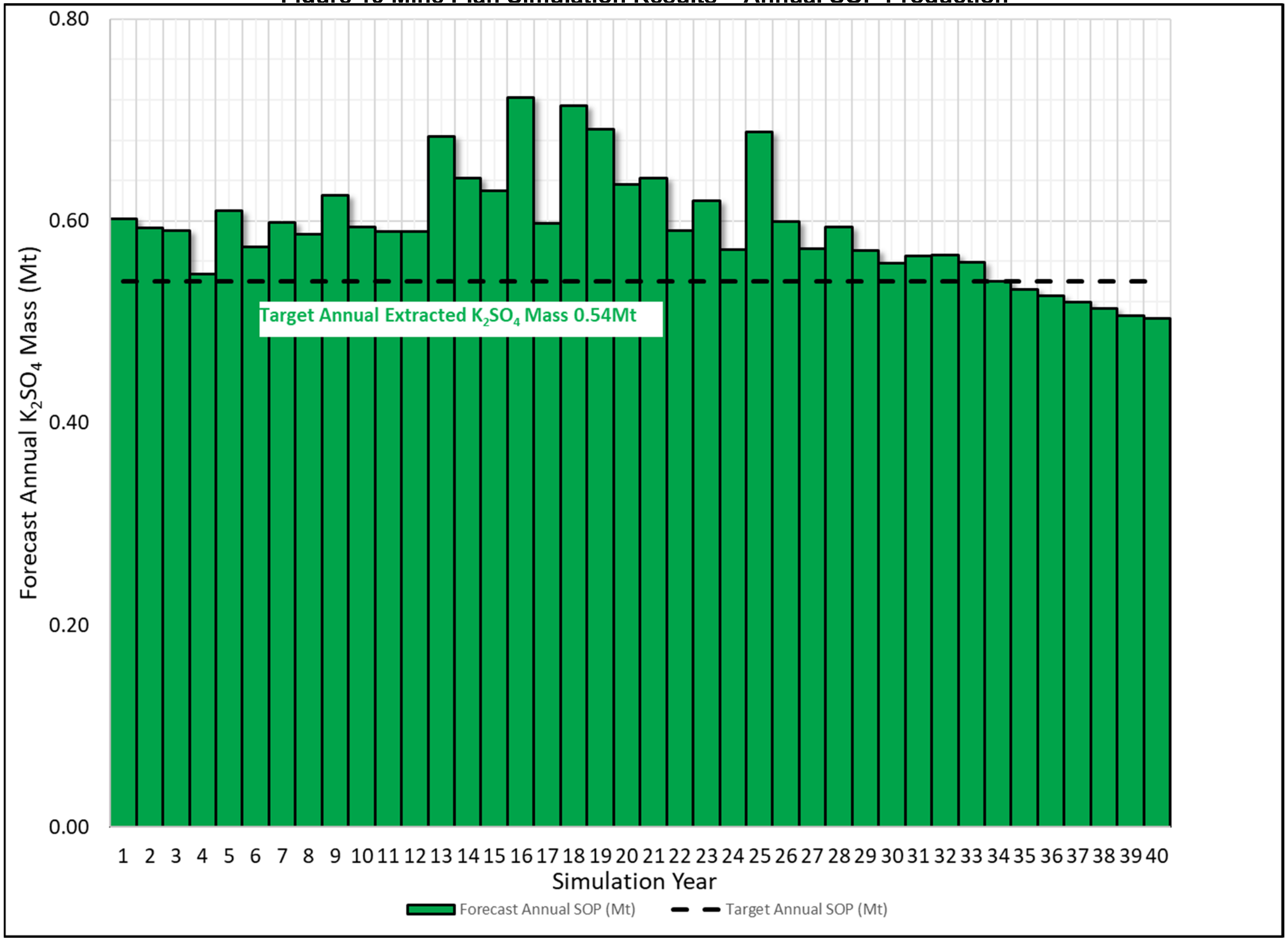


Figure 20 Mine Plan Simulation Results – Cumulative SOP Production

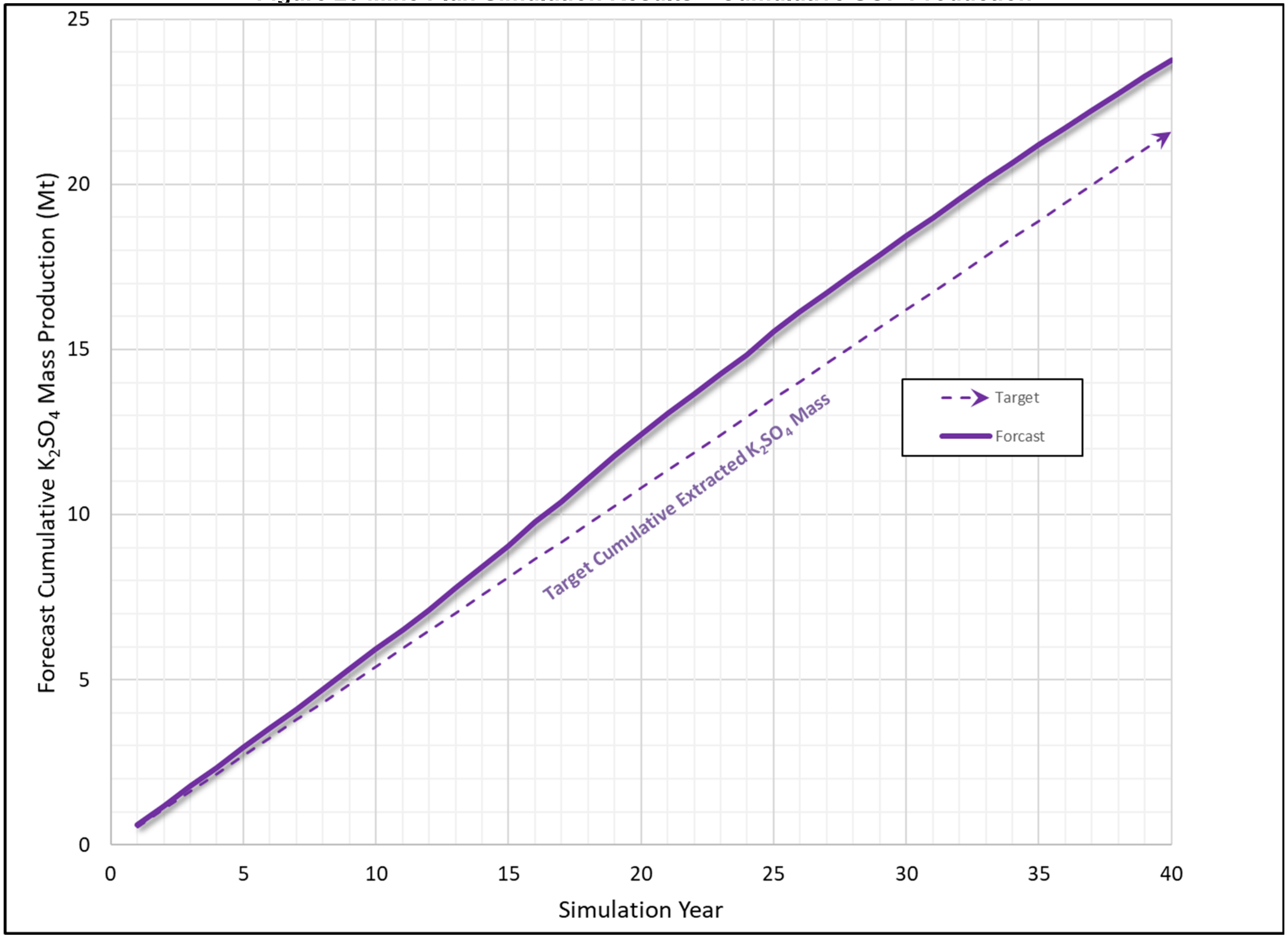


Figure 21 Mine Plan Simulation Results – Annual Flow Rate and Brine Grade

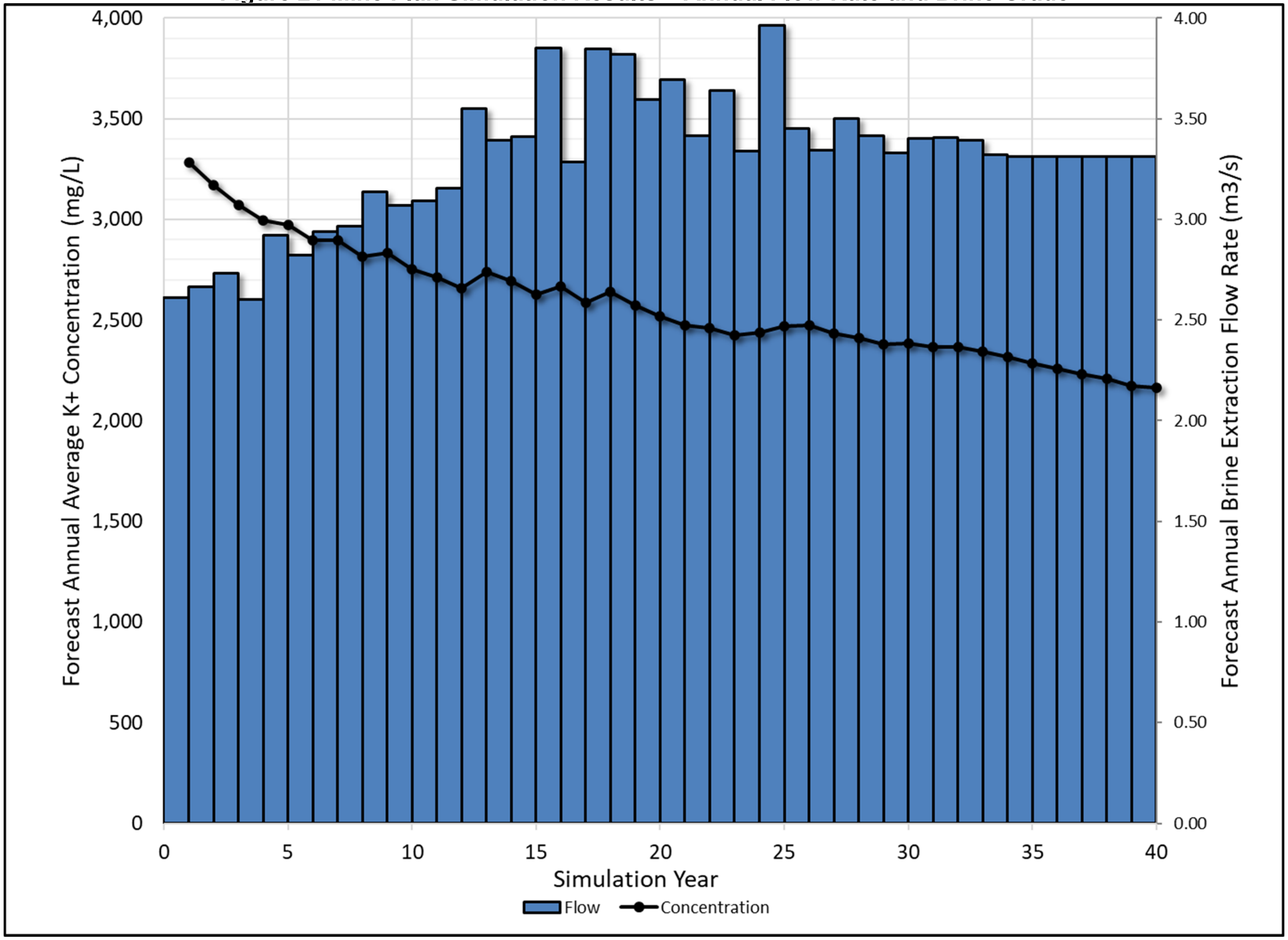


Figure 22. Balanced Annual SOP Production and Flow-Adjusted Brine Grade

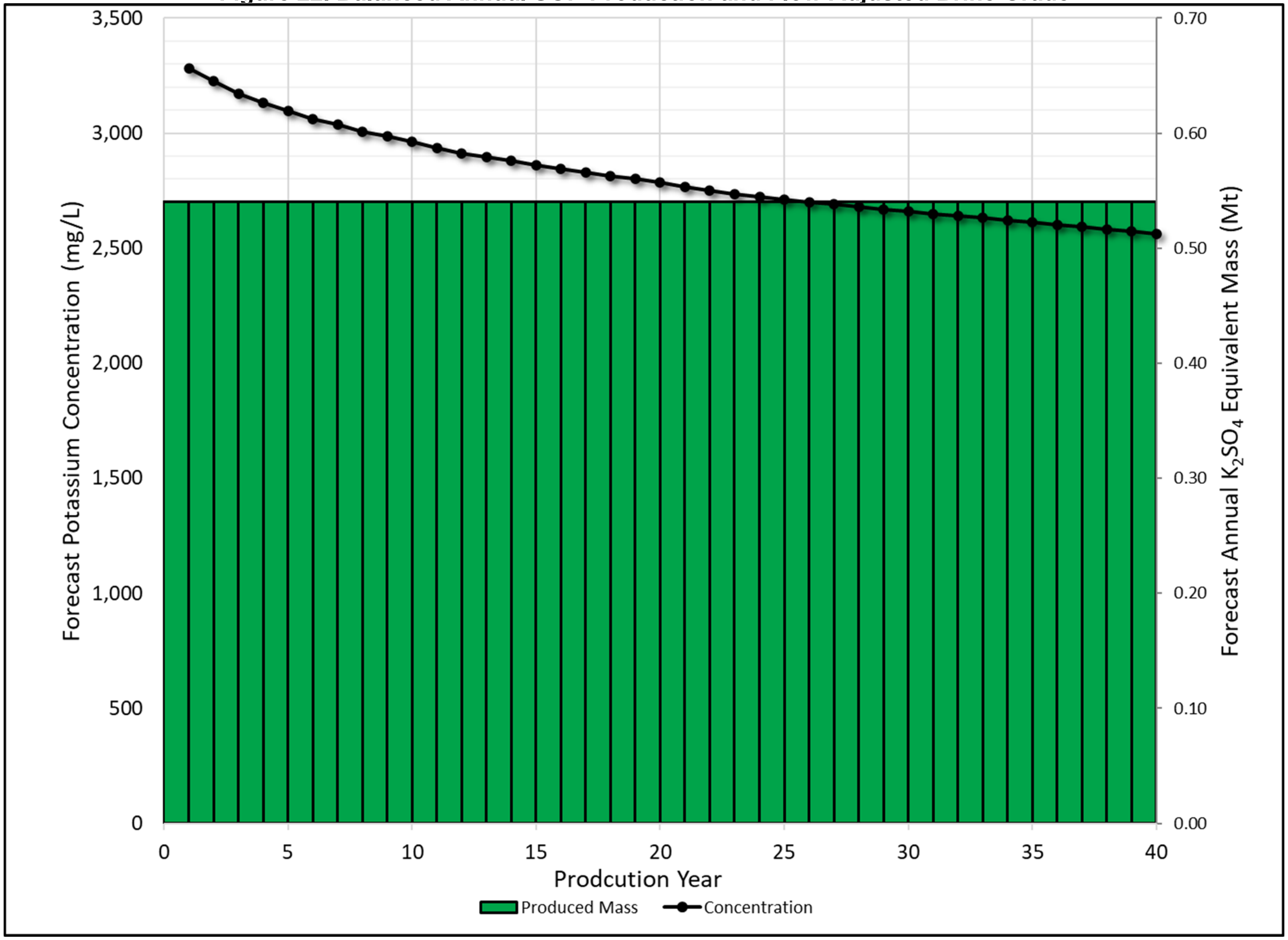


Figure 23 Mine Plan Simulation Sensitivity Results – Annual SOP Production

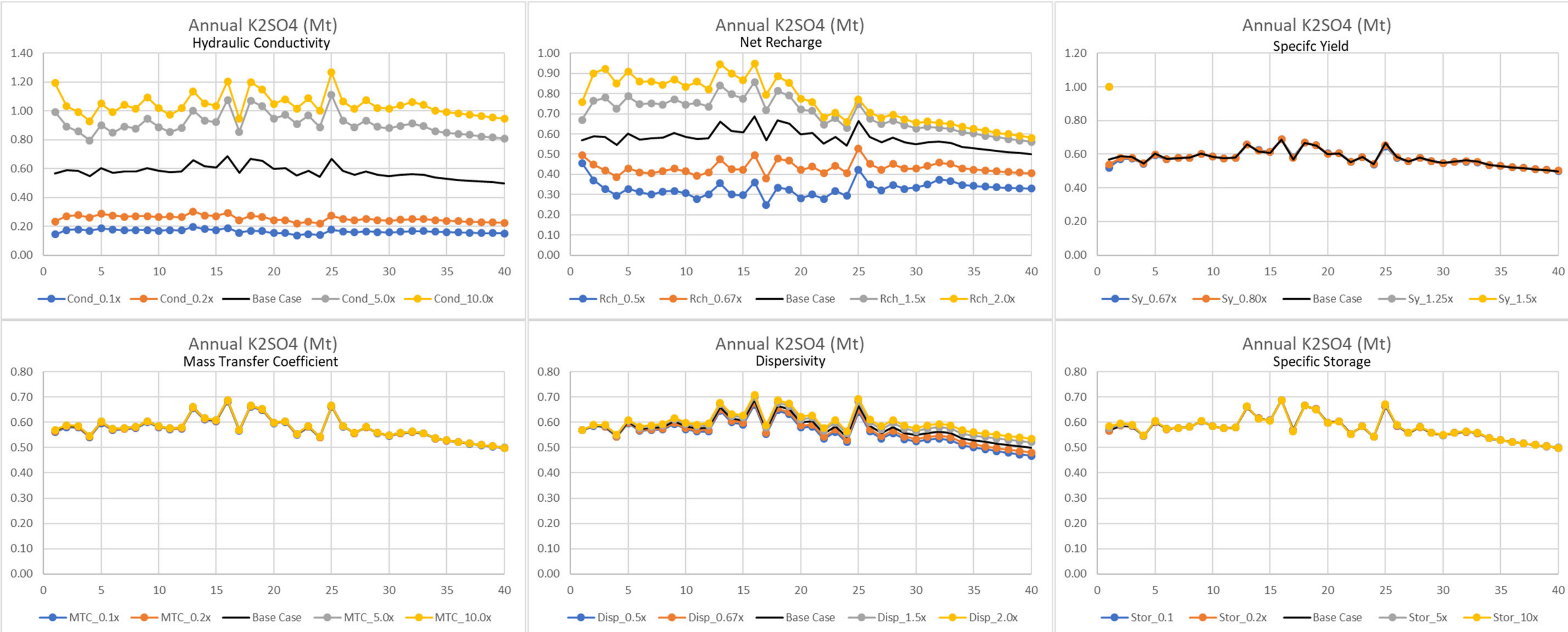


Figure 24 Mine Plan Simulation Sensitivity Results – Cumulative SOP Production

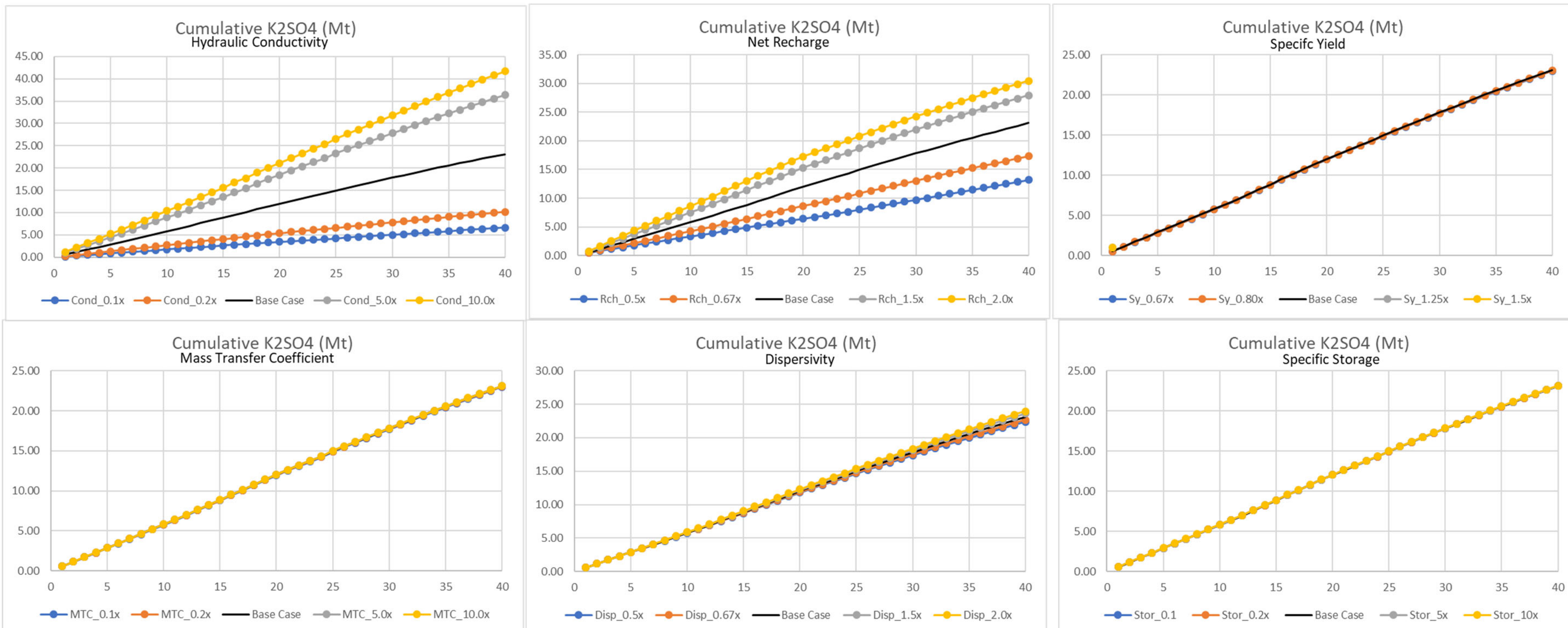


Figure 25 Mine Plan Simulation Drought Sensitivity Results – Annual and Cumulative SOP Production

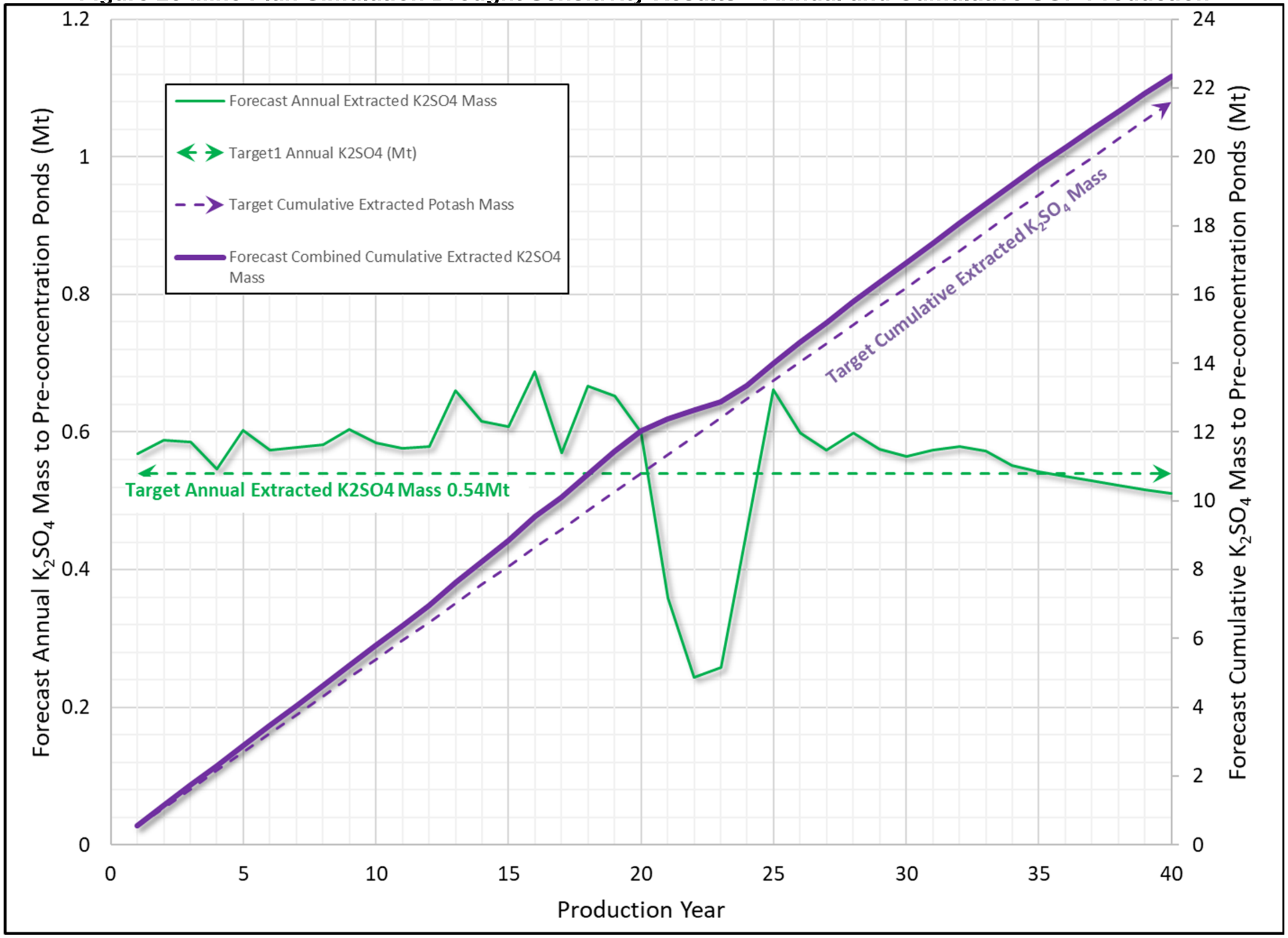
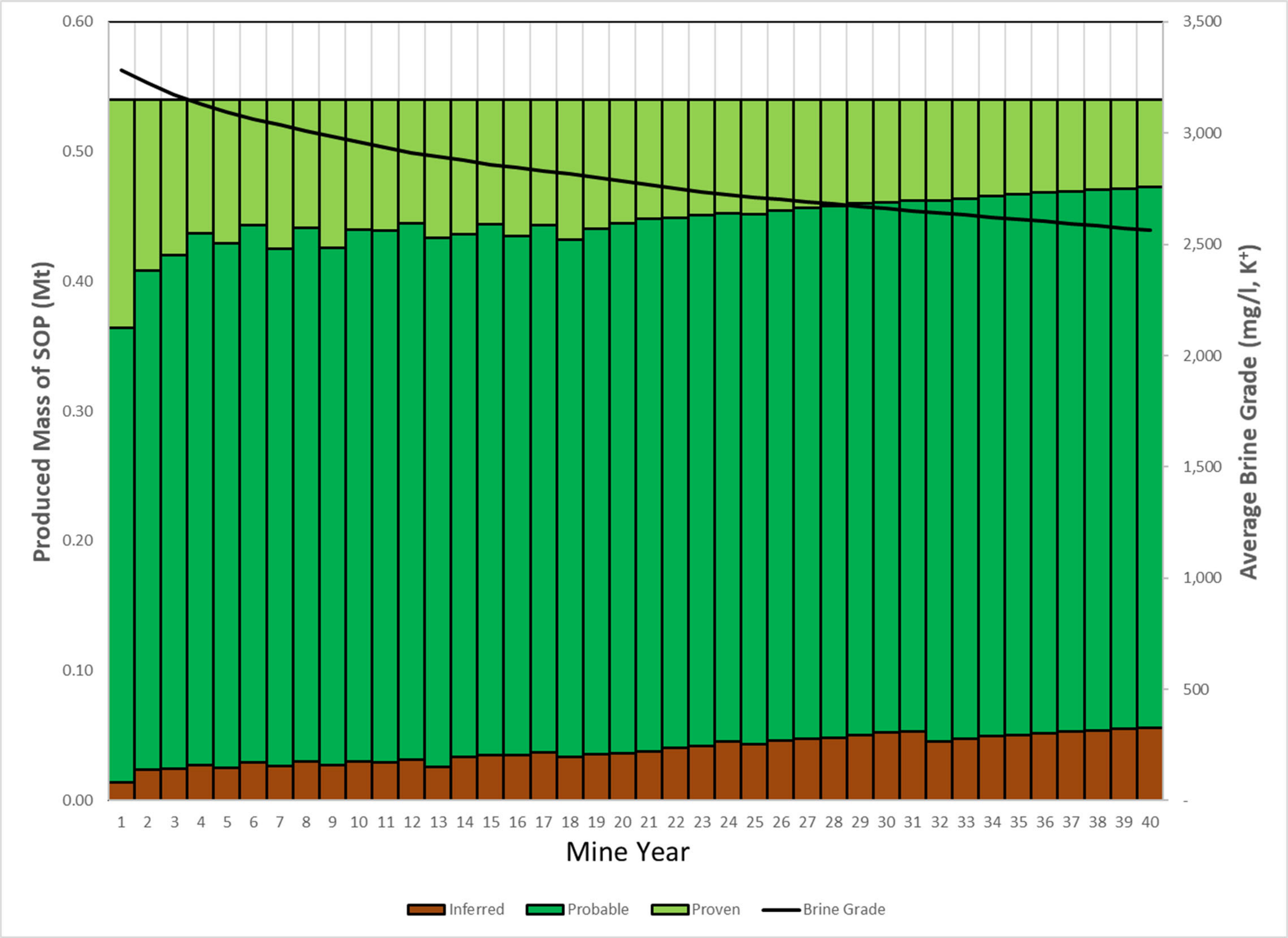


Figure 26 Annual SOP Production by Reserve Category



Appendix A STANTEC GAP ANALYSIS REPORT

Lake Mackay Sulphate of Potash Project

Phase I Definitive Feasibility Study – Gap Analysis

October 4, 2018

Prepared for:

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Revision	Description	Author		Quality Check		Independent Review	
0	Document Preparation for Final Report	Derek Loveday Rick Reinke Larry Henchel	10/1/18	Larry Henchel	10/3/18	Greg Gillian	10/4/18

Sign-off Sheet

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Prepared by ____

Derek Loveday and Richard Reinke

Reviewed by ____

Lawrence Henchel

Approved by ____

Greg Gillian

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E.0 EXECUTIVE SUMMARY

Norwest Corporation (Norwest), now Stantec Consulting Services, Inc. (Stantec), has completed a gap analysis of the technical information provided by Agrimin Limited (Agrimin) for the Lake Mackay Sulphate of Potash (SOP) project. This report forms part of Phase 1 of the Definitive Feasibility Study (DFS) for the Lake Mackay SOP project. The objective of this gap analysis is to identify additional technical data Agrimin would need to acquire to complete a DFS for the project.

This report includes an interdisciplinary review of the exploration, resource estimation, and hydrologic modeling work completed by Agrimin and prior operators and is based on data provided by Agrimin. Stantec was not charged with an evaluation of geotechnical or environmental considerations for the DFS; however, several geotechnical considerations relative to mine planning and design are enumerated in this report. Also not included in this report is a review of project economics and market studies that will drive the brine extraction plan (mine plan) in the DFS.

A description of the data provided and tasks performed during the gap analysis is enumerated in the main body of the report. A summary of additional technical information identified by Stantec as being required for the completion of a thorough DFS follows.

E.1 GEOLOGIC REVIEW

E.1.1 Documentation

The DFS document requires additional detailed descriptions of historic and current field sampling practices. Much of this information can be compiled from the draft report on drilling and laboratory testing (Hydrominex, 2016).

E.1.2 Geophysical Surveys

A passive seismic survey has been completed on the lakebed, and additional passive seismic and gravity surveys are currently being conducted. Additional deep wells to solid unweathered basement are required for calibration and correlation of the geophysical survey results. At least three (3) additional holes are deemed necessary to provide relevant information on the basement surface occurrence. These holes would be multi-purpose, in that brine and core assay data acquired from these holes will increase confidence in both the shallow and deeper brine resource. Additionally, basement aquifer water levels, which these wells will provide, are required to determine the basement upflow component of the water balance in the site conceptual hydrologic model. Previous numerical model studies indicated that basement upflow may account for as much as 50% of the water balance during mining. Accurate assessment of basement upflow will be required for reserve determination and mine planning.

E.1.3 NMR Geophysical Logging

Nuclear magnetic resonance (NMR) logging of existing cased wells and any future infill drill holes should be included in the exploration database for the DFS if the tool can be made available at reasonable cost in Australia. The obtained information would include downhole profiles of moisture content, porosity, permeability, specific yield, and wet-dry formation density. These parameters can be compared with direct laboratory measurements of core samples for accuracy and can be utilized to identify marker beds that may impact the hydrologic modeling.

E.1.4 Infill Drilling

It is Stantec's opinion that a robust DFS should include at least 25% Measured resource comprising the total reserve base (Measured plus Indicated resources). This Measured fraction would require approximately 30 additional sample points to a depth of approximately 4.5 meters (m) from surface[1] within current Indicated resource areas, using current industry guidelines (Houston et al., 2011). These infill sample points could be created using either borings or small test pits, several meters in breadth by 4.5 m in depth bgs, and would preferably be located in areas of first production in the anticipated brine extraction plan. Selection of a contiguous area close to the shoreline and project infrastructure would facilitate the program and cut costs.

Undisturbed samples should be extracted using Shelby tubes if drilling methods are used for an infill program. Data collected from the undisturbed samples, combined with those from the basement delineation program, would be used to characterize physical and hydraulic properties of the lakebed sediments, including additional Sy data points across the lakebed.

E.1.5 Direct Specific Yield Measurement

Additional core sampling is required for direct laboratory measurement of specific yield (Sy). Valid Sy measurements are limited to eight (8) holes where testing was completed by Core Labs and the British Geological Survey (BGS). Additional Intertek Sy sample test results, as described by Hydrominex (2016), appear to be inaccurate and should not be used for DFS resource and hydrologic modeling. These additional core samples could be obtained from the recommended basement delineation holes or any new infill drill holes. Sampling should be performed in conjunction with NMR logging, if possible, so results can be correlated to lab measurements. Undisturbed core samples (Shelby tube) should be acquired from a minimum of three (3) locations with an objective of sampling each distinct hydrostratigraphic unit to a depth of 4.5m. The Sy characterization of these units may be applied to other unsampled locations with suitable hydrostratigraphic definition, thereby increasing the relative assurance of Sy values extrapolated across the lakebed resource area.

E.1.6 LiDAR Survey

A light detection and ranging (LiDAR) survey is the preferred method of topographic survey that would provide the necessary resolution required for accurate determination of groundwater levels, the construction of a regional potentiometric surface for steady state numerical model calibration, and for mapping of islands to DFS standards. It will also be required for any accurate civil or mining engineering performed on or off of the lakebed to the level of a DFS report.

E.1.7 Reward Drill Hole Results

Historical drilling results from early project development (2007 to 2014) by Reward Minerals Ltd (Reward) have not been included in the Agrimin PFS. Brine assay data from these holes shows acceptable ion balance after chloride results are adjusted by one order of magnitude. This is probably a clerical error in reporting of brine chemistry from

[1] The depth of the currently defined shallow brine resource.

the labs but will require further investigation in future phases. Consideration should be given to including these drill hole results for future DFS resource modeling with additional validation and proper disclosure in reporting.

E.1.8 Brine Extraction Sample Results

Brine extracted from cores using a centrifuge produced higher grades than bailed/pumped brine samples. These higher grades were adjusted using top cuts for modeling of vertical variations in brine grade. It is Stantec's opinion that these samples should not be used for the DFS grade models. Only brine samples extracted from isolated well completions should be used for accurate modeling of vertical variations in brine grade.

E.1.9 2D Grid Versus 3D Block Modelling

A 2D grid model is considered sufficiently accurate and less complex that a 3DBM for this style of deposit. A gridded surface model is well suited for the nature of the drilling performed on the lakebed to date and is more readily transferred into the hydrologic numerical model. Hydrogeologic resource modeling and reporting from a 2D grid model should be considered for the DFS.

E.2 HYDROLOGIC REVIEW

E.2.1 Detailed Trenching and Monitoring Program

A focused and detailed trenching, monitoring and bulk sampling (trial mining) program should be implemented as part of the DFS. Two (2) test sites, one representing the west-side clay-rich zone and another on the east side nearby lakebed islands should be sufficiently representative of the overall hydrostratigraphic regime on the lakebed. Careful planning of locations and successful implementation may eliminate the requirement for infill drilling to increase resource confidence to Measured. These test sites should also include collection of detailed hydrologic information described elsewhere in the report including a basement well completion and collection of data on recharge of the brine aquifer during the rainy season.

E.2.2 Field and laboratory Testing of Aquifer Recharge

Laboratory column testing of brine cores to determine the impacts of surface meteoric water on brine grade should be included. Field monitoring of changes in brine grades during the rainy season should also be conducted to determine this component of the site conceptual hydrologic model for input into the numerical groundwater model used for reserves determination and mine planning.

E.2.3 Impact of Islands on Potassium Concentration

The potential flow of low-grade brine from beneath the lakebed islands to the trenches during mine production should be tested. Although brine beneath these islands is not included in the resource, low grade brine will likely flow toward the production trenches over the life of the mine.

E.3 MINE PLANNING AND RESERVE DETERMINATION REVIEW

The evaluation of the PFS mine plan indicates that additional planning effort needs to occur to optimize trench placement and create a compartmentalized extraction system for increased flexibility of operations. The extraction system should be based on an updated numerical flow and transport model to determine accurate production schedules and to accurately determine the quantity and grade of brine that will be delivered as available (pre-evaporation) reserves.

Stantec was not tasked with the adequacy assessment of current geotechnical testing; however, it is worth commenting that the geotechnical data to be used in the DFS-level construction of trenches, impoundments, buildings and other infrastructure needs to be as thorough and robust as in all other discipline areas.

E.4 CONCLUSIONS

Information identified in this gap analysis and assessment of hydrogeologic and brine resource data encompasses the following summary items:

- Additional procedural documentation.
- Additional drilling and/or test pitting.
- NMR logging.
- LiDAR survey.
- Additional laboratory work (brine geochemistry, Sy and column tests)

Information to support DFS-level hydrologic modeling, mine planning and reserve estimation encompasses the following:

- Detailed trenching and monitoring program (trial mining)
- Additional testing to characterize recharge from seasonal rainfall
- Basement delineation (paleo-channel investigation if warranted)
- Accurate playa-wide water level measurements
- Measurement of brine grade effects from extraction near islands
- Thorough collection of geotechnical data required for trench and berm design and project infrastructure siting

It is Stantec's best professional judgement that the additional data acquired based on the recommendations in this document along with data acquired for the PFS and the current trench testing program will be sufficient to develop a numerical groundwater flow and transport model for DFS level mine planning and potential reserve determination. The assumptions and level of detail in the current hydrologic model and mine plan, while sufficient for a PFS level study, will require considerable refinement for a DFS-level mine plan and potential reserve determination.

Abbreviations

~	Approximately
<	less than
>	greater than
Agrimin	Agrimin Limited
bgs	below ground surface
BGS	British Geological Survey
DFS	Definitive Feasibility Study
EM	Electromagnetic
km	Kilometer
LiDAR	light detection and ranging
meters	Meters
mg/l	milligrams per liter
Norwest	Norwest Corporation
PFS	Pre-feasibility Study
K	Potassium
NMR	Nuclear magnetic resonance
SOP	Sulphate of Potash
Stantec	Stantec Consulting Services, Inc.
Sy	Specific yield
XRD	X-ray powder diffraction

1.0 INTRODUCTION AND SCOPE

Norwest Corporation (Norwest) now Stantec Consulting Services, Inc. (Stantec) was engaged by Agrimin Limited (Agrimin) to complete a gap analysis of the technical data required for Agrimin to complete Phase I of a Definitive Feasibility Study (DFS) on their Lake Mackay Sulphate of Potash (SOP) project. Agrimin has recently completed a Pre-Feasibility (PFS) for the Lake Mackay SOP project and is currently engaged in an ongoing trenching and monitoring program, as well as upcoming geophysical surveys for basement mapping.

This gap analysis includes an interdisciplinary review of the exploration, resource estimation, and hydrologic modeling completed by Agrimin and prior operators on the property and is based on data provided by Agrimin. Stantec was not charged with an evaluation of geotechnical or environmental considerations for the DFS; however, several geotechnical considerations relative to mine planning and design are enumerated in this report. Also not included in this report is a review of project economics and market studies that will drive the brine extraction plan (mine plan) in the DFS.

As part of an information gathering exercise for this report, Stantec representatives Mr. Larry Henchel, Vice President Geologic Services, and Rick Reinke, Manager Water Resources and Senior Hydrogeologist, completed a site inspection of the project area in August 2018. This report is compiled by Mr. Derek Loveday, Stantec Project Manager, and Mr. Rick Reinke.

This gap analysis report is separated into the following logical components for clarity:

- Provided data
- Exploration data
- Resource estimation
- Hydrologic modeling
- Conclusion.

Stantec performed the following tasks to meet the objectives of this report:

- Completed a site inspection of the project area
- Reviewed technical reports and press releases
- Reviewed the project's exploration database and geohydrologic models
- Performed statistical evaluation of the exploration database
- Reviewed geophysical exploration methods and interpretations
- Spatially referenced exploration data and provided maps to be manipulable in AutoCAD
- Imported drill holes, downhole attributes and geologic model into MineSight 3D software
- Reviewed regional Geoscience Australia reports on geology, hydrogeology, and conceptualization of salt lakes and paleo-channels
- Reviewed results of several pumping tests from the current trench testing program
- Researched methods for quantifying recharge and geochemistry in the unsaturated zone

A discussion of the reviewed project elements and recommendations on additional technical information required for the completion of a robust and thorough DFS is included in the following sections. These recommendations are based on our past experience with brine-hosted mineral deposits and on our knowledge of the detail required for DFS reporting, which should approach a +/- 15% accuracy level.

2.0 PROVIDED DATA

The following data was provided to Stantec by Agrimin for review.

- Trench and test pit testing and monitoring results.
- Well monitoring results.
- Drill hole log, brine assay and sediment (core) test results.
- Site photos.
- Lake water levels.
- Knight Piesold hydromodel files.
- Project area maps.
- Geophysical survey results and reports.
- Resource block model.
- Resource model database.
- Project area GIS database.
- Agrimin and Rum Jungle Press release.
- Agrimin-Hydrominex 2016 Draft Technical Report (2016 Technical Report).
- Agrimin May 2018 PFS.
- Technical reports by Knight Piesold, Hydrominex and H&SC Consultants.

A list of specific reports and publications is provided in Section 9 of this report.

3.0 SITE VISIT

Larry Henchel, P.Geo., V.P. Geological Services, and Rick Reinke, P.Geo., Manager, Water Resources, visited the Lake Mackay SOP Project from August 7, 2018, through August 10, 2018. Several test locations across the area were visited, and debriefings and discussions of data acquisition methodologies and opportunities were conducted at the end of each day.

Norwest arrived at Kiwirrkurra airstrip on August 7, 2018, and were flown by helicopter to the Agrimin Lake Mackay camp. Michael Hartley, Agrimin Project Manager & Principal Hydrogeologist conducted a site safety orientation and overview of the project history upon arrival. The camp site contained a helicopter pad with laydown and shop areas, an office trailer with onsite lab facility, a dining tent/conference room with attach kitchen facilities, sleeper trailers, and shower/bathroom facilities. The pilot pond area was also visited on this day. This area consisted of several HDPE lined ponds for conducting evaporation studies, several test trenches, monitoring wells, and a weather station.

Trench test locations T1, T16, and T18 were visited on August 8, 2018. The pumping test at trench T1 was ongoing at the time of the site visit. Monitoring well data was downloaded, manual water level measurements were collected, and observations were made of the shallow lithology in the trench and the conditions at the pump discharge area. The TORO exploration wells in the tenement south of Lake Mackay were also visited on August 8, 2018. Manual depth to water measurements were collected from these wells, and pressure transducer data was downloaded.

On August 9, 2018, trench test location T6 was overflown on the way to visit trench test location T20. The pumping test at T20 had been recently completed, and observations were made of trench condition and the pumping test discharge area. On this day, the excavator was in route to location T13. A test pit was dug at the location of the excavator, and observations were made of shallow lithology and flows into the pit. Of particular interest at this test pit was the presence of a layer of large gypsum crystals at a depth of approximately 3 to 4 m bgs, from which considerable amount of brine flowed to the test pit. Trench test location T13 was then visited. T13 is located near one of the large islands in the east area of the playa. Monitoring well MC13 located on this island was visited along with several other monitoring wells on the playa (MC12 to MC17). Depths to water were measured at several of these monitoring wells.

August 10, 2018, consisted of driving to the Kiwirrkurra airstrip for the flight to Alice Springs. A debriefing meeting was held with Tom Lyons, Agrimin General Manager and Michael Hartley, in Alice Springs.

4.0 EXPLORATION DATA

The reviewed exploration data collected by Agrimin includes most of the necessary components required for SOP resource and reserves determinations for a DFS. Areas that were identified as requiring more data and/or supporting documentation are outlined below.

4.1 DOCUMENTATION OF FIELD SAMPLING METHODOLOGY

The PFS did not have sufficient documentation of field sampling methodology and handling of samples from the field to the laboratory. Different sampling methods, for example isolated interval brine sampling versus complete hole (mixed) brine testing, will have a material impact on the accuracy of the resource-reserve estimate and should be documented in a DFS.

It is noted that the 2016 Technical Report completed prior to the PFS (Hydrominex, 2016) included pertinent information on exploration methods and testing that was either included in summary form in the PFS or omitted. These 'missing' details should be included in the DFS.

4.2 GEOPHYSICAL SURVEYS AND CORRELATION DATA

The application of geophysical survey methods such as electromagnetic (EM), gravity and passive seismics for the imaging of the basement topography for paleo-channel mapping is viewed as appropriate for this task. Passive seismic and gravity geophysical surveys are currently being conducted at the project site. However, the proof of concept passive seismic survey report completed by Resource Potentials (Respot, 2018) stated the following: "More accurate depth constraints can be applied to the Lake MacKay passive seismic survey data in the future by acquiring additional passive seismic stations at drill holes that have intercepted basement, or drilling new holes that intercept basement next to passive seismic stations, for further 1D forward modelling to improve the average Vs value".

As such, drill hole records indicate only three (3) holes penetrating weathered (crystalline) basement lithologies (MA05 at 18m, MA03 at 18m and MA07 at 24m). A potential concern in this regard is the ability for the current drill hole data to provide adequate lithological data to correlate geophysical tools for accurate imaging of the basement floor.

At least three (3) deep core holes designed to penetrate true (unweathered) basement should be planned for selected areas of the playa for calibration of geophysical survey instrumentation and for comparison/correlation of results. Locations of these holes should be planned in conjunction with geophysical contractors as well as be in areas identified as most representative of the typical hydro-stratigraphy encountered below the lakebed. These holes would be multi-purpose in that brine and core assay data acquired from these holes will also increase both shallow and deep resource confidence. These wells will also be used to collect information that will help characterize the basement hydrologic regime as well as for use in reserve determination and mine planning.

4.3 NMR GEOPHYSICAL LOGGING

Nuclear magnetic resonance (NMR) logging of existing cased wells and any future infill drill holes should be included in the exploration database for the DFS if the tool can be made available at reasonable cost in Australia. The information obtained from these NMR logs will include downhole profiles of: moisture content, porosity, permeability, specific yield, and wet-dry formation density. The NMR logs can be correlated with direct core laboratory measurements of the above parameters to test for accuracy and be used for identification of marker bed signatures in lakebed sediments. For example, marker beds such as the brine-liberating gypsum crystal layers, observed during the Stantec site visit, could potentially be identified in the NMR-logs and correlated between holes. The widespread acquisition of NMR log data will better define horizontal and vertical variation in hydrologic parameters necessary for a DFS and may call for fewer infill drilling and sampling campaigns required for defining Measured resources.

4.4 INFILL DRILLING

Drill hole spacing is at approximately 5km spacing for most of the Agrimin-controlled tenements and is consistent with the Houston et al. (2011) benchmark guidelines for Indicated resources from immature salars. The Mackay lakebed sediments are interpreted by Stantec as belonging to the immature-type (clastic dominated) versus mature-type (halite dominated) using Houston et al. (2011) definitions. Using the same guidelines, an infill sampling program targeting an overall spacing of 2.5km to depths of at least 4.5m from surface[2] would be required to outline a Measured shallow resource.

It is recommended for a DFS-level project that, at a minimum, the Measured resource should comprise approximately 25% of the total available Measured plus Indicated resource. While this percentage is a subjective opinion of the authors, it is certain that having at least a portion of the reserve converted to the Proved assurance category from the Measured brine resource[3] adds confidence and value to the project., This infill sampling program would require approximately 30 sample points to achieve a 25 percent Measured categorization from the current PFS Indicated resource volume of 24,182 million m^3. These infill sample points could be created using either borings or small test pits, several meters in breadth by 4.5 m in depth bgs, the depth of the currently defined shallow brine resource, and would preferably be located in the areas of first production in the anticipated brine extraction plan. Selection of a contiguous area close to the shoreline and project infrastructure would facilitate the program and cut costs.

The above drill hole spacing is based on the Houston et al. (2011) guidelines and is not an objectively-based observation of the variability of the SOP resource parameters. The current data spacing (~5km) cannot determine short spaced, less than 5km, variations in resource parameters other than from very shallow data (to 1.5m bgs) collected from fence lines auger holes (PA-series)[4] . Observation of brine samples taken from these PA-series holes does not show materially significant changes in potassium grades over less than 5km; however, deeper (>1.5m) brine samples are not available for comparison.

Undisturbed samples should be extracted during any additional drilling, using Shelby tubes for additional physical and hydraulic laboratory characterization, particularly for Sy or column test parameters.

[2] Based on PFS shallow resource delineation by auger drilling to 4.5m bgs.
[3] Measured brine resource converts to Proved brine reserves, Indicated resources to Probable reserves.
[4] Between aircore holes MA09 and MA10.

4.5 DIRECT SPECIFIC YIELD MEASUREMENTS

According to the draft drilling and laboratory testing report (Hydrominex, 2016) there were significant differences in the specific yield (Sy) test results between Intertek and testing conducted by Core Labs and the British Geological Survey (BGS). It is understood from the 2016 report that there is uncertainty in the Sy results from Intertek due to poor correlation of Sy versus hydraulic conductivity, higher than expected sand content in the grain size distribution, and Intertek reporting almost twice the Sy (~8%) when compared to Core Labs/BGS (~4%). Observation of the Sy information presented in the PFS indicates that only Core Labs/BGS Sy results were used in the PFS hydrologic modeling, which would be the proper approach given the uncertainty in the Intertek values..

The Core Labs/BGS Sy results from the 2016 report are perceived to be accurate, although apparently derived from only eight (8) drill holes distributed predominantly within the central and eastern portions of the Agrimin tenements. Additional direct measurements of Sy from undisturbed (Shelby tube) samples are deemed necessary to fill in gaps in the Sy data distribution across the lakebed and to improve confidence in the values used for resource and reserve estimation.

Additional core samples could be obtained from the recommended basement delineation holes or any new infill drill holes. Sampling should be performed in conjunction with NMR logging, if possible, so results can be correlated to laboratory measurements. Undisturbed core samples should be acquired from a minimum of three (3) locations, with the objective of sampling each distinct hydrostratigraphic unit occurring to a depth of 4.5m.The Sy characterization of these units may be applied to other unsampled locations with suitable hydrostratigraphic definition, thereby increasing the relative assurance of Sy values extrapolated across the lakebed resource area. Core currently stored in Perth could be logged with a renewed objective of establishing discreet hydrostratigraphic horizons. Testing of stored cores for Sy determination is not recommended due to the uncertainty of the physical condition of cores being maintained after long-term storage. The same laboratories (Core Labs/BGS) should be used for continuity with the existing Sy data set.

4.6 LIDAR SURVEY

Topographic data used for the PFS resource model was limited to elevation data on a 500 m grid spacing. Surface topography data used for the PFS would need to be improved for DFS-level accuracy. A light detection and ranging (LiDAR) survey would provide the surface resolution required for a DFS and post-DFS construction. Small changes in elevation could have significant influence the inputs into hydrologic model used in mine planning and reserve determination and would also more accurately map the island and lakebed boundary limits. The accuracy of a LiDAR survey will also be required for any accurate civil or mining engineering performed on or off the lakebed.

5.0 RESOURCE ESTIMATION

5.1 REWARD DRILL HOLE RESULTS

The list of drill holes used in the geologic model do not include the Reward program LM series holes, totaling twenty-two (22) holes. This is not to be confused with the LMA series of eleven (11) holes that are listed in Table 5.1 of the PFS as LM holes. The provided database shows the Reward LM series holes varying in depth from 1.0m to 4.8m and averaging 2.5m. The brine chemistry for these holes in the provided database (MACKAY_DATABASE_2017_0517.xlsx) is believed to have incorrectly reported chlorides. When Stantec increased the reported chloride concentrations by one order of magnitude (x10) the resulting ion balance was calculated to be acceptable (< 5% variance) and similar to the ion balance test results from Intertek. These Reward LM series results should be considered for subsequent resource modeling if other relevant data such as laboratory testing methods are available and field testing procedures are documented. Note, the specific gravity measurements for the LM -series holes are reported with too low of a precision (1 or 2 significant digits) to be included for resource modeling.

The accreditation of the laboratory that performed the Reward brine geochemical testing should be investigated. It seems likely that the laboratory employed by Reward was an environmental testing facility; these types of laboratories are typically not equipped to test the high salinities involved with enriched mineral brines. Our experience has shown that the cation components in this situation are typically accurate and that the ionic components (SO_4^{2-}, Cl^{-}) are the most affected by the testing process. Adjustment of the anion values to achieve overall ion balance can be performed, with appropriate documentation, in order to use the adjusted values in the resource/reserve modeling.

5.2 BRINE EXTRACTION CENTRIFUGE SAMPLING

It is understood from recent email correspondence between Agrimin (Tom Lyons) and Stantec dated September 13, 2018, that in order to obtain brine assay results at specific depth intervals, the brine samples were extracted using a centrifuge from sediment (core) samples. A top cut of 7,000 milligrams per liter (mg/l) potassium (K) was applied to these brine extraction (centrifuged) samples as these had consistently higher potassium values than the bailed or pumped samples. Though these extraction samples represent a small set of the overall brine assay database used for modeling, the inclusion of these top cut samples for a DFS should be avoided until more research is undertaken as to why these samples report higher grades and what, if any, factorial relationship there is between these brine extraction samples and adjacent bailed/pumped samples. Vertical grade profiling should be modeled using samples extracted from isolated well completions only.

5.3 DEFINING A MEASURED RESOURCE

It is Stantec's opinion that given certain conditions a Measured resource might be delineated using existing borings and sample points. Using the classification system of Houston et. al. (Houston, 2011), Measured brine resources are defined by points of observation/sampling on 5,000 m centers, implying a 2,500 m area of influence. It appears that the Competent Person representing the PFS resource estimates was hesitant to classify a Measured resource partly based on inadequate Sy results at that time. Given a measurement of brine potassium within the shallow resource zone, and either a valid measurement of Sy or an extrapolated value based on suitable definition of hydrostratigraphic units, a number of these areas of influence may be classified as Measured. A better distribution and understanding of Sy values across the lakebed and within the shallow resource should permit the delineation of a Measured resource using the 2,500 m areas of influence.

This method of classification has been referred to as the “spotted dog” or “egg yolk” approach, so named due to the geometry of numerous isolated circles within certain assurance category areas. An assessment of relative continuity of brine grade and Sy between these non-contiguous areas would need to be performed to ascertain the amount of Measured resource that might be achievable with this approach.

5.4 2D GRID VERSUS 3D MODELING

The PFS geologic model used for reporting resources was a 3D block model. Attempts to model vertical variability of the brine aquifer properties using a 3D block model may not produce the desired vertical stratification actually observed in the exploration records due to smearing of grade estimates. A 2D grid model is considered sufficiently accurate and not unnecessarily complex for this style of deposit, and is well suited for the nature of the drilling performed on the lakebed to date. Additionally, 2D gridded surfaces are more readily transferable into the hydrologic numerical model. Hydrogeologic resource modeling and reporting from a 2D grid model should be considered for the DFS.

6.0 HYDROLOGIC INFORMATION FOR MODELING

The information and reports provided by Agrimin and the current ongoing field program were reviewed in terms of information required for the site conceptual hydrologic model and numerical model inputs required for mine planning and determination of reserves.

6.1 CONCEPTUAL HYDROLOGIC MODEL

A conceptual hydrologic model summarizes the input and output components of the water balance of a hydrologic system and the hydrologic properties governing flow through the system. The conceptual model is used to determine which components to include in development a numerical model on the site and how these components are represented as boundary conditions and select hydrologic properties in the numerical model. Inputs to the Lake Mackay SOP Project water balance include infiltration of precipitation, potential inflow from paleo-channels, potential upflow from basement aquifers, and surface water inflow from nearby drainages. Outflows include evapotranspiration from the brine water table, potential losses to paleo-channels and the basement aquifer, brine outflow to nearby surface water drainages, and trench production during mining operations. Recharge from infiltration of precipitation, evapotranspiration from the brine water table, potential inflows from paleo-channels and the basement aquifers, and trench production are likely the largest components of the Lake Mackay SOP Project water balance. Any outflows to paleo-channels, the basement aquifer, and nearby surface water drainages are likely to be localized and intermittent and would not be significant water balance components of the conceptual hydrologic model. All of the above elements will have to be understood and quantified as much as possible to improve the accuracy of the DFS model.

6.2 NUMERICAL GROUNDWATER MODEL

Mine planning and reserve determination from a brine resource requires the development of a numerical groundwater flow and transport model to represent the site conceptual model. Individual conceptual model components are represented as boundary conditions in the numerical model. The magnitude and rate of flows through the groundwater system are governed by the hydraulic and storage properties of the modeled aquifers and the unsaturated zone and natural or induced groundwater head gradients in the system. Chemical transport parameters also govern the flow of brine within the groundwater system and how brine is assimilated into recharge water as it percolates through the unsaturated zone to the water table. Hydraulic information collected during prior field programs and the current trench testing program, should be sufficient to determine brine aquifer hydraulic conductivity and confined specific storage for numerical model construction. Additional field and laboratory data will be required to quantify brine aquifer recharge, the effects of potential inflows from paleo-channels and the basement aquifer on brine production, and the flow of low-grade brine from beneath the islands as pressure gradients are induced in the brine aquifer during mining. The following sections describe these additional data requirements.

6.3 HYDROLOGIC DATA

6.3.1 Detailed Trenching and Monitoring Program

A focused and detailed trenching, monitoring, and bulk sampling (trial mining) program should be implemented as part of the bridge data collection phase prior to commencing the DFS. The preferred sites for such a program would be in areas most likely to be considered for initial brine extraction and representative of the hydro-stratigraphic regime encountered over most of the lakebed. Two potential sites have been identified for such a program, one being in the south playa near the pilot pond location and another in the east. The south site would be representative of the hydrologic conditions encountered in the western half of the lakebed (clay-rich, relatively low permeability) as opposed to the east side (gypsum sand-dominated surface) with higher permeability values and influence of lakebed islands. Results from these detailed programs in the two representative playa areas can be used as corollaries for other areas of the lakebed with similar hydro- stratigraphic properties and would be a viable alternative to using drill holes to expanding resource confidence to Measured plus Indicated.

The proposed program should also be designed around monitoring the impacts of trench extraction on brine grade and flow at depth below the current deep resource limit of 11.25m bgs to better understand the water balance throughout the lakebed.

6.3.2 Laboratory and Field Testing for Seasonal Recharge

Impacts of surface meteoric water on in situ brine grade should be assessed. This would include both lab and field scale studies to quantify recharge and evapotranspiration parameters at the detailed trial mining locations described previously. The recommended approach would be to obtain undisturbed drill core samples and include X-ray diffraction (XRD) mineralogical analysis and a complete column testing program with brine sampling at regular intervals. Column testing would involve flushing fresh water through cores collected from representative intervals from the playa surface down into the brine water table. Geochemical modeling of the column tests using software such as PHREEQC will provide detailed information on the process of dissolution of brine components into recharge water.

Field monitoring of brine grades during the rainy season should include high frequency brine sampling at selected wells during rainfall events and long term in-situ monitoring of electrical conductivity (EC). Field monitoring could also include conducting long term infiltrometer tests with fresh water or low grade brine and monitoring EC or brine sampling at a nearby well, or monitoring water levels at the discharge locations during trench pumping tests. PFS hydrologic modeling assumed that recharge will increase as brine aquifer water levels are drawn down during mine production. This should be evaluated by locating trench pumping discharge at a sufficient distance that drawdown is minimal and monitoring water levels beneath the discharge, and, also, by monitoring water levels with the discharge located near the trench were drawdown is large.

6.3.3 Basement, Paleo-channel, and Brine Aquifer Water Levels

As part of the basement drilling program referenced previously, at least three nested well locations completed in the deep basement aquifer and shallow brine aquifer should be installed and equipped with datalogging pressure transducers in order to confirm the presence and magnitude of the upward gradient referenced in the prior modeling work. As stated in the hydrological modelling report in the PFS (Knight Piesold, 2018), previous modeling has indicated that an upward groundwater gradient may contribute as much as 50% to the water balance, but this has not been sufficiently quantified to a DFS level. This aspect of the water balance needs to be better understood from both a hydrogeologic modeling perspective and its potential consequences to future permitting work.

Water levels should continue to be monitored in all TORO wells located south of Lake Mackay These wells may be located in a paleo-channel and may allow for characterization of flow from outside the playa.

A quarterly groundwater level monitoring program should be implemented with manual water levels collected at all wells and continuous water levels at selected wells should continue to be collected with datalogger pressure transducers. All quarterly manual water level measurements should be collected within a period of one week, if possible.

6.3.4 Impact of Islands

The potential flow of low-grade brine from beneath the lakebed islands to the trenches during mine production should be evaluated. Although brine beneath these islands is not included in the resource, low grade brine will likely flow toward the production trenches over the life of the mine. The current ongoing trench test at location T13 should be extended into the rainy season and the sampling frequency increased. Monitoring should include frequent field measurements with a high range electrical conductivity (EC) probe on Aqrimin's current PCD650 hand held meter. A potassium ion specific probe may also be available for the PCD650. Refrigerated samples should be stored at camp and field EC and K^+ measurements used to determine which samples to submit for lab analysis.

7.0 MINE PLANNING AND RESERVE DETERMINATION

The evaluation of the PFS mine plan indicates that additional planning effort needs to occur to optimize trench placement and create a compartmentalized extraction system for increased flexibility of operations. The extraction system should be based on an updated numerical flow and transport model to determine accurate production schedules and to accurately determine the quantity and grade of brine that will be delivered as available (pre-evaporation) reserves.

Stantec was not tasked with the adequacy assessment of current geotechnical testing; however, it is worth commenting that the geotechnical data to be used in the DFS-level construction of trenches, impoundments, buildings and other on-playa infrastructure needs to be as thorough and robust as in all other discipline areas.

8.0 CONCLUSIONS

8.1 HYDROGEOLOGY AND BRINE RESOURCES

Information identified in this gap analysis and assessment of hydrogeologic and brine resource data encompasses the following:

- Additional procedural documentation.
- Additional drilling and/or test pitting.
- NMR logging.
- LiDAR survey.
- Additional laboratory work (brine geochemistry, Sy and RBRC).

Additional drilling or test pit sampling would be required to increase resource confidence to at least 25% Measured as part of the mine plan, obtain more Sy sample test results, and penetrate the unweathered basement floor in at least three (3) of the holes. NMR logging of these holes and existing holes, given NMR tool availability, together with a LiDAR survey will fill in the gaps in the parameters necessary for DFS-level modeling. Trial mining and monitoring from two sites will provide the necessary proof of concept for the brine extraction plan, and has the potential to replace some of the drilling or trenching required to increase resource confidence. Future planning will include design of drilling and/or trenching programs, layouts for trial mining sites, along with program budgeting and scheduling tasks.

Other observations include the option of including historical sample results currently not included in the PFS, removing brine extraction test results from the DFS model and use of a 2D grid model instead of a 3D block model for DFS-level resource modeling.

8.2 HYDROLOGIC MODELING, MINE PLANNING AND RESERVE ESTIMATION

Information to support DFS-level hydrologic modeling, mine planning and reserve estimation encompasses the following:

- Detailed trenching and monitoring program (trial mining).
- Additional testing to characterize recharge from seasonal rainfall.
- Basement delineation (paleo-channel investigation if warranted).
- Accurate playa-wide water level measurements.
- Measurement of brine grade effects from extraction near islands.
- Thorough collection of geotechnical data required for trench and berm design and project infrastructure siting.

It is Stantec’s best professional judgement that the additional data acquired based on the recommendations in this document, along with data acquired for the PFS and the current trench testing program, will be sufficient to develop a numerical groundwater flow and transport model for DFS-level mine planning and potential reserve determination. The assumptions and level of detail in the current hydrologic model and mine plan, while sufficient for a PFS-level study, will require considerable refinement for a DFS-level mine plan and potential reserve determination.

The PFS modeling study used the field and lab data to determine average hydraulic conductivity and specific yield over the entire playa at several depth intervals. The current Agrimin trench testing program and the recommended NMR logging and laboratory testing should provide sufficient data to construct a numerical model which reliably represents the spatially varying hydraulic properties. This applies over the majority of the Agrimin tenements, including those located in the West Australia area of the Lake Mackay, as well as providing sufficient information to estimate these parameters in the West Australia tenements to the north and the tenements in the Northern Territories not covered by the current and prior data acquisition programs.

PFS modeling made several assumptions regarding rainfall recharge to the brine aquifer based on regional rainfall records and satellite imagery. The field and lab testing recommended to characterize the recharge process, in addition to the local rainfall data from the weather station at the pilot ponds, should allow for DFS-level characterization of recharge.

Modeling prior to the PFS included a conceptualization of basement upflow which accounted for a large percentage of the overall water balance. The PFS stated, and Stantec concurs, that there was insufficient data to characterize this element. The PFS model assumed a much higher percentage of annual precipitation recharge of the brine aquifer during trench production than the previous modeling study. This discrepancy between the two modeling approaches should be reconciled for the DFS. The recommended basement borings and nested wells, and geophysical surveys currently planned by Agrimin should provide sufficient information to characterize the basement upflow component of the water balance for inclusion in the DFS numerical model.

The mine plan evaluated in the PFS assumed complete build out of a trench network at the start of mining, and flows from this trench network were evaluated over the proposed duration of mining. The additional data recommendations in this report will allow for the construction of a numerical groundwater flow and transport model which can be used for detailed mine planning and evaluation of mine build out over the life of the mine. Detailed mine planning will likely result in a more efficient mine development plan, with the playa compartmentalized into local mining units based on like hydrologic properties, and with these mine units being developed at different periods over the life of mine.

Financial modeling, mine construction, geotechnical evaluation, and mine process facilities are out of the scope of this gap analysis. The hydrologic modeling and mine planning discussed herein would be sufficient to determine a DFS-level reserve. However, no assumptions have been made or evaluated on the constructability, process, or financial viability of the project.

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Appendix B STANTEC RESOURCE MODEL REPORT

Mineral Resource Estimate

Method and Approach (software, dimensions, boundary limits)

The potassium Mineral Resource estimates are reported from a layered grid model of the Lake Mackay lakebed sediments. The grid model was constructed using MineSight™ software (v15.60-1) and developed using metric Universal Transverse Mercator (UTM) Zone 52 coordinates with elevations reported above mean sea level (AMSL).

Resource Model Extents

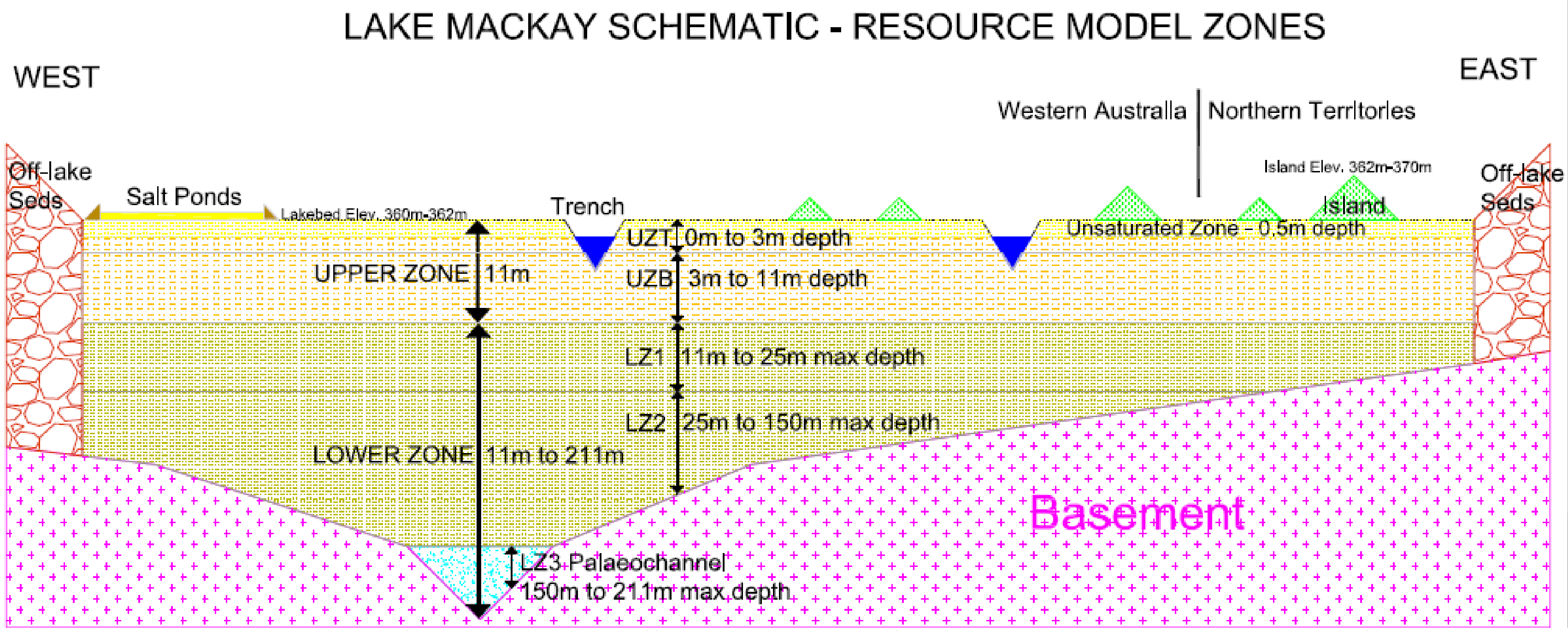
The model is setup to cover the entire footprint of Lake Mackay, covering a rectangular space of 104.8km^2(East) by 83.6km^2(West). A grid node spacing of 200m by 200m was selected to capture the necessary topographic and grade resolution, plus other physical parameters that would support a feasibility-level brine extraction study for sulphate of potash (SOP) production. Model extents are summarized in Table 6.1. below.

Table 6.1 Mineral Resource Model Extents

Coordinates UTM Z52	Model Extent (m)			Grid Node Spacing (m)
	Minimum	Maximum	Range	
Easting	428,000	532,800	104,800	200
Nothing	7,488,200	7,571,800	83,600	200
Elevation	0	500	500	n/a

The resource model layers are grouped into two main zones, an upper and lower zone that are in turn further separated into sub-zones (horizons) as illustrated in the schematic section in Figure 6.1. Model parameters and procedures followed in the construction of the grid model are outlined below.

Figure 6.1. Resource Model Zones Schematic Section



The boundary limits of the Mineral Resource Estimate are defined by Agrimin's tenements, Lake Mackay shoreline and basement topography as shown in Figure 6.1. The lake shoreline and island boundaries were identified from topographic and aerial photo interpretations. The data used for the boundary survey included Agrimin's Light Detection and Ranging (LiDAR) survey covering the WA tenements and public domain data for the remaining areas. The lakebed and island boundaries from the survey were a close match to prior boundaries obtained from public domain maps of the area.

The lakebed-island boundaries were used to code the model grid nodes within (1=IN) or outside (0=OUT) the boundary. Islands less than 1 hectare (Ha) in area were too small to be coded in the model given the grid node spacing. These small islands (<1Ha) are included as part of the lakebed resource. A similar grid coding method was used to identify Agrimin controlled WA tenements and development area as well as NT tenement application areas.

Surface Topography

LiDAR survey data was merged with public domain digital elevations models outside of the area of the LiDAR survey and reduced to a 200m by 200m grid resolution using a triangulation algorithm. A separate lakebed-only topographic grid was developed that projected the lakebed surface horizontally beneath islands as illustrated in Figure 6.1. This lakebed surface grid was used as a reference surface to project horizon boundaries from the reference surface to solid basement below using software macros. The surface topography grid elevations are illustrated in Figure 6.2. The lakebed surface referenced grid elevations (islands removed) are illustrated in Figure 6.3.

Figure 6.2 Surface Topography Grid Elevation

Figure 6.3 Lakebed Surface Reference Grid Elevation

Resource Parameters

Parameters affecting the quantity of available potassium with a reasonable prospect of eventual economic extraction for SOP production include:

- Volume of lakebed sediments hosting potassium-rich surficial salt or brine.;
- Void space (porosity) of the host sediments.
- Amount of surficial salt in the unsaturated lakebed sediments.
- Concentration of potassium (mg/l) in the brine saturated sediments.

The surficial salt and porosity components described above are the distributed physical parameters in the resource model. The resource model zones and resource parameters, together with model results, are discussed below.

Resource Model Zones

Exploration of the lakebed sediments has identified two main zones that host potassium-rich brines in lakebed sediments. These lakebed sediments rest unconformably atop a consolidated basement surface that defines the lower limit of the resource extent. Figure 6.1 (Resource Model Schematic Section) illustrates the layout of these main zones and associated subdivisions in the resource model. The following discussion summarizes the physical extents of the zones that host the potash brine resource. A discussion on the sedimentology and mineralization of the resource zone is found within Chapter 4 of this report.

Upper Zone

The upper zone (UZ) extends from the lakebed surface to a vertical depth of 11m as shown in Figure 6.1. The lakebed surface is a flat surface with topographic relief ranging from 360m to 361m (AMSL) (excluding islands) over a total surface area of approximately 342,655 hectares (ha). Lakebed islands are situated above the lakebed surface. These islands are aeolian landforms whose elevation varies from approximately 361m (lakebed surface) to 371m. The total surface footprint of the islands is approximately 35,829ha. Island sediments resting above the lakebed surface (or UZ) have not been identified as a potassium resource due to the lower concentration of potassium in the brackish water samples taken from these island sediments.

The UZ is subdivided into an upper zone top (UZT) and upper zone bottom (UZB) as illustrated in Figure 6.1. Exploration records indicate the lakebed sediments surrounding islands to be dry to unsaturated to an average depth of 0.5m below lakebed surface through most of the year. This brine (water) level forms the limit of the unsaturated interval of the UZT and is a fixed depth (0.5m) for potassium resource estimation. This unsaturated interval, not including islands, contains precipitated potassium salts from past brine water levels. These salts go into solution during intermittent rainfall events and are reprecipitated during intervening dry periods. All zones (horizons) below the unsaturated interval of the UZT to the basement surface are saturated with brine.

The brine-saturated portions of the UZT extend from 0.5m to of 3m depth below surface. A 3m depth limit has been selected for the UZT to represent the average depth influence of trench pumping tests used to estimate brine production from proposed surface trenching methods. The UZB is a sedimentologically similar interval to the UZT above and extends to a depth limit of 11m below the lakebed surface. The majority of the hydrologic and brine chemistry components used for resource estimation were sourced from test site locations located in the UZ.

Model statistics defining the UZ extent within the Agrimin tenements are outlined in Table 6.2 below. The three UZ horizon thicknesses and extents are shown in Figure 6.4 through Figure 6.6 from top to bottom.

Table 6.2 UZ Interval Statistics

Brine Saturation	Zone Horizon	Depth (m)	Average Thickness (m)	Area (Ha)	Volume (Mm3)	No. Penetrations (holes/trenches)
Unsaturated	UZT	0m to 0.5m	0.5	323,844	1,619	312
Saturated		0.5m to 3m	2.5	357,952	8,949	287
	UZB	3m to 11m	8.0	357,952	28,636	179

Figure 6.4 UZT Unsaturated Horizon Thickness and Extent

Figure 6.5 UZT Saturated Horizon Thickness and Extent

Figure 6.6 UZB Horizon Thickness and Extent

Lower Zone

The lower zone (LZ) interval represents that zone between the UZ and the basement surface. The LZ is separated into three horizons LZ1, LZ2 and LZ3, as shown in Figure 6.1. The LZ1 and LZ2 are sedimentological similar to the UZB above but with increased clay content. Separation of the LZ1 and LZ2 is based on the quantity and depth of drill hole penetration of the lakebed sediments below the UZ. The LZ3 includes an incised paleochannel that is predominantly a sandy interval as opposed to a relatively clay rich LZ2 above. The LZ3 unit, the extents of which are defined from geophysical surveys and drill hole penetrations, extend from a depth of 150m below surface to a maximum depth of 211m below surface.

Model statistics defining the LZ extent within the Agrimin tenements are outlined in Table 6.3 below. The three LZ horizon thicknesses and extents are shown in Figure 6.7 through Figure 6.9 from top to bottom.

Table 6.3 LZ Interval Statistics

Zone Horizon	Depth (m)	Average Thickness (m)	Area (Ha)	Volume (Mm3)	No. Penetrations (holes/trenches)
LZ1	11m to 25m	13.6	354,398	48,127	80
LZ2	25m to 150m	101.4	245,226	248,711	16
LZ3	150m to 211m[1]	43.9	38,725	17,003	1

Note [1]- Maximum depth to basement

Figure 6.7 LZ1 Horizon Thickness and Extent

Figure 6.8 LZ2 Horizon Thickness and Extent

Figure 6.9 LZ3 Horizon Thickness and Extent

Basement Surface

The brine-saturated lakebed sediments unconformably overly a basement surface that represents the bottom limit of the overall resource zone. A basement surface grid was developed from interpretation of electromagnetic (EM), gravity and passive seismic survey data, discussed in Chapter 5 of the report, as well as from penetration of basement formation from seven drill holes. Digital renderings of the geophysical interpretations combined with the drill hole data was used to generate a grid surface using a triangulation method combined with a post-processing data smoothing algorithm. The grid surface was developed using Carlson™ software and later imported into MineSight™.

The basement surface, as interpreted from the geophysical and exploration data, shows an incised paleochannel at depths greater than 150m as illustrated in Figure 6.10. The depth of the basement surface below the lakebed was limited to a maximum of 211m based on core observations from deep (215m TD) drill hole LMD001 whose location is shown in Figure 6.4. Passive seismic survey results show potential for basement limiting surface to extend beyond 211m, however in the absence of direct evidence from drill hole penetration, the maximum depth was limited to that observation from hole LMD001. Figure 6.10, basement depth from lakebed surface map, shows the total package of lakebed sediments within the Agrimin tenements that hosts the SOP resource.

Figure 6.11 illustrates two southwest (SW) to northeast (NE) cross-sections through the grid model outlining all resource horizon intervals atop the basement surface grid. Due to the extremely flat topography and large project area, a vertical exaggeration of 1:100 has been used to illustrate the vertical extents of the resource horizons.

Figure 6.10 Basement Depth from Lakebed Surface

Figure 6.11 Grid Model Cross Sections

Distributed Physical Parameters

Distributed physical parameters used in the estimation of potash resources include measurements of surficial salt in the unsaturated UZT horizon and porosity measurements in the lakebed sediments. Porosity is a key component in the estimation of potassium resources in brine since it represents the pore (void) volume within the host lakebed sediments that is occupied by potassium-rich brine.

Surficial Salt

The purpose for collecting the near surface salt mass measurement was to obtain an equivalent concentration in brine of the surficial salts after dissolution of the solids (salt) when fresh water is introduced following a rainfall (inundation) event in the unsaturated UZT. These solid salt deposits are remnants of past brine levels and precipitated capillary brine.

Measurement of surficial salt were taken from Shelby tubes samples in 2019. The Shelby tube samples were driven from surface to a depth of 1m at 16 column test hole (CTH) locations.

The salt mass measurements were undertaken at Stantec's Perth soil laboratory. At each sample site, the weighted (by length) average mass per unit volume (mg/l) was calculated from measurements taken at regular intervals[1] to a depth of 0.5m below surface (unsaturated zone).

The calculated salt mass at each site was then in turn averaged across each of the four surface recharge zones distributed across the lakebed. These recharge zones were identified as part of the hydrologic modeling discussed in Chapter 7 and are shown in Figure 6.12 together with the CTH sites where salt mass measurements were taken. The surface recharge zones broadly reflect the lakebed surface sedimentology observed in the field, i.e. increasing coarseness of the lakebed sediments from west to east across the lakebed.

The average mass per unit volume (Shelby tube) was further adjusted to reflect a total salts concentration (mg/l) that would be expected within the pore volumes (porosity) of the unsaturated zone when saturated following a rainfall event. This unsaturated zone dry porosity was measured from the Shelby tube samples at Stantec's Perth soil laboratory and averaged across the four surface recharge sites illustrated in Figure 6.12.

Table 6.4 lists the calculated average concentration of total salts in brine for each surface recharge zone following a rainfall event, assuming complete dissolution of the surficial salts. The quantity of potassium in the unsaturated zone brine was then calculated using the same relative distribution of major ions in the underlying saturated UZT as estimated at each model grid node from UZT brine samples.

Figure 6.12 Recharge Zones and Salt Mass Sample Locations

Table 6.4 Average Total Salts for Unsaturated UZT

Recharge Zones (W to E)	West	Central	Central	East
Count (n)	2	8	2	4
Minimum (mg/l)	156,800	117,120	152,484	67,647
Maximum (mg/l)	209,221	202,865	174,372	178,022
Average (mg/l)	183,011	162,025	163,428	110,114
Average in Void (mg/l)	329,987	326,766	304,732	187,758

Porosity

Porosity is one of the key variables in estimating brine resources for salt lakes. As discussed by Houston et., al. (2011), there is considerable misunderstanding of the terminology related to porosity. Total porosity (Pt) relates to the volume of brine contained within a volume of aquifer material. Except in well-sorted sands some of these pores are not connected to others, and only the interconnected pores may be drained. Interconnected porosity is referred to as the effective porosity (Pe). If the effective porosity is totally saturated with

[1] Most intervals were set at 10cm

brine only some of this brine will be drained during pumping. This is due to considerations such as capillary forces in the pores. The porosity that freely drains by gravity is known as the specific yield (Sy), or drainable porosity. Brine retained in the pores is referred to as specific retention (Sr). These relationships are represented as:

Pt > Pe and Pe = Sy + Sr

In fine- grained sediments, such as clays and silts, much of the water is 'bound water' in small pores or held by clays or capillary forces, with specific retention exceeding specific yield, whereas in coarser- grained sediments specific yield exceeds specific retention. Salt lakes are often dominated by clays and fine- grained sediments and the appropriate porosity metric for estimation of static resources that have a low level of influence from recharge is the specific yield. However, the determination of the specific yield is challenging, due to the unconsolidated nature of the sediments.

It is important to note that specific yield is a concept, not an analytical value, and therefore there is not a standard analytical method for its determination. Different laboratories use different methods and equipment for determination of specific yield.

There are however, four key methodologies used for determining the specific yield parameter, these include:

1. Pumping tests for unconfined aquifers.
2. Down-hole geophysical analysis (Nuclear Magnetic Resonance);
3. Laboratory derived (either by low-pressure centrifuge, vacuum suction (i.e. RBRC method) or other membrane drainage methods); or
4. Grain Size Analysis

Specific yield values at Lake Mackay were derived from hydrogeological model calibration to the observed drawdown in monitoring bores during long-term pumping tests from extraction trenches excavated to 6m in depth across Lake Mackay. This produced specific yield values ranging from 1% to 29%. Specific yield determination from trench pump tests are viewed as the most representative of expected yields from surface trenching to depths of 3.0m below surface i.e. the drawdown limit used for the trench pumping tests. This is due to the much larger volume of aquifer affected by drawdown during trench pumping versus the relatively small volume of a core sample from a lab measurement.

A low-pressure centrifuging method (equivalent to 5 psi or one-third of an atmosphere) was also used for the determination of specific yield on over 300 core samples across three separate laboratories, including the British Geological Survey laboratory, which has processed samples from a number of brine projects globally. As different laboratories employ differences in analytical methods, Agrimin has had porosity samples analysed in the separate laboratories for specific yield determinations at centrifuge conditions equivalent to a low pressure (5 psi).

Prior to 2018, 302 porosity samples were submitted to the Intertek soil laboratory in Perth as the primary laboratory, with additional samples sent to Core Laboratories in Perth and the British Geological Survey sedimentology laboratory in the UK as check laboratories. In 2019, an additional 52 porosity samples were sent to DB&S laboratories located in Albuquerque, USA. Low-pressure centrifuging produced specific yield values ranging from 0.1% to 16.4%. Samples with higher proportions of sand and silt had higher specific yields.

Grains size distribution was also researched as a possible means of determining yield. In 2017, 207 sediment samples were analysed for grain size distribution. These samples were processed using wet sieving and laser particle size distribution equipment. The resulting sand-silt-clay percentages were compared to a ternary grain size diagram to estimate the specific yield. The results from the grain size analyses were compared to curves published by sedimentologists relating grain size to specific yield. This analysis produced specific yield values ranging from 3% to 25% and a regression result that is 1.8 times higher than the specific yield produced on duplicate samples by the low-pressure centrifuging method, which is the preferential method used for the updated Mineral Resource Estimate. In 2019, 29 grain size distribution samples were collected however, these samples were used for soil classification in support of identifying four surface recharge zones and for providing additional checks on prior grain size distribution data.

In 2019, column leach tests and Tempe cell tests were conducted at the Stantec Perth soils lab from Shelby tube samples collected at 16 sites distributed across the lakebed. The purpose of these tests was to obtain natural surface recharge parameters to be used in the calibration of the hydrologic model and included measurement of total porosity, specific yield and total salt mass of unsaturated sediments to an average depth of 0.5m from surface.

Indirect measurement of total porosity and specific yield were obtained from downhole geophysical NMR logs taken from the diamond and sonic drilling programs. Vertical porosity profiles were obtained at 0.25m increments from the logs and validated against core sample results. Although comparison between the NMR logs and core samples were similar, the NMR log data was identified as best suited for the understanding of vertical trends in the porosity. As such, NMR log data reflected observations of the lakebed lithology in drill cores and supported the separation of the resource model into upper and lower zones.

Taking a conservative approach, only direct total porosity and specific yield test results were used for resource estimation. Direct porosity measurements for the unsaturated zone were obtained from the column test and Tempe cell results. For the saturated zone below both laboratory and trench pump test results were used. Indirect measurements of porosity, namely geophysical analysis and grain size analysis were used for comparison with direct measurement and to identify spatial trends in porosity. This data together with observations of lithologic logs from trench profiles and drill cores were ultimately used to identify specific yield trends in the data. The porosity values applied within the resource model are summarised in Table 6.5 below.

Table 6.5. Mineral Resource Porosity Estimates

Zone	Depth (m)	Total Porosity (%)				Specific Yield (%)			
		West	Central	Central	East	West	Central	Central	East
UZT	0m to 0.5m	55	50	54	59	28	22	31	34
	0.5m to 3m	46				6	11		14
UZB	3m to 11m	42				5			
LZ1	11m to 25m	42				5			
LZ2	25m to 150m	42				4			

LZ3	150m to 211m[1]	42	12

Note[1]: Maximum depth to basement

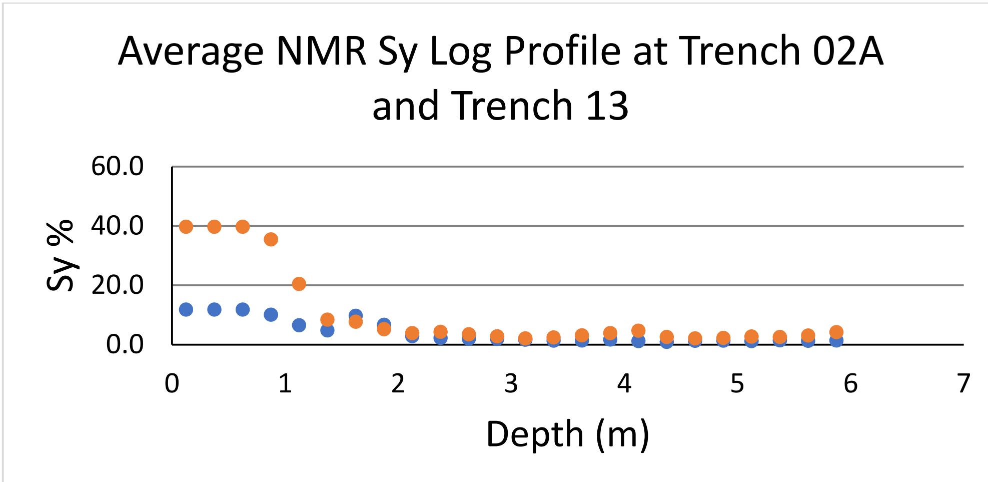
Observation of the sample data indicated that total porosity did not vary significantly in both vertical profile and spatial distribution. All total porosity measurements were derived from direct measurement from Shelby tube samples or from drill core samples. The greatest variability in total porosity, though minor, was observed in the unsaturated (0m to 0.5m) UZT horizon. This variability reflects the increased complexity in sediment type and grain size sorting, given this horizon is exposed to both ingress of aeolian sands and precipitated salts during dry periods followed by finer clay sediments during flood events. For this reason, separate total porosity measurements have been assigned to each of the four recharge zones shown in Figure 6.12. The total porosity estimates for the four recharge zones for the unsaturated UZT (0m to 0.5m) are shown in Table 6.5.

Specific yield measurements were identified as being more closely aligned (than total porosity) to variations in sediment type and grain size. Specific yield is shown to increase with increasing coarseness of the host sediments. Direct measurement of specific yield at CTH sites (0 to 0.5m) and from trench pump test results (0.5 to ~3m) showed a regional trend of increasing specific yield from west to east across the lakebed for the UZT. Observations of the lake sedimentology from drill cores and trench profiles also showed an increasing coarseness in sand content from west to east across the lakebed. This is best illustrated in Figure 6.13 that shows grid estimates of composite granularity (coarseness) trends for the saturated UZT using an indexed code representing increased relative coarseness from predominantly clay (1) to more sandy (3) sediments. For comparison, specific yield measurements from the trench pumping tests are also labelled in Figure 6.13. These trench pump tests are understood to be more representative of specific yield, given the proposed brine extraction method from the saturated UZT is from a trench network.

Figure 6.13 UZT Granularity and Saturated Sy Domains

Regional trends in the lakebed sedimentology as illustrated for the saturated UZT horizon in Figure 6.13 were also reflected in the observations of indirect specific yield measurements taken from downhole NMR geophysical logs. A composite of the average specific yield log profiles at two closely spaced (infill) drilling sites surrounding Trench 02A and Trench 13 is shown in Figure 6.14. The locations of the infill holes surrounding each trench site are bracketed in Figure 6.11. At each trench location 11 holes were geophysically logged to the end of hole that was limited to within the UZ to a maximum depth of 6.5m. Hole spacing varied from 500m to 1,500m.

Figure 6.14 Trench 02A and Trench 13 Drilling - Average NMR Sy Log Profile



The purpose of the infill drilling was primarily to obtain a better understanding of the short spaced (500m to 2000km) variability in brine chemistry and then to use the opportunity to obtain a better understanding of specific yield from NMR logs. The selection of Trench 02A and Trench 13 for the infill drilling was motivated from the initial pumping results (high and low yields) correlating to the regional trend in UZT lakebed sedimentology. Trench 02A is located in the clay dominant southwestern zones, as evidenced in Figure 6.13, and Trench 13 is located in the coarser eastern area that is also surrounded by relatively numerous islands. As expected, the indirect measurements of specific yield at Trench 13 is higher than Trench 02A. However, the relative difference in specific yield with increasing depth between Trench 02A and Trench 13 is less pronounced as shown in Figure 6.14. Specific yield at both sites tends to flatten at approximately 3m depth below surface.

The specific yield profile at Trench 13 and Trench 02A reflects the increasing homogeneity of the lakebed sediments from surface, and as such specific yield variability is expected to lessen at depths below the UZT (>3m depth). With this expectation, together with observation of the direct measured Sy from core plugs at depth, a single average specific yield has been assigned to the UZB and LZ horizons found at depths below 3m as indicated in Table 6.5.

At depths less that 3m, representing the UZT, average specific yield values from 19 trench pump tests were assigned to each domain for the saturated UZT (0.5 to 3m). Trench pump tests for estimating specific yield are viewed as more representative of specific yield given the proposed brine extraction method from the saturated UZT. These averages were derived after capping the trench pump test results to a specific yield minimum of 4% and maximum of 18%. The capping was deemed necessary to best reflect overall regional trends in specific yield and associated lakebed sedimentology. These saturated UZT specific yield domains are illustrated in Figure 6.13.

For the unsaturated UZT (0 to 0.5m), the specific yield domains were further separated into four recharge zones as illustrated in Figure 6.11. Average specific yield was assigned to each of these surface recharge areas using direct lab measurement from 16 CTH sites (Figure 6.13). Capping of the CTH specific yield results was deemed unnecessary following review of the data.

Brine Grade

The target resource for the Lake Mackay Potash project is the potassium in brine contained within the lakebed sediments. For the purposes of the feasibility study, the concentration of potassium in brine plus other major ions and brine specific gravity were estimated into the grid model for each resource horizon. Major ions estimated together with potassium (K), include: chloride (Cl), sodium (Na), sulphate (SO_4), magnesium (Mg) and calcium (Ca). These ions make up the primary constituents of salt products that can be produced from the brine, of which potassium is a primary component required for SOP production.

The brine sample test results demonstrated that the production of SOP, with the chemical formula of K_2SO_4, is only constrained by potassium. The ratio of potassium (K) to sulphate (SO4) in K_2SO_4 is 1.23. The K:SO4 ratio in the brine sample data all exceed 1.23 with an average of 5.

The distribution of potassium (mg/l) in the grid model for the UZT resource horizon can be observed in Figure 6.15 and Figure 6.16. A combined UZT total potassium grid estimate, weighted on thickness and specific yield, for the unsaturated UZT (Figure 6.16) and saturated UZT (Figure 6.17) is shown in Figure 6.17. The potassium grade distribution as shown in Figure 6.17 best represents the spatial range of potassium grades that would initially feeding a surface trench network in the proposed mine plan. Potassium grade distribution for the remaining resource horizons UZB, LZ1, LZ2 and LZ2 can be observed in Figure 6.18 through Figure 6.21.

Figure 6.15 Unsaturated UZT Potassium Grade Distribution

Figure 6.16 Saturated UZT Potassium Grade Distribution

Figure 6.17 UZT Total Potassium Grade Distribution

Figure 6.18 UZB Potassium Grade Distribution

Figure 6.19 LZ1 Potassium Grade Distribution

Figure 6.20 LZ2 Potassium Grade Distribution

Figure 6.21 LZ3 Potassium Grade Distribution

The vast majority of the lakebed sediments within the resource zones are saturated with brine. The only exception is the near surface unsaturated interval that extends from surface to a depth of 0.5m within the UZT horizon. As such, the estimation of brine grade between these two sediment types (saturated versus unsaturated) has been approached differently in the determination of potassium resource quantities. Furthermore, brine grades for the saturated UZ has been observed to be diluted in concentration below islands when compared to samples taken outside of islands and these differences have been accounted for in the brine grade estimations. Each of these three brine grade estimations are discussed separately below.

Brine Saturated Lakebed Sediments

A total of 239 primary samples were identified as containing brine sourced from within the UZ (11m depth) and 41 primary brine samples for the LZ below. The range in potassium grade (mg/l) for these UZ and LZ primary samples is outlined in Table 6.6. Nine (9) out of a total of 239 (4%) UZ samples and two (2) out of the 41 (5%) LZ samples were less than 1,500 mg/l potassium and ultimately not used for brine resource estimation. The number and average potassium grade from primary samples with >1,500mg/l potassium is shown in Table 6.6. These low-grade (<1,500 mg/l) samples were identified as anomalous, local and not representative of natural conditions. For resource estimation, only brine sample grades >1,500 mg/l were considered. No top cut was applied to the resource estimation.

Table 6.6. Potassium Grade from Primary Samples

ZONE	All Samples (mg/l)				>1,500 mg/l	
	No.	Minimum	Maximum	Average	No.	Average
UZ	239	30	6520	3361	230	3,468
LZ	41	530	4688	3257	39	3,386

Brine resource samples taken from open holes were assigned depth-intervals from the top of the hole to the total depth of the hole at the time the sample was taken. Samples taken from isolated completions were assigned a depth interval of the relevant screened interval. The brine grades taken from open holes are a composite of the brine entering the hole along the length of hole when the sample was taken. As such, a single sample may cover more than one resource horizon.

The assigned depth intervals for the brine resource samples were composited at 0.25m regular intervals downhole. Each composite interval was then tagged by the resource horizon they penetrated. Using a resource horizon code match, the brine grades were estimated into each of the five corresponding resource horizons using a maximum range covering the extent of the lakebed. An inverse distance squared algorithm was used for estimating brine grade and Specific Gravity (SG) into grid nodes for each of five separate resource horizons, namely: saturated UZT (0.5m to 3m) and UZB representing the UZ; and LZ1, LZ2 and LZ3 representing the LZ.

Table 6.7 lists the average brine grade and SG from 0.25m composites from each resource horizon that was tagged from the model grids. The number of penetrations for the LZ horizon (44) shown in Table 6.8, exceeds the number of samples recognized as covering the overall LZ (39), as shown in Table 6.7. This is due to the resolution of the model grids set at 200m by

200m resulting in 0.25m composite grades close to the UZ and LZ boundary being assigned to both UZB and LZ1 horizons. This overlap is considered minor and not of material importance to the overall confidence in the resource estimate, given that brine grade is expected to be gradational across resource horizons. The distribution of potassium concentrations in brine for each brine saturated resource horizon is shown in Figure 6.16 through Figure 6.21.

Table 6.7 Average Brine Grade and SG from 0.25m Composites

ZONE	No. Sample Intercepts	Average Brine Grade (mg/l) and SG from 0.25m composite intervals						
		K	Mg	Na	Ca	Cl	SO4	Brine SG
UZT	219	3,475	2,964	97,072	530	144,955	22,353	1.180
UZB	93	3,302	2,879	95,122	542	142,049	21,979	1.175
LZ1	44	3,414	2,901	98,205	553	144,075	22,309	1.174
LZ2	12	3,343	2,820	96,974	581	141,982	21,409	1.172
LZ3	1	1,910	280	100,000	778	146,900	9,180	1.177

Saturated Sediments Below Islands

Sampling of brine from bores on islands and on island boundaries at elevations below the surrounding lakebed shows a lower concentration of ions that is in proportion to the size of the islands. This observation was made from data collected from brine samples within UZ saturated sediments at the following sites: Trench 13 shown in Figure 6.22, bore MC16-05 shown in Figure 6.23, and Trench 02A shown in Figure 6.24. The diluted grades are understood to be associated with the impacts of fresh or brackish water contained within the aeolian island sediments deposited above the lakebed sediments below.

Figure 6.22 Trench 13 Island and Lakebed Brine Sample Sites

Figure 6.23 MC16-05 Island and Lakebed Brine Sample Sites

Figure 6.24 Trench 02A Island and Lakebed Brine Sample Sites

Table 6.8. lists the area of the island at each of the three sample sites together with the percentage of remaining totals salts (major ions) and potassium under islands when compared to surrounding lakebed. Figure 6.25 is a chart of the total salt percent remaining against island area. The three points of observation shown can be fitted to a logarithmic formula as shown in Figure 6.25. The three islands used in this investigation fit into the category of large, intermediate and small islands discussed in Chapter 5 of this report. Using the best fit formulas displayed in Figure 6.25, a dilution factor has been applied for brine grade estimates within the brine saturated sediments for the UZ beneath islands. The dilution factor per island type is listed in Table 6.9.

Table 6.8 Remaining Brine Salt Percent Below Select Islands

Sampling Site	Island Area (ha)	Percent Salt Remaining	
		Total Salts	Potassium
Trench 13	2,096	13	10
MC16-05	534	33	33

Trench 02A	41	83	80

Figure 6.25 Remaining Total Salt Percent Versus Island Area

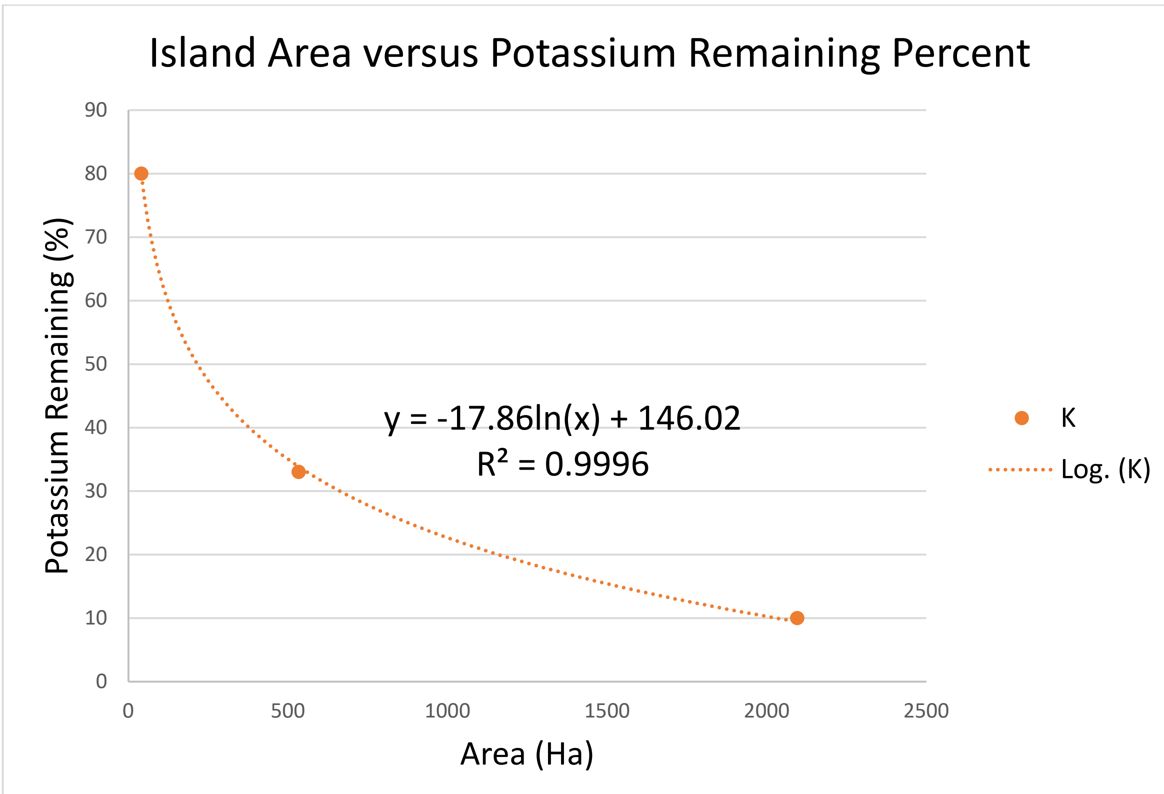


Table 6.9 Brine Grade Dilution Factors for UZ below Islands

Island Type	Average Area (ha)	Dilution Factor	Island Type
Landform Island	2,351	0.07	Landform Island
Large Island	870	0.25	Large Island
Intermediate Islands	237	0.48	Intermediate Islands
Small Island	21	0.92	Small Island

Brine grades within the LZ horizons (>11m depth) are not expected to be diluted though this has not been demonstrated. There is also a very likely vertical dilution profile in brine grade below islands within the UZ. The current brine sample database has not effectively captured this transition due to mixing of brine in the samples from the UZT and UZB. Brine grade transition from lakebed to below islands is not well understood and as such all potassium Mineral Resources are classified as Inferred below islands.

Unsaturated Sediments

Additional sources of potassium currently not in brine-form is contained within precipitated salts from past brine levels in the unsaturated UZT horizon (0 to 0.5m). This potassium is available for extraction via proposed methods (trenching) following dissolution during and after rainfall (inundation) events. During intervening dry periods, the potassium is reprecipitated within the unsaturated zone if the brine has not been extracted via the proposed surface trench network.

This brief period of salt dissolution is captured in the resource estimates by distributing the potassium and other major ions from the measured salt mass into the same relative proportion as that of the underling brine grade estimates for the saturated UZT below. This distribution is done at each model grid node after assigning an average salt mass concentration at each of four surface recharge zones illustrated in Figure 6.12. Average salt mass per recharge zone was determined from Shelby tube samples collected at the column test sites illustrated in Figure 6.12. Table 6.10 lists the average total salt mass in mg/l equivalent within the pore spaces for the unsaturated UZT.

Table 6.10 Average Totals Salts Concentrations in Unsaturated UZT

Recharge Zone	Total Salt (mg/l)
West	329,987
Central1	326,766
Central2	304,732
East	187,758

Data Verification

For the purposes of the feasibility study, the sampling and testing programs for data used in the model were reviewed by the Competent Person and were found to be comprehensive and in accordance with industry guidelines. Field and laboratory procedures are discussed Chapter 5 of this report. The discussion below focuses on the results of the recent 2018-19 exploration program that was recommended by Stantec and implemented by Agrimin to bring the project to the current feasibility-level.

Validation of the resource model inputs and outputs is separated into the following components: laboratory inspections, site inspections, brine assays, physical parameters, infill drilling and model review.

Laboratory Inspections

The Competent Person has personally inspected and logged Shelby tube and drill core samples at Daniel B. Stephens & Associates Inc. (DBS&A) laboratories located in Albuquerque, New Mexico USA. These samples were collected by Agrimin during the 2019 field season from infill drilling sites (drill cores) and from the column test sites (Shelby tubes). Laboratory procedures for measuring specific yield measurements completed by DBS&A were discussed at the laboratory.

Site Inspections

The Competent Person for Mineral Resources has not conducted a site inspection of the property. A site visit was not deemed necessary by the Competent Person having observed drill cores from the 2019 program and experience on similar deposit types.

Other qualified geologists and hydrogeologists who are members of Stantec Consulting Services Inc visited the site on August 8 and 9, 2018. They observed trench pumping sites and bore locations across the lakebed, visited the large island that was to become the Trench 13 sampling site, observed a trial trench excavation with resultant brine inflows and exposed near-surface lakebed strata and investigated retained sediment samples obtained from recent auger drilling activities. Aerial reconnaissance of the entire lakebed was conducted and siting for plant and pond infrastructure was observed.

Brine Assays

For the 2018 and 2019 campaigns, Bureau Veritas was used as the primary laboratory and check assays submitted to Intertek. Both Intertek and Bureau Veritas are independent, NATA accredited, minerals laboratories located in Perth. Comparison of results from these laboratories confirmed the Intertek and Bureau Veritas analyses are suitable for the Mineral Resource estimation. In 2019 additional check samples were sent to Hazen Laboratories, located in Denver, CO USA. Table 6.11 provides a comparison of the 2019 program brine assay results between the three independent laboratories.

Table 6.11 Check Assay Results from 2018-19 Programs

Hole ID	Interval (m)			Potassium (mg/l)				
	From	To	Zone	BV1 Prime	BV1 Duplicate	BV1 Re-sample	Intertek	Hazen
T02AH-001	0.0	6.5	UZ	2,700			2,710	2,670
T02AH-004	0.0	6.5	UZ	1,990		2,445		1,910
T02AH-005	0.0	6.6	UZ	2,520				2,600
T02AH-011	0.0	6.6	UZ	3,250	3,320			
T02AH-013	0.0	6.5	UZ	1,490		1,520		
T13H-001	0.0	6.2	UZ	3,870			3,726	3,780
T13H-004	0.0	6.3	UZ	3,330				3,290
T13H-005	0.0	6.5	UZ	3,370				3,370
T13H-0102	0.0	12.7	Island	30			26	

T13H-011	0.0	3.3	UZ	750			760	
LMD18-01	157.0	215.5	LZ3	1,910			1,932	2,010
LMD19-03	15.0	18.0	LZ1	530				478
LMD19-03	75.0	109.0	LZ2	930				1,040

Observation of the brine assay results in Table 6.5 shows that no inconsistency is found between independent brine assay results. Differences between the laboratory results are interpreted to be non-material and likely associated with some turbidity (mud) in the sample that may have passed through the filters when preparing the samples.

Internal blind duplicate samples tested at the Bureau Veritas laboratories did not identify any anomalous results. Ion balance checks were also conducted for all assay samples used for resource estimation and no samples were rejected due to cation-anion balances exceeding accepted industry standard of +-10%.

Physical Parameters

In 2019, a downhole NMR geophysical logging tool was used to identify changes in physical parameters in the lakebed sediments with increasing depth from surface and, if possible, use these results for direct measurement of porosity. Table 6.12 provides a direct comparison of laboratory determined specific yield versus the corresponding NMR measurement. Observations of the results show that the NMR results are dissimilar but in the same range. It must be noted that the laboratory measurements are from 3 inch core samples, whereas the NMR readings cover an interval of 0.25m. Ultimately, the NMR results were best viewed as a relative measure of porosity and only used as guide in the determination of the resource horizon intervals.

Table 6.12 NMR Versus Laboratory Porosity

Hole ID	**Sample Interval**			**Total Porosity (%)**			**Specific Yield (%)**			**NMR Tool**
	From (m)	**To (m)**	**Zone**	**DBS&A**	**NMR**	**Difference**	**DBS&A**	**NMR**	**Difference**	
T02AH-005	3.0	3.6	UZ	40	50	10	2	0	-2	Dart
T02AH-007	2.9	4.0	UZ	35	50	15	1	2	1	Dart
T02AH-001	2.9	3.5	UZ	48	49	1	4	1	-3	Dart
T02AH-0011	3.0	3.5	UZ	42		7	0		1	Dart

T02AH-011	0.5	0.6	UZ	54	55	1	13	24	11	Dart
T02AH-011	1.1	1.2	UZ	52	41	-11	1	8	7	Dart
T02AH-011	1.5	1.6	UZ	27	37	10	5	4	-1	Dart
T02AH-011	3.0	3.6	UZ	44	33	-11	3	1	-2	Dart
T02AH-013	2.9	3.5	UZ	51	42	-9	2	2	0	Dart
T02AH-0131	3.0	3.5	UZ	46		-4	1		1	Dart
T13H-001	3.0	3.1	UZ	29	53	24	1	1	0	Dart
T13H-001	3.1	3.5	UZ	26	34	8	2	2	0	Dart
T13H-005	3.0	3.1	UZ	45	34	-11	4	3	-1	Dart
T13H-005	3.1	3.5	UZ	48	34	-14	4	3	-1	Dart
T13H-006	3.0	3.1	UZ	42	47	5	2	1	-1	Dart
T13H-006	3.1	3.5	UZ	34	46	12	1	1	0	Dart
T13H-007	3.0	3.1	UZ	34	38	4	1	2	1	Dart
T13H-007	3.1	3.3	UZ	39	41	2	2	2	0	Dart
T13H-013	3.0	3.5	UZ	44	42	-2	1	2	1	Dart
T13H-011	3.0	3.5	UZ	56	58	2	2	2	0	Dart
T13H-010	3.0	3.5	UZ	39	19	-20	13	4	-9	Dart
LMD18-01	175.9	176.0	LZ	26	33	7	6	14	8	Javelin
LMD19-03	27.8	27.9	LZ	48	8	-40	8	1	-7	Javelin

Infill Brine Sampling

Prior to 2018-19, brine sampling programs within Agrimin's WA tenements were conducted at 5km spacing in most areas. In 2019 Agrimin conducted two infill drilling programs whose primary objectives were to obtain brine samples of the upper 6m of lakebed sediments to assess the short-spaced (<5km) variability in brine grade. Under the guidance of Stantec, two sites were selected for infill drilling, namely: areas surrounding Trench 02A in the southwest and Trench 13 in the east of lake. The brine sample locations and sample results surrounding Trench 02A and Trench 13 are shown in Figure 6.26 and Figure 6.27 respectively. Brine sampling procedures and methods used for this infill sampling program are discussed in Chapter 5 in this report.

Figure 6.26 Trench 02A Infill Brine Sampling

Figure 6.27 Trench 13 Infill Brine Sampling

As shown in Figure 6.26 and Figure 6.27, the infill brine sampling was conducted at sample spacing varying from 500m immediately surrounding the trench, located at T02AH-001 and T13H-001, to 1,500m at the outer extremities. Results show that there was not a significant variation in potassium grade with increasing distance from the trench, however the notable exceptions are for sample sites on or nearby islands at sites T02AH-007 and T02AH-009 and at site T02AH-013 as shown in Figure 6.26. Brine grade dilution underneath islands is discussed in Section 6.4.2 of this chapter. The low grades observed at site T02AH-013 is anomalous and is interpreted to be possibly associated with surface piping (fracturing) that may have introduced fresh water to that immediate area. Bine grades observed at site T02AH-013 were not included as part of the resource estimate since a bottom cut of 1500 mg/l potassium has been applied.

Overall, the results on the infill brine sampling program shows that there is not a significant variation in brine grades on the lakebed at distances less than 5km.

Model Review

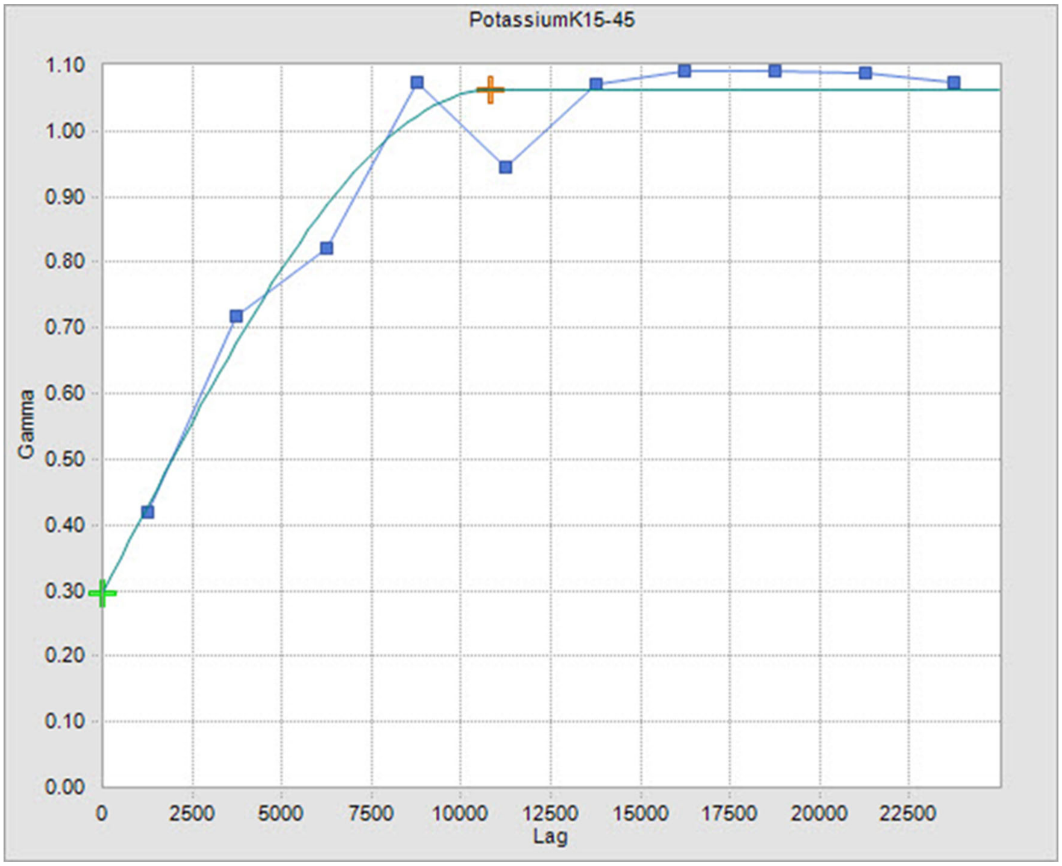
Model grid estimates were reviewed against point source data where applied. Results did not show any departure of material significance between the input data and corresponding grid estimates.

Resource Classification

Separate Measured, Indicated and Inferred resource areas have been identified for each resource horizon based on the quantity, quality and distribution of physical parameters, plus overall geological complexity. Geospatial analysis of the potassium brine grades was also used to help guide the understanding of the confidence in the data based on distances of sample pairs.

Semi-variograms generated from potassium concentration assay results indicate that there is a statistical relationship between sample pairs at distance of up to 10,000m. Figure 6.28 is a global semi-variogram of the potassium grade data at Lake Mackay. Using these geospatial observations as a guide, the Measured Mineral Resource was considered for ranges of up to approximately 2,500m from the nearest sample site and the Indicated Mineral Resource up to approximately 5,000m.

Figure 6.28 Potassium Brine Grade Semi-variogram



The potassium Mineral Resource exploration at Lake Mackay has focused on the UZ located in the Company's Western Australia (WA) tenements, and correspondingly this area contains the Measured plus Indicated Mineral Resource. The UZT is the target Mineral Resource horizon for proposed brine extraction via surface trenches and has been the primary focus of the Company's exploration at Lake Mackay. The exploration data supports a Measured plus Indicated Mineral Resource for the saturated portions of the UZT (0.5m to 3m) and an Indicated Mineral Resource for the overlying unsaturated portion of the UZT (0 to 0.5m). The Mineral Resource zone directly below islands is classified as Inferred based on quantity of data associated with these areas.

The distribution of the classified Mineral Resource from for each five Mineral Resource horizons are shown in Figure 6.29 through Figure 6.33.

Figure 6.29 UZT Resource Classification Plan

Figure 6.30 UZB Resource Classification Plan

Figure 6.31 LZ1 Resource Classification Plan

Figure 6.32 LZ2 Resource Classification Plan

Figure 6.33 LZ3 Resource Classification Plan

Mineral Resource Estimates

The drainable porosity Mineral Resource estimates are shown in Table 6.13 and the total porosity Mineral Resources are shown in Table 6.14. The Mineral Resources are reported in accordance with the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves' (JORC Code, 2012 Edition). The JORC Code (2012) 'Table 1 Checklist of Assessment and Reporting Criteria' can be found in Appendix A of this report. The Competent Person's statement can be found in Appendix B of this report.

The Mineral Resource estimates are reported for five layered, potassium-enriched brine resource zones (horizons) that overly a consolidated basement. The drainable porosity (or specific yield) Mineral Resource contains 123 million tonnes ("Mt") of SOP to a maximum depth of 211m, as shown in Table 6.13. This Drainable Porosity Mineral Resource represents the static free-draining portion of the Total Porosity Mineral Resource prior to extraction. It does not consider any groundwater recharge which could increase the amount of extractable brine over the life of an operation. The project area has an average annual rainfall of 320mm and the brine resource commences only 50cm below lake bed surface.

The total porosity Mineral Resource contains 1,096Mt of SOP to a maximum depth of 211m, as shown in Table 6.14. A portion of the Total Porosity Mineral Resource, in addition to the Drainable Porosity Mineral Resource, will be extractable depending on the transient groundwater flow and transport conditions affecting the brine resource during extraction and the active recharge regime within the lake system. This recharge is particularly relevant to the upper zone of the Mineral Resource. A substantial portion of the lower zone Total Porosity Mineral Resource may not ultimately be extracted.

The Mineral Resource area is limited to the extent of the Company's tenements in Western Australia, tenement applications in Northern Territories (NT), Lake Mackay's boundary and the basement topography that underlies the lakebed sediments. The classification of the Mineral Resource horizons shown in the Table 6.13 and Table 6.14 is shown in Figure 6.29 through Figure 6.33. The potassium grade distribution for the Mineral Resource horizons are shown in Figure 6.17 through Figure 6.21.

Table 6.13 Drainable Porosity Mineral Resource Estimate (otherwise known as Specific Yield)

Resource Zone	Aquifer Volume (Mm^3)	Measured plus Indicated						Inferred		Total Resource	
		Measured		Indicated		Total		Total			
		K (mg/l)	SOP (Mt)	K (mg/l)	SOP (Mt)	K (mg/l)	SOP (Mt)	K (mg/l)	SOP (Mt)	K (mg/l)	SOP (Mt)
UZT	10,568	3,473	3.9	3,719	3.3	3,558	7.3	2,969	3.7	3,360	11.0
UZB	28,636	-	-	3,405	6.5	3,405	6.5	3,084	3.6	3,292	10.1
LZ1	48,127	-	-	3,542	9.7	3,542	9.7	3,428	9.0	3,487	18.7
LZ2	248,711	-	-	-	-	-	-	3,382	75.0	3,382	75.0
LZ3	17,003	-	-	-	-	-	-	1,910	8.7	1,910	8.7
Total	**353,046**	**3,473**	**3.9**	**3,527**	**19.5**	**3,509**	**23.5**	**3,232**	**99.9**	**3,285**	**123.4**

Note: Million metric tonnes differences in totals are due to rounding and considered non-material.

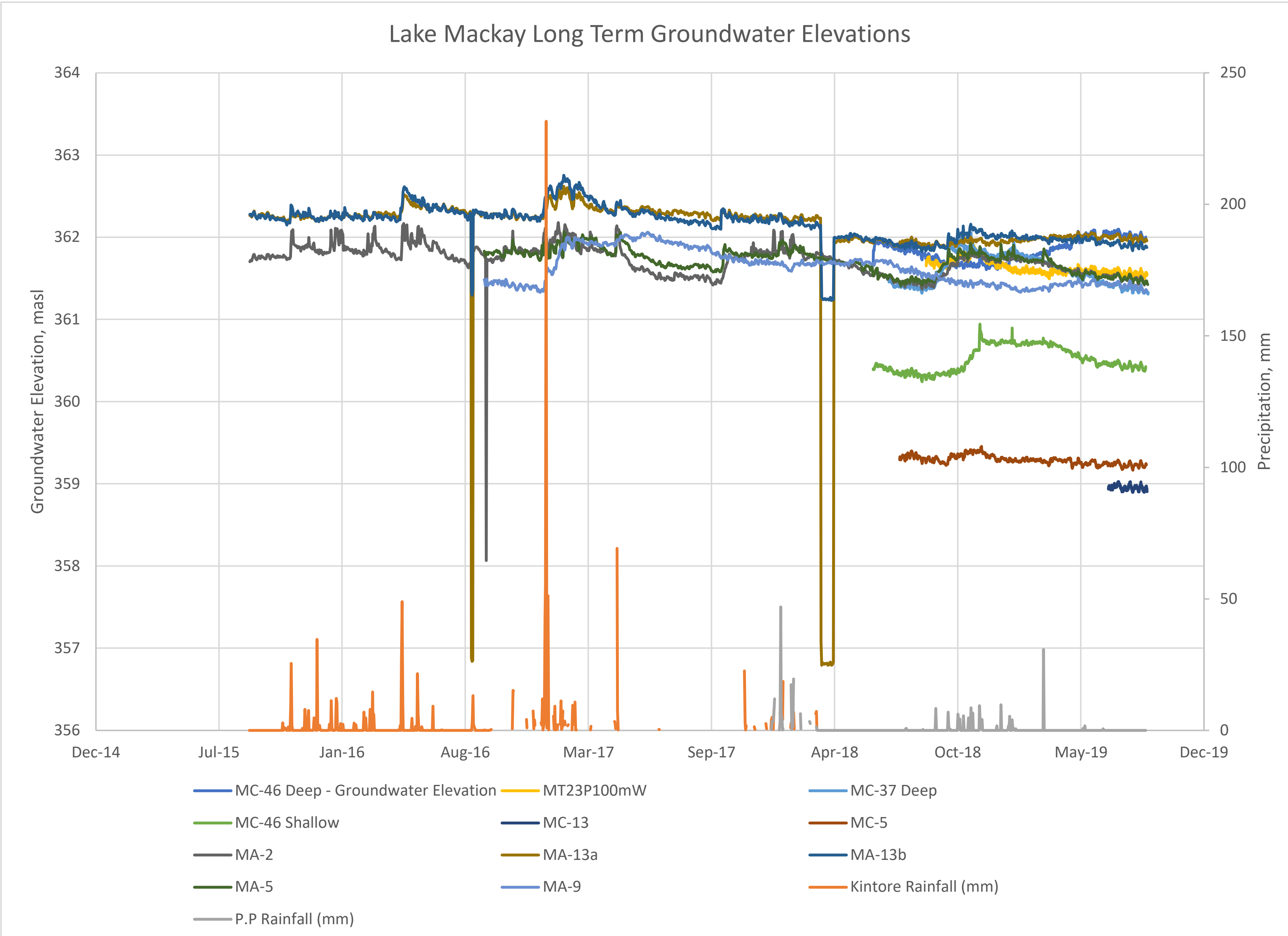
Table 6.14 Total Porosity Mineral Resource Estimate

Resource Zone	Aquifer Volume (Mm^3)	Measured plus Indicated						Inferred		Total Resource	
		Measured		Indicated		Total		Total			
		K (mg/l)	SOP (Mt)	K (mg/l)	SOP (Mt)	K (mg/l)	SOP (Mt)	K (mg/l)	SOP (Mt)	K (mg/l)	SOP (Mt)
UZT	10,568	3,473	16.5	3,719	8.6	3,558	25.1	2,952	10.9	3,375	36.0
UZB	28,636	-	-	3,405	54.6	3,405	54.6	3,084	29.8	3,292	84.4
LZ1	48,127	-	-	3,542	81.4	3,542	81.4	3,428	75.7	3,487	157.0
LZ2	248,711	-	-	-	-	-	-	3,382	787.8	3,382	787.8

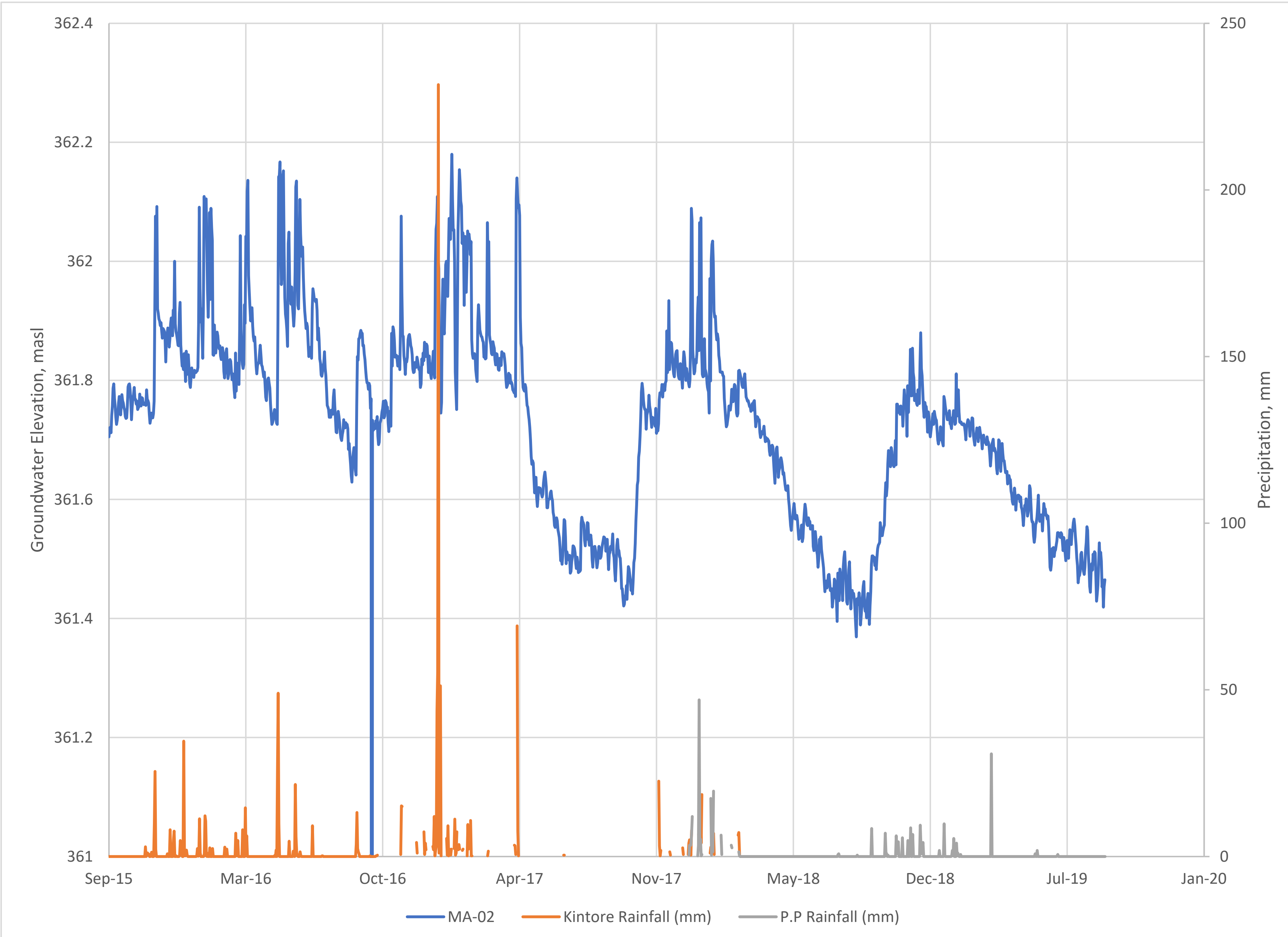
LZ3	17,003	-	-	-	-	-	-	1,910	30.4	1,910	30.4
Total	**353,046**	**3,473**	**16.5**	**3,501**	**144.6**	**3,498**	**161.1**	**3,323**	**934.6**	**3,349**	**1,095.7**

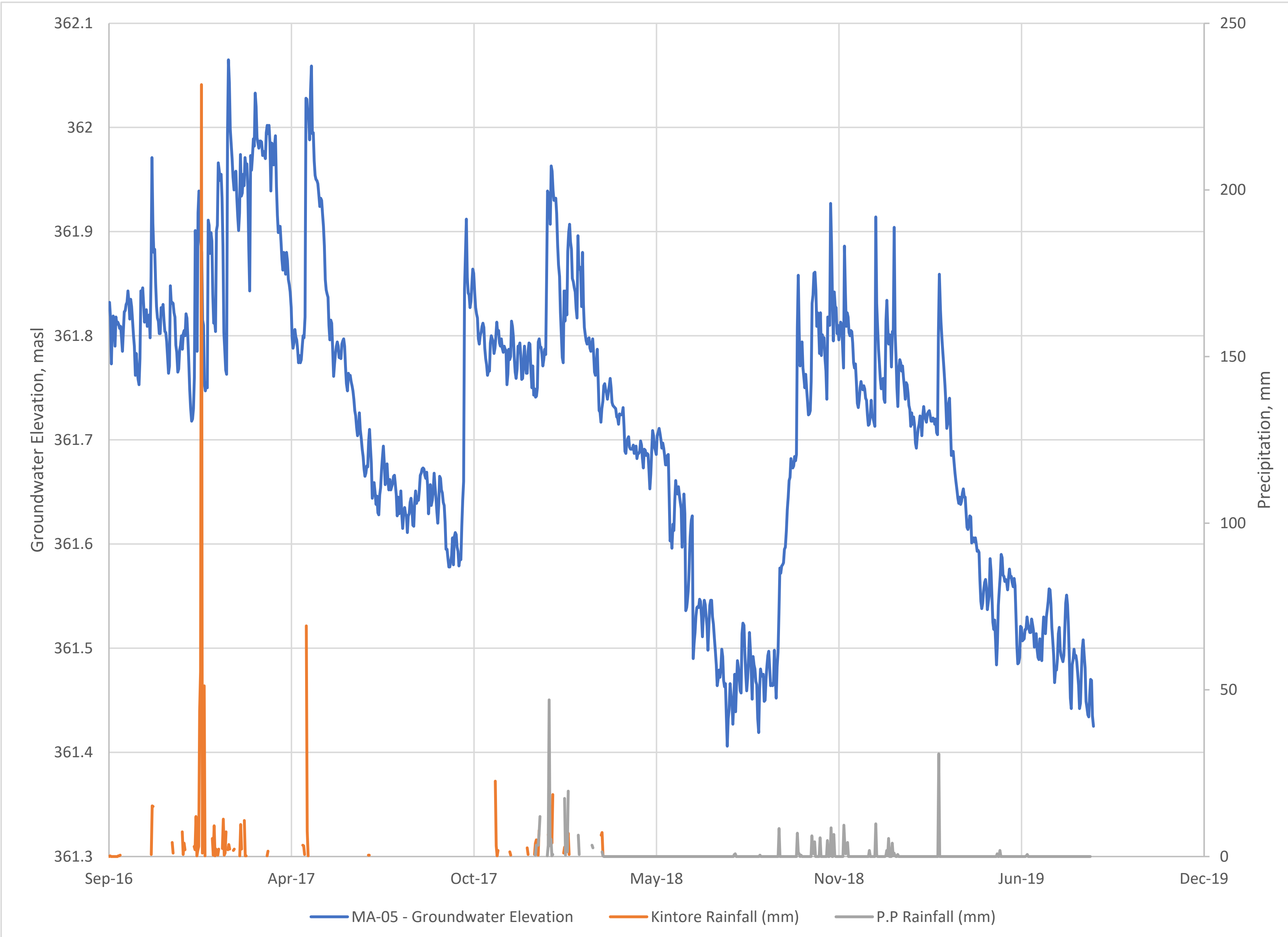
Note: Million metric tonnes differences in totals are due to rounding and considered non-material.

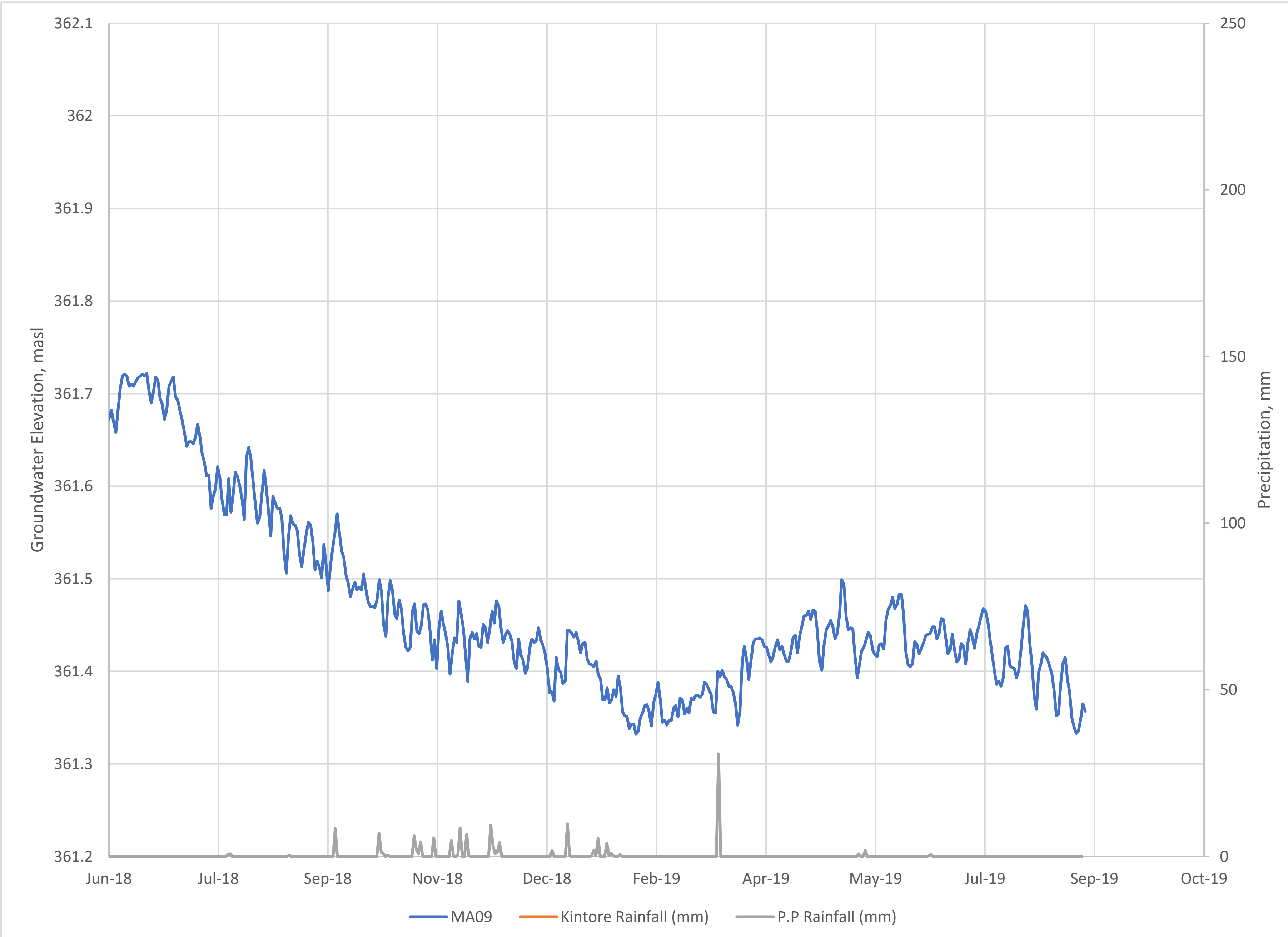
Appendix C ON-LAKE BORE HYDROGRAPHS



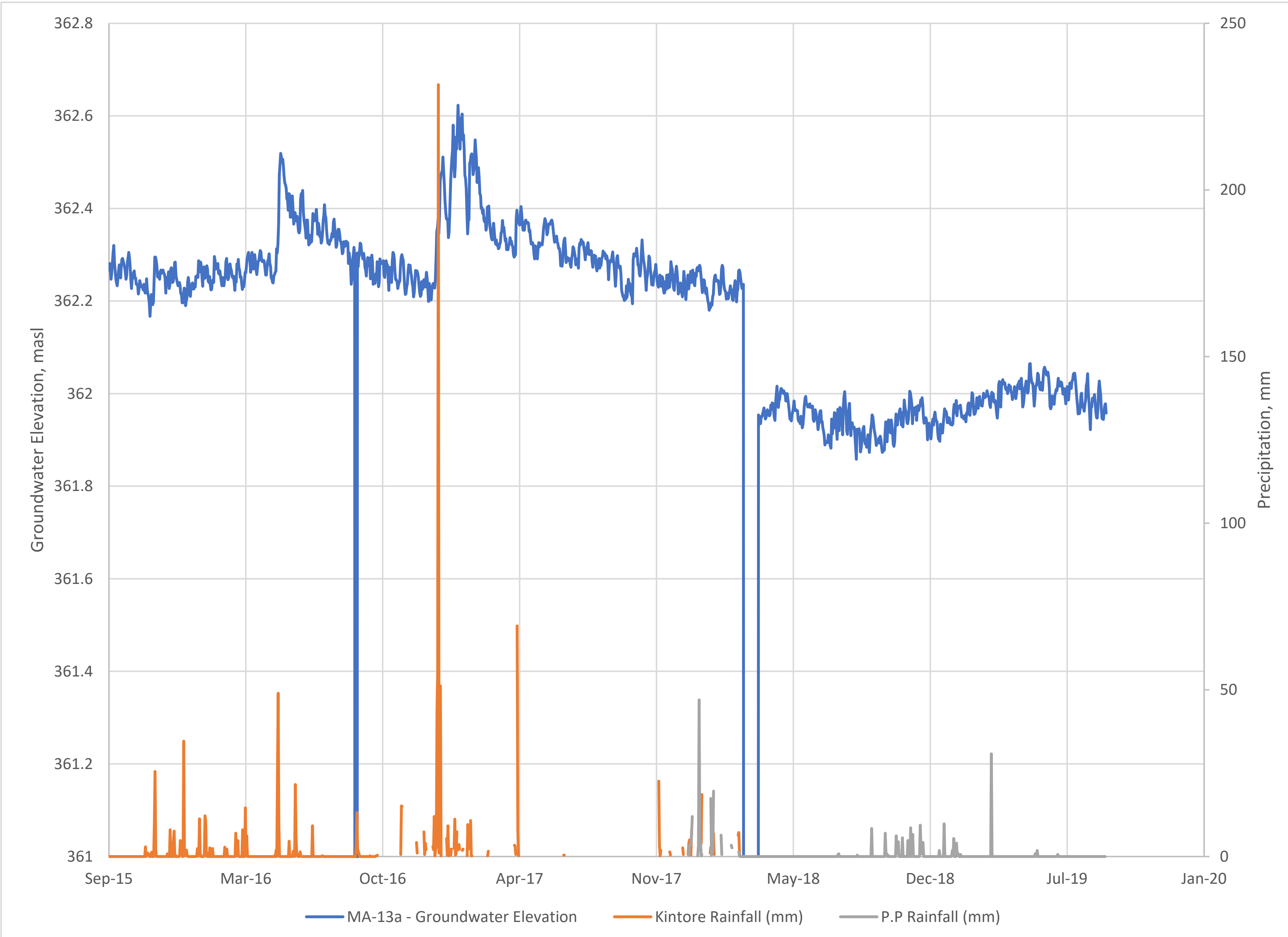
Lake Mackay Long Term Groundwater Elevations
Groundwater Elevation, masl
Precipitation, mm
364
363
362
361
360
359
358
357
356
250
200
150
100
50
0
Dec-14
Jul-15
Jan-16
Aug-16
Mar-17
Sep-17
Apr-18
Oct-18
May-19
Dec-19
MC-46 Deep - Groundwater Elevation
MT23P100mW
MC-37 Deep
MC-46 Shallow
MC-13
MC-5
MA-2
MA-13a
MA-13b
MA-5
MA-9
Kintore Rainfall (mm)
P.P Rainfall (mm)


362.4
362.2
362
361.8
361.6
361.4
361.2
361
Groundwater Elevation, masl
250
200
150
100
50
0
Precipitation, mm
Sep-15
Mar-16
Oct-16
Apr-17
Nov-17
May-18
Dec-18
Jul-19
Jan-20
MA-02
Kintore Rainfall (mm)
P.P Rainfall (mm)

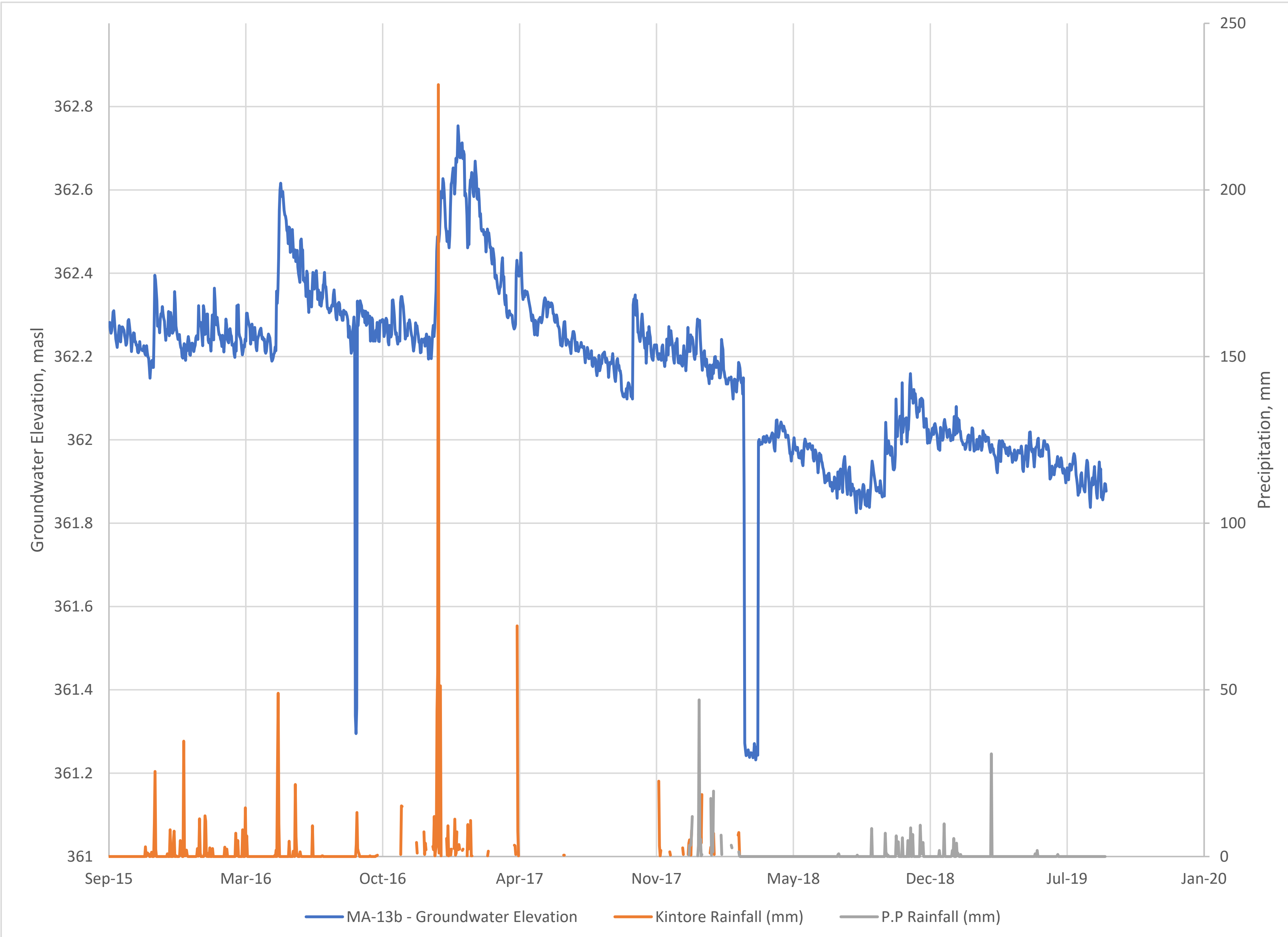

Groundwater Elevation, masl
Precipitation, mm
362.1
362
361.9
361.8
361.7
361.6
361.5
361.4
361.3
250
200
150
100
50
0
Sep-16
Apr-17
Oct-17
May-18
Nov-18
Jun-19
Dec-19
MA-05 - Groundwater Elevation
Kintore Rainfall (mm)
P.P Rainfall (mm)



362.1
362
361.9
361.8
361.7
361.6
361.5
361.4
361.3
361.2
Groundwater Elevation, masl
250
200
150
100
50
0
Precipitation, mm
Jun-18
Jul-18
Sep-18
Nov-18
Dec-18
Feb-19
Apr-19
May-19
Jul-19
Sep-19
Oct-19
MA09
Kintore Rainfall (mm)
P.P Rainfall (mm)



Groundwater Elevation, masl
Precipitation, mm
362.8
362.6
362.4
362.2
362
361.8
361.6
361.4
361.2
361
250
200
150
100
50
0
Sep-15
Mar-16
Oct-16
Apr-17
Nov-17
May-18
Dec-18
Jul-19
Jan-20
MA-13a - Groundwater Elevation
Kintore Rainfall (mm)
P.P Rainfall (mm)



Groundwater Elevation, masl
Precipitation, mm
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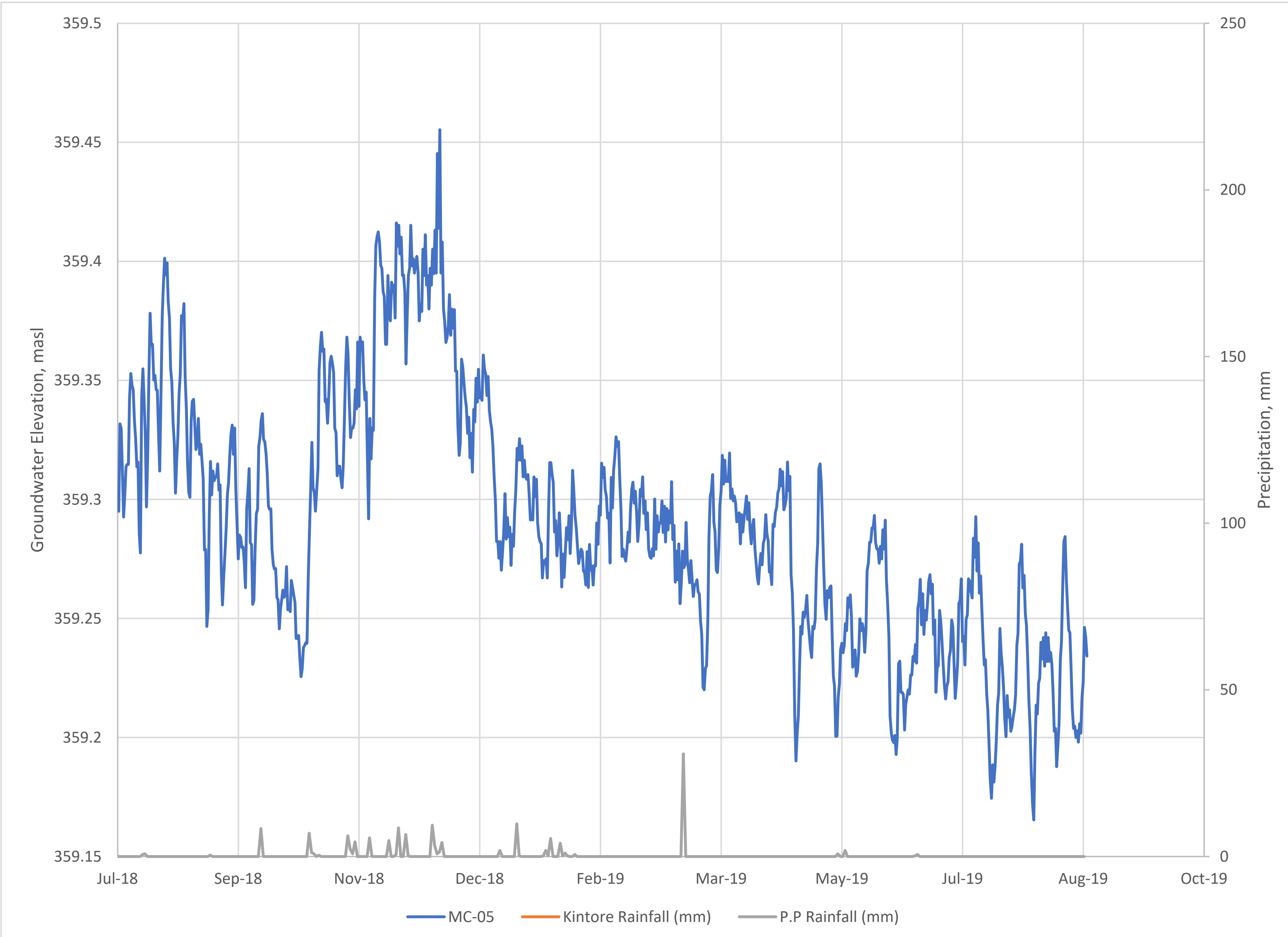
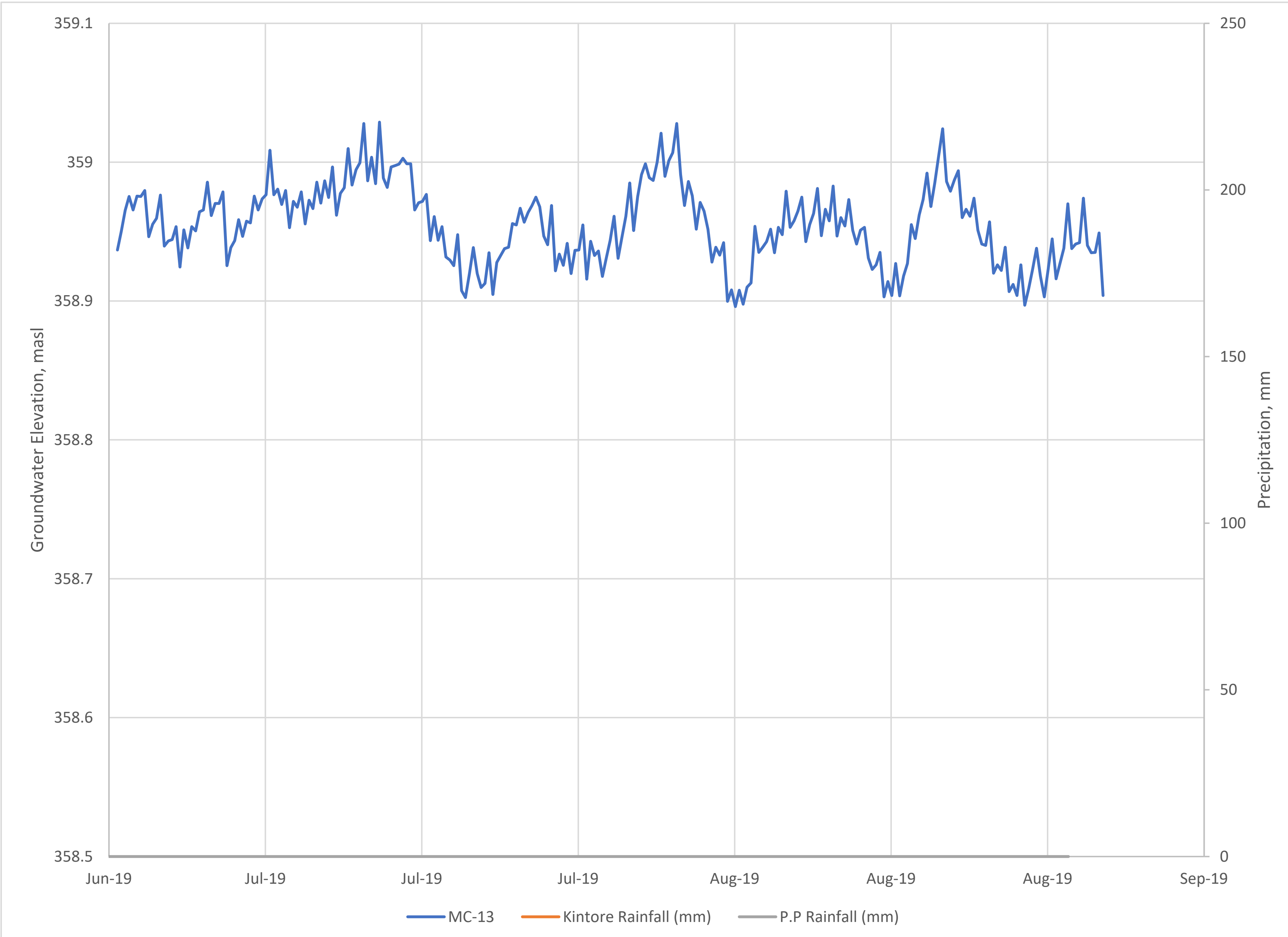
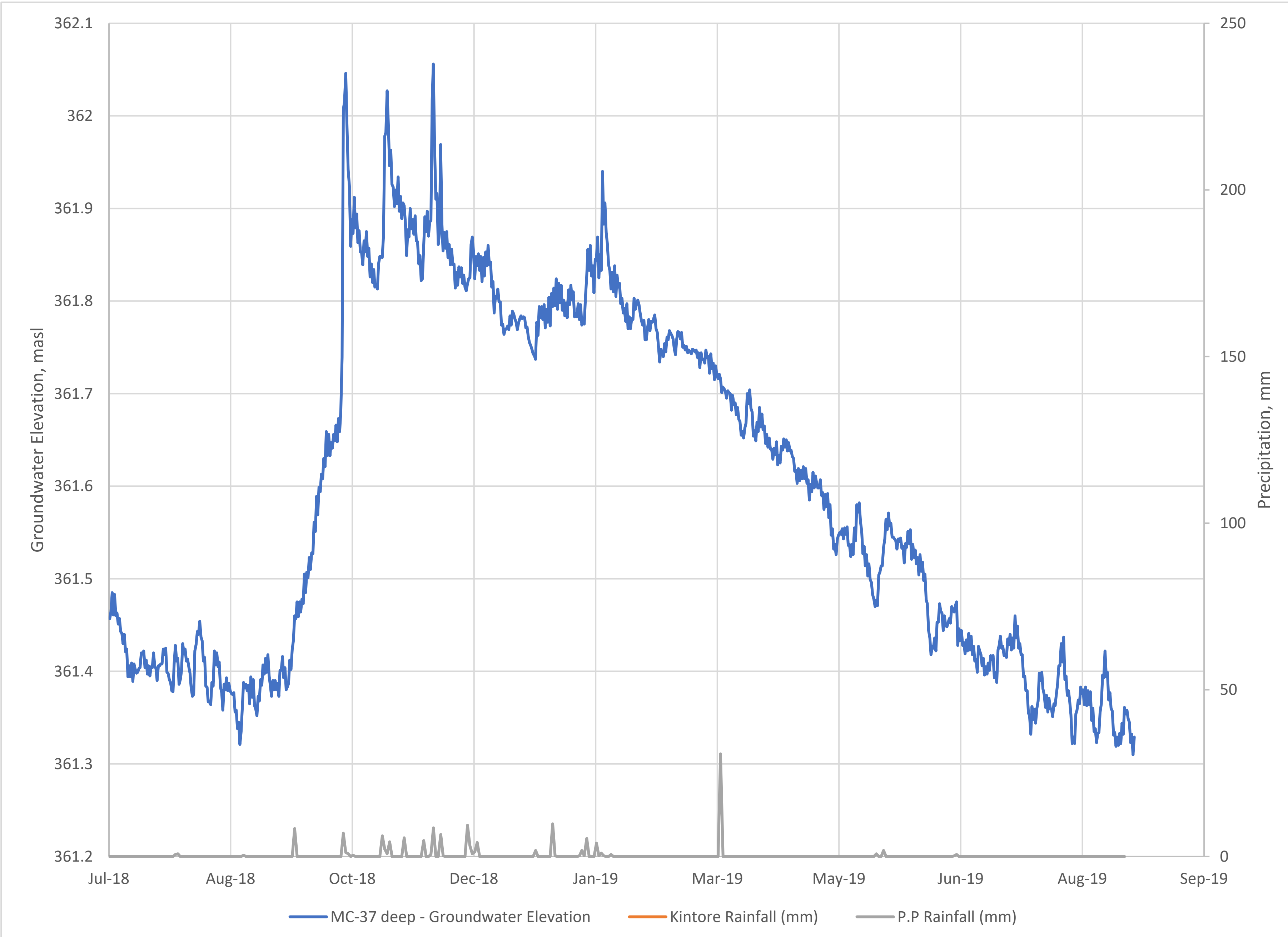
362.6
362.4
362.2
362
361.8
361.6
361.4
361.2
361
250
200
150
100
50
0
Sep-15
Mar-16
Oct-16
Apr-17
Nov-17
May-18
Dec-18
Jul-19
Jan-20
MA-13b - Groundwater Elevation
Kintore Rainfall (mm)
P.P Rainfall (mm)



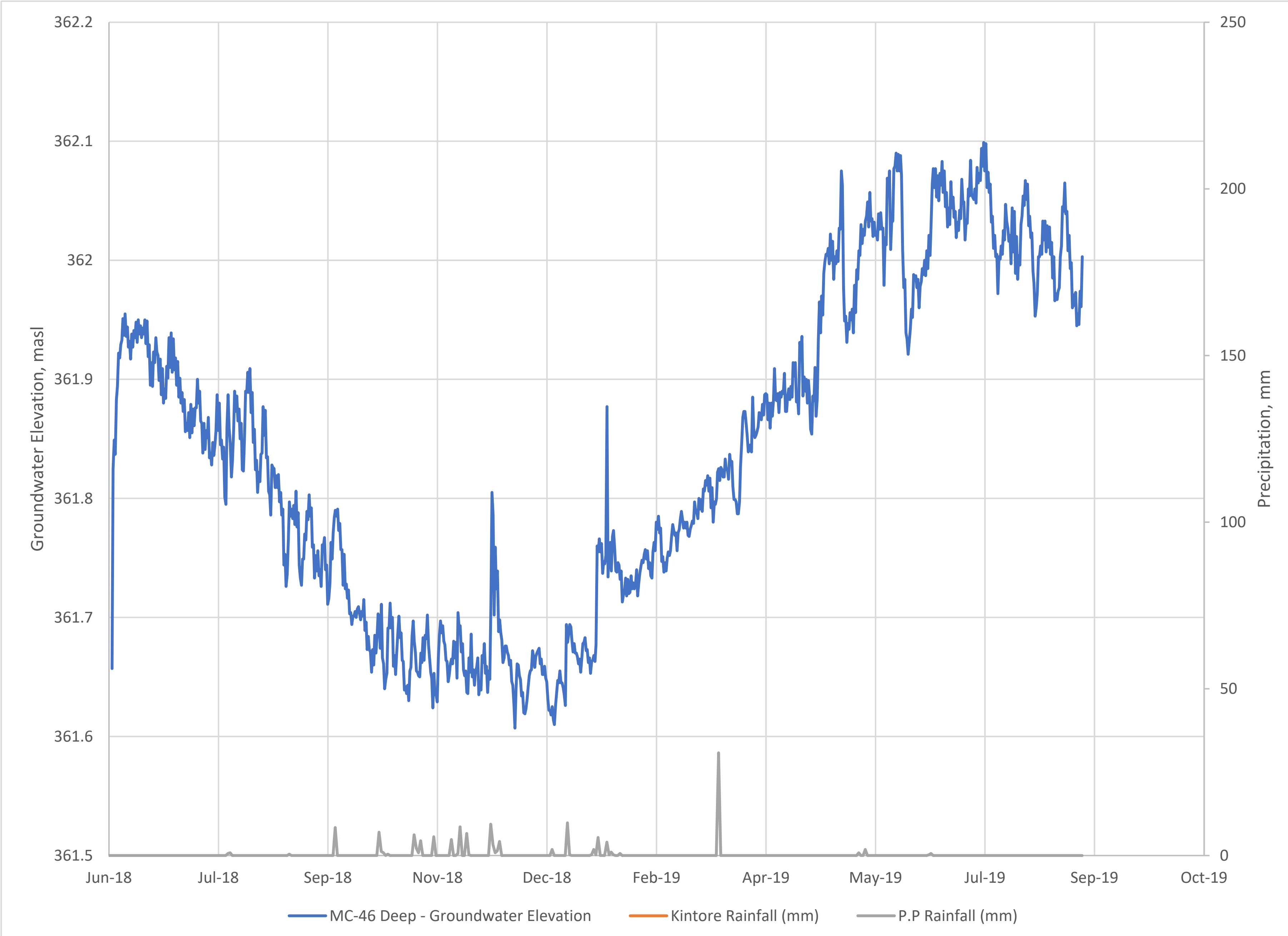
Groundwater Elevation, masl
Precipitation, mm
359.5
359.45
359.4
359.35
359.3
359.25
359.2
359.15
250
200
150
100
50
0
Jul-18
Sep-18
Nov-18
Dec-18
Feb-19
Mar-19
May-19
Jul-19
Aug-19
Oct-19
MC-05
Kintore Rainfall (mm)
P.P Rainfall (mm)



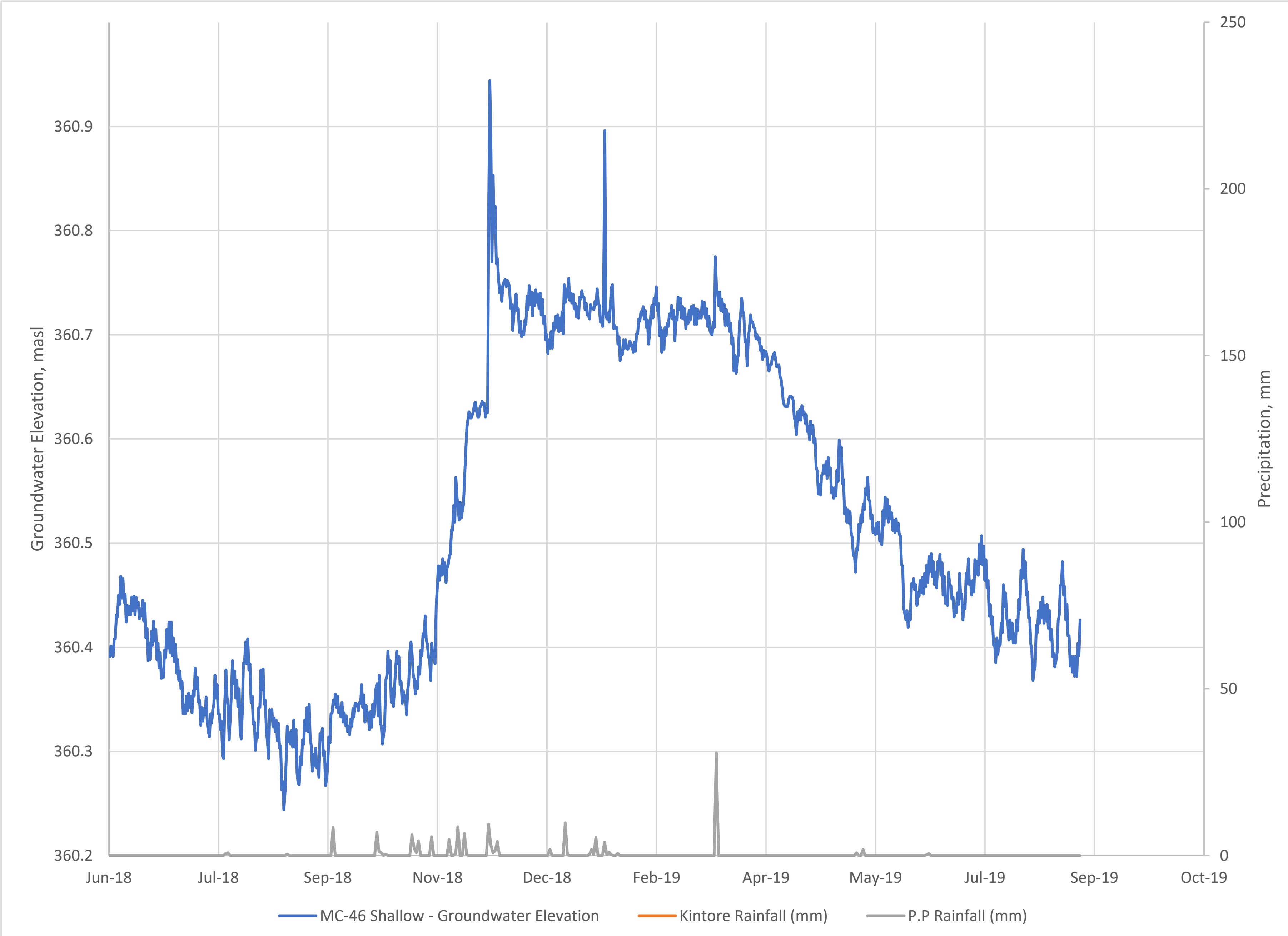
359.1
359
358.9
358.8
358.7
358.6
358.5
Groundwater Elevation, masl
250
200
150
100
50
0
Precipitation, mm
Jun-19
Jul-19
Jul-19
Jul-19
Aug-19
Aug-19
Aug-19
Sep-19
MC-13
Kintore Rainfall (mm)
P.P Rainfall (mm)



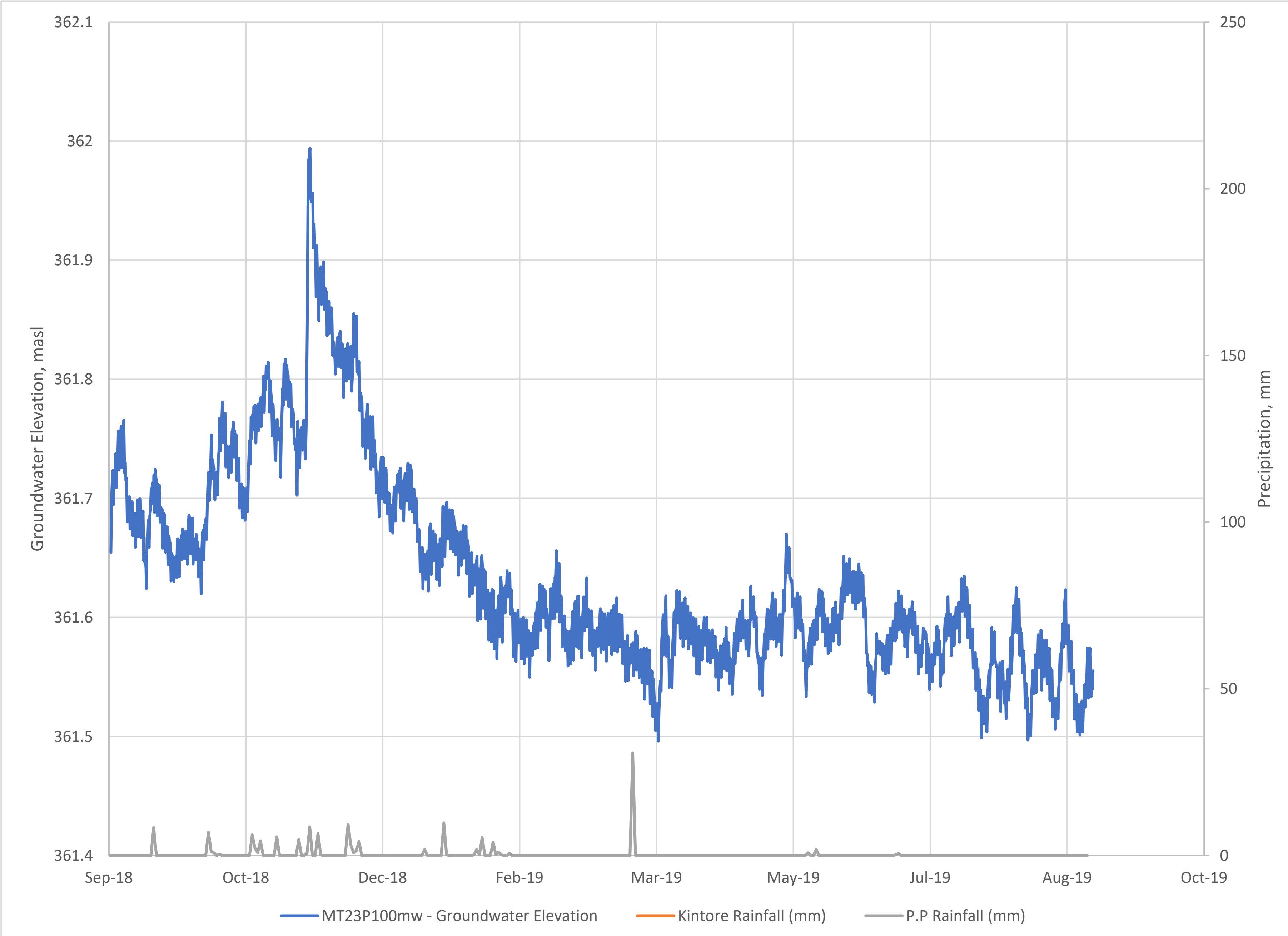
362.1
362
361.9
361.8
361.7
361.6
361.5
361.4
361.3
361.2
Groundwater Elevation, masl
250
200
150
100
50
0
Precipitation, mm
Jul-18
Aug-18
Oct-18
Dec-18
Jan-19
Mar-19
May-19
Jun-19
Aug-19
Sep-19
MC-37 deep - Groundwater Elevation
Kintore Rainfall (mm)
P.P Rainfall (mm)



362.2
362.1
362
361.9
361.8
361.7
361.6
361.5
Groundwater Elevation, masl
250
200
150
100
50
0
Precipitation, mm
Jun-18
Jul-18
Sep-18
Nov-18
Dec-18
Feb-19
Apr-19
May-19
Jul-19
Sep-19
Oct-19
MC-46 Deep - Groundwater Elevation
Kintore Rainfall (mm)
P.P Rainfall (mm)



Groundwater Elevation, masl
Precipitation, mm
360.9
360.8
360.7
360.6
360.5
360.4
360.3
360.2
250
200
150
100
50
0
Jun-18
Jul-18
Sep-18
Nov-18
Dec-18
Feb-19
Apr-19
May-19
Jul-19
Sep-19
Oct-19
MC-46 Shallow - Groundwater Elevation
Kintore Rainfall (mm)
P.P Rainfall (mm)


362.1
362
361.9
361.8
361.7
361.6
361.5
361.4
Groundwater Elevation, masl
250
200
150
100
50
0
Precipitation, mm
Sep-18
Oct-18
Dec-18
Feb-19
Mar-19
May-19
Jul-19
Aug-19
Oct-19
MT23P100mw - Groundwater Elevation
Kintore Rainfall (mm)
P.P Rainfall (mm)

Appendix D TRENCH TEST ANALYSIS REPORT

Trench Test Analysis Report

Mackay Potash Project

July 18, 2019

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Revision	Description	Author		Quality Check		Independent Review	
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Rev2	Final with client comments	Okeson/ Reinke	7/17/19	Reinke/ Jack	7/18/19	Henchel/ Gillian	7/17/19

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(signature)

Richard Reinke

Reviewed by ______________________________
(signature)

Larry Henchel

Approved by ______________________________
(signature)

Greg Gillian

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LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

All attachments are being transmitted as separate electronic files.

Abbreviations

Agrimin	Agrimin Limited
ATO	adaptive time-stepping
bgs	below ground surface
cm	centimeters
DFS	Definitive Feasibility Study
DTW	depth to water
km	kilometer(s)
L/s	Liters per second
m	meter
m/day	meters per day
mm	millimeters
MFSF	Modflow-Surfact Version 4.0 (MFSF).
MPP	Mackay Potash Project
PCG5	MODFLOW PGC solver
PEST	Parameter ESTimation
PFS	Pre-feasibility Study
Stantec	Stantec Consulting International LLC
USGS	United States Geological Survey

1.0 INTRODUCTION

This report details the analysis performed by Stantec Consulting International LLC (Stantec)on pump testing of prototype trenches by Agrimin Limited (Agrimin) at Lake Mackay, Western Australia.

1.1 PROJECT HISTORY

Agrimin Limited (Agrimin) is developing the Mackay Potash Project (MPP) on and near Lake Mackay in Western Australia. The project is based on extracting brine from trenches on the Lake. Several groundwater models have been developed historically for this brine extraction process. These models have been used to progress the MPP through the Pre-feasibility Study (PFS) stage.

1.2 ANALYSIS OBJECTIVES

The MPP is currently moving to the Definitive Feasibility Study (DFS) stage of project development. This requires refinement of the hydrogeological understanding of the lake and the proposed on-lake trench network. A series of 100 meter (m) long trenches were excavated on the lake, and short-term trench pumping tests have been conducted to evaluate hydraulic properties of the lake sediments. Long-term production tests are currently being conducted at two of these trenches (T02A and T13).

This report documents the short-term trench testing and analyses and preliminary analyses of the long term testing at T02A and T13. The long-term trench tests at T02A and T13 will be documented in detail in a separate report.

1.3 REPORT ORGANIZATION

This report is organized into nine chapters, including this introductory chapter. Chapter 2 gives a generic trench test description. Chapter 3 summarizes the external data (barometric pressure, precipitation, and evapotranspiration) that impact the test analysis. Chapter 4 presents the analysis approach for a trench test. Chapter 5 summarizes the trench test execution. Chapter 6 summarizes the trench test analysis results. Conclusions and recommendations are presented in Chapter 7, and limitations of the analysis are presented in Chapter 8. Cited references are presented in Chapter 9. Individual trench test analysis summaries are attached as appendices.

2.0 GENERIC TRENCH TEST DESCRIPTION

This section describes the general approach to conducting a trench test and the data gathered. There were 17 trench tests undertaken. The trench test locations are shown on Figure 2-1, in Appendix B.

2.1 TRENCH CONSTRUCTION

The trenches were constructed with an excavator. The excavator moved across the lake to a pre-determined test location. Several days were spent constructing the trench and installing monitoring piezometers. The trenches were generally 100 m long, 6 m wide at the surface, 1 m wide at the base, and 6 m deep. Individual trench construction was field modified to adjust to site conditions.

Each trench construction was documented with a short summary report. These reports generally included a post-construction summary table, notes on lithology and ground conditions, construction notes, site photographs, piezometer installation summary, observations of the hydraulic behavior of the trench during construction, trench location, and if a trench pump out test was conducted or planned.

The trench construction summary reports were the basis for construction of the groundwater flow models for analysis of trench pump out tests. The individual trench construction reports are included in the attachments summarizing the analysis of that trench test.

2.2 TRENCH PUMPING TESTING

During trench construction, groundwater flowing into the trench was controlled and removed by pumping or removal by construction equipment. This created an initial cone of depression around the trenches. Following construction, the groundwater was given time to equilibrate prior to the trench test being initiated.

2.2.1 Monitoring Set Up

Water levels were monitored with recording pressure transducers in the surrounding piezometers. Before a test began, transducers were installed in the piezometers and in the trench to quantify the pressure changes at those locations. The data was typically logged at 15 minute intervals in the trench and every 6 hours in the monitoring piezometers. Piezometer water levels were recorded at 15 minute intervals for the first few tests.

A pump was installed in the trench with an in-line flow meter installed in the discharge line. Flow rates were reported, and for some tests the total volume of water produced at discrete intervals was recorded. The change in flow meter totalizer readings indicated the volume of water that had been pumped since the previous reading.

2.2.2 Test Procedure

The test was initiated by pumping water from the trench and discharging at distance of 400 to 500 m from the trench to reduce the possibility of recharging the aquifer in the vicinity of the trench. The pumping rate was generally decreased after an initial trench water level pump-down. The test sites were visited at one to three-day intervals as the test was conducted to take measurements and ensure the test equipment was functioning.

After the pumping rates and observed water levels appeared to stabilize, pumping was terminated. The water level recovery was monitored for a period after pumping for all of the tests. Following recovery, the transducers and other equipment were recovered from the site.

3.0 EXTERNAL IMPACTS ON TRENCH TESTS

The primary data gathered from the tests were changes in water pressure recorded by transducers and volumes of water extracted. The changes in observed water pressure are influence by factors besides the pumping of water from the trench (barometric pressure, precipitation, and evapotranspiration). This section describes these factors and the approach taken to account for these factors in analysis of the trench tests.

3.1 BAROMETRIC PRESSURE

Changes in atmospheric pressure can produce large fluctuations in pressure transducer readings in wells or piezometers. The effect of barometric pressure was removed from all piezometer data based on regional barometric data recorded at the Walungurru Air Station located in Kintore, Northern Territory approximately 80 kilometers (km) southeast of Lake Mackay. An example of barometric pressures recorded at the Kintore station are shown on Figure 3-1, in Appendix B.

3.2 PRECIPITATION

Precipitation at the site is generally low with a mean annual rainfall of approximately 281 mm/year in the Lake area (Knight Piesold, 2018). Precipitation occurs in isolated events with high variability in precipitation amounts. Most of the precipitation occurs over the November to March period with lower mean precipitation over the April to October period.

Precipitation can impact the observed groundwater levels due to recharge of the water table as precipitation infiltrates through the lakebed surface. This mechanism is currently being quantified with various recharge specific experiments at several locations across Lake Mackay.

For the purpose of the trench test analysis, the periods of reported precipitation were compared with the period over which each test was conducted. This was done for both data from the on-site weather station located near pilot ponds (Figure 3-2, in Appendix B) and, in some cases, trench specific precipitation monitoring. The correlation of the precipitation and changes in observed water levels was examined. If there was no precipitation during or right before the test period, recharge was not considered in the test analysis. If there was a correlation between precipitation and observed water levels, the amount of recharge was estimated from the water level changes.

3.3 EVAPOTRANSPIRATION

Lake Mackay is a terminal lake, meaning that the amount of water coming into the lake surface and subsurface and leaving the surface and subsurface is either in balance or results in longer-term changes in water levels. In most instances, the water budget appeared to be in balance.

Mean annual evaporation is approximately 3,270 millimeters (mm) and is greatest during the months of November, December, and January. The mean annual evaporation is an order of magnitude larger than the mean annual rainfall.

4.0 TRENCH TEST ANALYSIS

The standard trench test analysis approach is described in this section. The goal of the analysis was to identify composite properties for a trench in that area of the lakebed. There is considerable heterogeneity, especially in the vertical direction as the trench completion reports demonstrate. While it is possible to over-parametrize a numerical model and achieve a better fit to observations, it is important to focus on the questions the model is being used to answer. In this case, the trench pumping tests were being conducted to investigate the long-term potential for trenches to produce brine across the lakebed at a scale of 100 m in length or larger. The parameters obtained from this analysis are reflective of the overall performance of a trench.

The following sections describe the data used to construct local scale groundwater models for each trench location. A sensitivity analysis was conducted to identify a likely range of parameter values. The models were then analyzed with the PEST (Parameter ESTimation) program starting from the current best parameter fit of the model results to the observed water level responses in the monitoring piezometers.

4.1 DATA USED

Stantec was provided with a completion report of the trench construction, raw data logger files, photos, and processed data for each trench test including flow rate and totalizer readings and water levels in the piezometers. Meteorological data was available from the pilot pond weather station and the Kintore weather station.

4.2 MODEL CODE

A numerical model framework was developed using Modflow-Surfact Version 4.0 (MFSF). This is an enhanced version of the a publicly available groundwater flow simulation program MODFLOW developed by the United States Geological Survey (USGS) and is designed to simulate three-dimensional groundwater flow using the finite-difference method. The program was selected for this study, in part, because it is thoroughly documented, widely used by consultants, government agencies, and researchers, and is consistently accepted in regulatory and litigation proceedings.

In addition to its attributes of widespread use and acceptance, MFSF was selected because of its versatile simulation features. MFSF can simulate transient or steady-state saturated groundwater flow in one, two, or three dimensions and offers a variety of boundary conditions, including specified head, areal recharge, hydraulic barriers, injection or extraction wells, evapotranspiration, drains, and rivers or streams. Aquifers simulated by MFSF can be confined or unconfined, or convertible between confined and unconfined conditions. MFSF's three-dimensional capability and boundary condition versatility are essential for the simulation of groundwater flow conditions given the complex hydrostratigraphy of the Study Area, which consists of a multi-layered geologic system with variable unit thicknesses and the hydrogeologic framework necessitates the inclusion of a variety of boundary conditions. MFSF has an advanced version of the MODFLOW PGC solver (PCG5) which utilizes adaptive time-stepping (ATO) which was required to efficiently solve the groundwater flow model finite-difference equations. The parameter estimation code, PEST, was used in the calibration of the models.

4.3 MODEL DISCRETIZATION

Model grids were developed to facilitate representation of the physical trench dimensions. The base model domain is 1,000 m wide by 1,000 m long and 6 m thick. It is divided into 114 rows, 144 columns, and 5 active model layers. The trench is oriented north to south in the middle of the model grid with columns being 1m wide in this area to accurately capture the changes in the trench width with depth. There are five model layers with the first four being 1 m thick and the fifth being 2 m thick. Model grid spacing is 10 m wide in the area of the trench so that the 100 m long trench covers 10 rows. Grid spacing reduces to 5 m at the north and south end of the trench to increase the model resolution for piezometers located along the main trench axis.

The model domain is bordered with constant head or general head boundary conditions. These were set to the same elevation as the initial water levels in the model. This reflects a groundwater system near equilibrium prior to the pumping test and reflects the ability of water to flow to the trench over greater distances.

Figure 4-1, in Appendix B shows the model grid and trench layout over both the whole model domain and a closeup of the trench area.

Trenches are represented by model cells of higher hydraulic conductivity and specific yield in the model to reflect the water-filled trench. The trench width in each model layer was based on the trench completion report and cells reflecting this width are given trench properties for the corresponding layer. This enables matching the amount of water available in the trench at the start of the pumping test so that water yield from the formation can be better estimated. The calculated water production was removed from the model by well boundary conditions set to the correct pumping rates for that model stress period. This enabled the model to extract the correct volume of water for each model stress period.

4.4 TRENCH PUMPING

The test pumping data consisted of spot flow rate readings and, in some cases, totalizer readings. Based on the processed data received, the time of the start of the test was identified, and the pumping rate changes over time noted as the test progressed. These periods of pumping rate changes were assigned individual stress periods in the model time discretization. A daily pumping rate in cubic meters per day was identified for each stress period of the model, and the rate was distributed proportionally in each trench cell using well boundary conditions along the trench length. A new stress period started when a significant change in the reported pumping rate occurred.

4.5 OBSERVATION DATA

The trench tests were monitored by recording changes in water level (or depth to water) using transducers at five or more piezometers that were installed either along the trench axis or perpendicularly away from the trench near the middle (50 m) of the length of the trench. In general, the trenches were oriented north to south, so the perpendicular piezometers were labeled east (E) or west (W) along with the distance from the trench center (commonly 20, 50, or 100 m). The wells along the trench axis were labeled north (N) or south (S) along with the distance from the trench end. To maintain consistency in the analysis approach, in the few instances where the trench was oriented east to west (T22 and T10) the trench was rotated for the model analysis so that the piezometers located perpendicular to the trench axis were represent in the model as east or west piezometers instead of the reported north or south locations.

Water levels in the trench and piezometers were recorded using pressure transducers supplemented by manual depth to water (DTW) measurements. The processed data was reported and plotted as depth to water and plotted in the processed data workbooks. An example of this is shown on Figure 4-2, in Appendix B.

Observed changes in water level were small enough such that they could be masked by changes in barometric pressure. To reduce this uncertainty, the changes in water level from the start of the test were adjusted by the changes in barometric pressure since the start of the test. A typical result of this barometric correct procedure is shown in Figure 4-3, in Appendix B. The data in this figure shows the pressure changes being smoother and more distinct after correction for barometric effects.

The observed changes in water level at the piezometers were used as targets for the trench test model calibration. The changes in water levels at the trench were reviewed for consistency with the reported trench pumping rates and overall changes in water level at the trench. The changes in trench water levels were not used as calibration targets for the model. The observed water levels in the trench could be impacted by skin effects of the trench walls or other localized phenomena, while the test analysis was focused on matching the water level response for the larger aquifer as represented by water level responses in the piezometers. The responses in water levels were converted to water level drawdown time series and the magnitude of observed drawdowns over time are the primary model calibration target.

Spreadsheets containing processed field data and barometric data and analysis are included in the digital data accompanying this report.

5.0 TRENCH TEST EXECUTION SUMMARY

The section describes the number of trenches constructed, the tests conducted, and test parameters such as pumping rates and observed inflows.

5.1 TRENCH LOCATIONS

A total of 24 locations where trench construction was planned are shown on Figure 2-1, in Appendix B. The trenches and testing periods are summarized on Table 5-1, in Appendix A.

5.2 PUMPING TESTS CONDUCTED

Pumping tests were conducted at 17 of the proposed 24 trenches. The testing program was flexible and responded to field observation and operational needs. The testing for each of the trenches is summarized on Table 5-1, in Appendix A. Fifteen of the 17 trench pumping tests are described in this report. Preliminary results of the long-term tests conducted at Trenches T02A and T13 are described in this report. More detailed analyses of the T02A and T13 testing will be reported separately.

6.0 TRENCH TEST ANALYSIS RESULTS

The section summarizes the trench test analysis results. Attachments 1 through 23 contain electronic files (if applicable) with the trench construction report, the processed data file, analyzed data, the model set up file, and the model file associated with the trench test analysis. The trench tests can be broadly grouped into five categories. These are: 1) standard test length without significant precipitation, 2) earlier tests prior to rainfall information being available, 3) standard test length with significant precipitation, 4) trenches that were abandoned or did not have tests conducted, and 5) longer-term pumping tests. Each group is covered in a separate section in this chapter.

6.1 STANDARD TEST LENGTH WITHOUT SIGNIFICANT PRECIPITATION

This group is comprised of tests on trenches with little to no precipitation reported during the tests. This group comprises T01, T03, T06, T18, and T20.

6.1.1 T01

Trench 01 was constructed from June 17, 2018 to June 23, 2018. The observed brine inflow was reported as low. The trench was pumped from August 6, 2018 to August 9, 2018. The pumping rate was initially 2 liters per second (L/s) which dropped to an average of 0.3 L/s over three days of pumping.

Water level monitoring data was recorded at two piezometers (20mE and 50mE). Calibration of the numerical model with PEST resulted in bulk parameter estimates of 0.46 meters per day (m/day) for horizontal hydraulic conductivity, 0.013 for specific yield, and 2.04×10^{-4} m^{-1} for specific storage which are consistent with the low water production rates for this test. The processed data spreadsheet, groundwater modeling files, and model calibration plots from the test are included in Attachment 1.

6.1.2 T03

A pumping test was conducted for Trench 03 from July 6, 2018 to July 15, 2018. The pumping rate began at 2.38 L/s and dropped on the second day of the test to 0.6 L/s. After three days, the pumping rate dropped to 0.22 L/s where it remained for the duration of the test.

The calibration of the numerical model for the test improved with PEST, and bulk parameters were estimated as 1.53 m/day for horizontal hydraulic conductivity, 0.122 for specific yield, and 4.95×10^{-3} m^{-1} for specific storage. The processed data, model work up spreadsheet, calibration targets spreadsheet, calibration spreadsheet, and model files are included in Attachment 3.

6.1.3 T06

Trench 06 was constructed from October 22, 2017 to October 28, 2017. The observed brine inflow was reported as high. Abundant brine inflow was reported at approximately 1.9 m below ground surface (bgs).

A pumping test was conducted on this trench from March 11, 2018 until April 7, 2018. Water level recovery was monitored, and a second pumping test was started on April 11, 2018. The second test had equipment challenges, so the analysis focused on the first test. Minor precipitation (0.7 mm on March 10, 2018 and 0.1 mm on March 11, 2018) was reported from the pilot pond weather station prior to the beginning of the test. This corresponded to a rise in the average piezometer water level (DTW on 79.9 centimeters (cm) on March 9, 2018 to 66.1 cm on March 11, 2018 at the start of the test). It appears that this volume of precipitation would be unlikely to create such a rise in the water table. Field personnel noted that a significant atmospheric pressure low moved through the area during this period, but there was very little rain at the T06 test location. This low atmospheric pressure may have passed over the Kintore station (80 km distant) at different time which may account for this water level change.

The numerical model results using PEST indicated an effective hydraulic conductivity of 24.3 m/day, a specific yield of 0.025, and a specific storage of 4.04 x 10^{-6} m^{-1}. This parameter estimation performed differently from the other models. PEST sought to decrease the specific yield and storage much lower than seen in other simulations. The specific yield reached the lower bound of 0.025 used for the modeling and parameter estimates reflect this. Low specific yield and specific storage would be consistent with the field observation of over 10 cm of water level increase for a small precipitation event as discussed previously, however, this appears to be inconsistent with the high effective hydraulic conductivity. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 6.

6.1.4 T18

Trench 18 was constructed from June 17, 2018 to June 23, 2018. The observed brine inflow was reported as low with brine inflow primarily occurring from a zone at 3 to 4 m bgs.

A pumping test was conducted on this trench from July 21, 2018 until August 8, 2018. Minor precipitation (0.3 mm on August 2, 2018 and 1.1 mm on August 3, 2018) was reported from the pilot pond weather station during the pumping test.

Pumping rates started at approximately 1 L/s and were maintained at this level for 5 days. The pumping rate then dropped over time to approximately 0.6 L/s at the end of the test.

The numerical model results using PEST indicated an effective hydraulic conductivity of 6.34 m/day, a specific yield of 0.14, and a specific storage of 6.54 x 10^{-4} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 18.

6.1.5 T20

Trench 20 was constructed from October 28, 2017 to October 30, 2017. The observed brine inflow was reported as low-moderate.

A pumping test was conducted on this trench from March 11, 2018 to April 20, 2018. Minor precipitation (0.7 mm on March 10, 2018 and 0.1 mm on March 11, 2018) were reported from the pilot pond weather station near the beginning of the test. Pumping rates started at 3 L/s and were maintained at this level for six days. The pumping rate then dropped to approximately 1 L/s for the next 16 days. The next 17 days continued with a pumping rate of approximately 1 L/s interspersed with three intervals of zero pumping due to equipment difficulties.

The numerical model results using PEST indicated an effective hydraulic conductivity of 2.85 m/day, a specific yield of 0.150, and a specific storage of 1.50 x 10^{-3} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 20.

6.2 EARLIER TESTS WITHOUT PRECIPITATION INFORMATION

This group is comprised of tests on trenches earlier in the program prior to precipitation records being available. This group consists of T02, T05, T14, T16, and T22.

6.2.1 T02

Trench 02 was constructed from August 6, 2017 to August 11, 2017. The observed brine inflow was reported as moderate. A trench pumping test was conducted from September 4, 2017 to September 9, 2017. No pumping rate was reported, and the completion report states the data was of little value. Without the pumping rate, a numerical model was not developed. The completion report and processed data spreadsheet are included in Attachment 2.

6.2.2 T05

Trench 05 was constructed from August 21, 2017 to August 26, 2017. The observed brine inflow was described as moderate to low. All of the observed inflow was between 1.5 and 1.8m bgs.

A pumping test was conducted at this trench from October 13, 2017 to November 6, 2017. It began with an initial pumping rate of 6 L/s which dropped to under 1 L/s by the second day of the test. For the last 12 days of the test a pumping rate of 0.3 L/s was reported.

The numerical model results indicated an effective hydraulic conductivity of 2.81 m/day, a specific yield of 0.109, and a specific storage of 5.00 x 10^{-3} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 5.

6.2.3 T14

Trench 14 was constructed from August 1, 2017 to August 5, 2017. The observed brine inflow was moderate to high. All of the observed inflow into the trench was between 0.5 and 1.9 m bgs.

Two pumping tests were conducted at this trench. The second pumping test was from November 26, 2017 to December 17, 2017. Based on the more complete data set for this test and reported precipitation of 4.4 mm on December 15, 2017 at the pilot pond weather station, the second test was analyzed for this work. A steady pumping rate of 0.5 L/s was reported for the duration of this test.

The drawdown targets for this test do not correspond very well to the expected behavior based on the reported constant pumping rate. The eight monitoring piezometers all show little drawdown or an increase in reported water levels during the first few days of the test. This could potentially be due to a precipitation event, but the precipitation data set does not cover this period. This poor match reduces the confidence in the parameter values from the PEST modeling.

The numerical model results using PEST indicated an effective hydraulic conductivity of 17.3 m/day, a specific yield of 0.167, and a specific storage of 3.23 x 10^{-3} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 14.

6.2.4 T16

Trench 16 was constructed from July 24, 2017 to July 26, 2017. The observed brine inflow was moderate to high. Observed brine ingress was in the form of diffuse flow within the top 2.5 m. Persistent flow was reported between 1 m and 2.5 m in depth.

A pumping test was conducted on this trench from August 4, 2017 to September 30, 2017. Pumping rates were calculated from the totalizer readings. The pumping rated started at 4.57 L/s and then dropped to 2.82 L/s through day 6 of the test. The pumping rate then dropped to approximately 1.6 L/s for the remainder of the test with four periods on the order of one day where the pump was not operating. Water levels at piezometer 20mE showed an unexplained rise in the water levels later in the test. For this reason, this piezometer was not used in the model calibration.

The numerical model results using PEST indicated an effective hydraulic conductivity of 19.5 m/day, a specific yield of 0.062, and a specific storage of 2.34 x 10^{-4} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 16.

6.2.5 T22

Trench 22 was constructed from September 9, 2017 to September 15, 2017. This trench was not initially planned and was constructed after a test pit displayed promising hydrogeological properties. The trench was constructed in an area of very soft ground and observed brine ingress was recorded as very moderate-to-high, but with significant spatial variability along the trench for areas of deeper inflows. The completion report for this trench is included in Attachment 22.

Two pumping tests were conducted at this trench. The first test was conducted from October 12, 2017 to November 6, 2017. It began with an initial pumping rate of 6 L/s which dropped to 5 L/s and maintained for approximately five days. A very high pumping rate of 36 L/s was reported on the second day of the test with the assistance of two flex drives. The modeling was not able to match this pumping rate and observed drawdowns. Since the duration of this pumping rate was not well delineated, the modeling used approximately a 20% increased rate for an entire day. This test showed higher inflow rates that were still on the order of 1.5 L/s at the end of the test. The calibration of the numerical model for the test improved with PEST, and bulk parameters were estimated as 9.33 m/day for horizontal hydraulic conductivity, 0.295 for specific yield, and 5.44 x 10^{-4} m^{-1} for specific storage. The model work up spreadsheet, processed data spreadsheet, drawdown targets spreadsheet, calibration spreadsheet, and model files are included in Attachment 22.

The second test was conducted from November 11, 2017 to December 18, 2017. The second test was analyzed as a verification for the first test analysis. Unfortunately, the observed piezometer drawdowns were inconsistent with the reported pumping rates. A pumping rate of 4 L/s was reported for 17 days. The piezometer drawdowns increased at the start of the test which is consistent with the pumping rates. They then recovered while the pumping presumably was still occurring. It is clear the analysis is missing either an additional source of water such as a large precipitation event or a change in the pumping rates. Due to this discrepancy, no further work was conducted on the second test for this trench.

6.3 STANDARD TEST LENGTH WITH SIGNIFICANT PRECIPITATION

This group is comprised of tests on trenches with significant precipitation reported during the tests. This group comprises T08, T09, T10, T11, and T23.

6.3.1 T08

Trench 8 was constructed from September 2, 2017 to September 9, 2017. The observed brine inflow was reported as low.

A pumping test was conducted on this trench from January 14, 2018 to January 28, 2018. Approximately 62 mm of precipitation was reported from the pilot pond weather station in the five days prior to the test (January 9, 2018 to January 13, 2018). Minor precipitation (0.1 mm on January 14, 2018, 0.3 mm on January 15, 2018, and 2.5 mm on January 20, 2018) was reported during the test and a larger precipitation events of 20.6 mm was reported on the last day of the test from the pilot pond weather station.

The test began with three days of pumping at 2.2 L/s. The following day had no pumping followed by days at 2 and 1.6 L/s before the test settled into a constant pumping rate of 1 L/s for the duration of the test.

Pumping in the model for the test stopped on January 28, 2018 at 12:00 pm with a final period of 0.76 days without pumping. This showed the predicted water level recovery using the calibrated model parameters.

The numerical model results using PEST indicated an effective hydraulic conductivity of 6.69 m/day, a specific yield of 0.082, and a specific storage of 2.37 x 10^{-4} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are all contained in Attachment 8.

The actual water levels recovered very quickly on January 27, 2018 with water levels rising on the order of 40 to 80 cm over the six hours between 6:00 pm and midnight. The modeling (without recharge) showed a minor recovery during the same period. The reported precipitation for this period was 2.06 cm at the pond weather station. This amount of recharge would be expected to raise the water level on the order of 25 cm for the estimated specific yield of 0.082. This suggests a very high percentage of the precipitation became recharge at this trench for this event, and it appears that there may have been more precipitation near Trench 08 than that seen at the weather station. Field personnel noted that the trench was inundated with surface water flow from this precipitation event which may account for higher than expect water level rise in the piezometers.

6.3.2 T09

Trench 9 was constructed from October 2, 2017 to October 9, 2017. The observed brine inflow was reported as moderate to high and dominated by conduit inflow between 1.5 and 3 m bgs.

A pumping test was conducted on this trench from January 13, 2018 to February 24, 2018. Approximately 62 mm of precipitation was reported from the pilot pond weather station in the five days prior to the test (January 9, 2018 to January 13, 2018). Eleven precipitation events were recorded during the test at the pilot pond weather station. Six of these reported more than 1.0 mm of precipitation (2.5 mm on January 20, 2018, 20.6 mm on January 28, 2018, 6.7 mm on February 12, 2018, 3.6 mm on February 27, 2018, and 3.2 mm on February 28, 2018).

The reported pumping rate for the test was 5 L/s or greater for all but one day of the test. A zero L/s pumping rate was recorded on January 20, 2018 due to pump problems. Examining the daily notes and the totalizer on the volumes pumped showed an incrementally lower pumping rate and a second period where the pump was not functioning. The timing of the pump failure was estimated from the recorded trench water levels, allowing for some more resolution of when the water levels were able to recover. The test was calibrated to the period before the January 28, 2018 precipitation event.

The numerical model results using PEST indicated an effective hydraulic conductivity of 65.92 m/day, a specific yield of 0.170, and a specific storage of 1.05 x 10^{-4} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 9.

An estimate of the percentage of recharge can be made using the estimated specific yield, precipitation amounts, and recorded rises in water level. For the January 28, 2018 event with 20.6 mm of precipitation, four of the five piezometers recorded an average rise in water level for the period between 14.25 and 15.25 days into the test of 5.125 cm. Piezometer 20mN had the water level drop from time 14.75 to 15.0 days into the test. Multiplying the 5.125 cm water level rise by the estimated specific yield of 0.17 gives an average recharge volume of 0.87 cm which is approximately 36% of the 2.4 cm of the precipitation reported at the T09 location for this period.

The February 1, 2018 event with 20.8 mm of precipitation was reflected in a rise in water level at each of the piezometers between 18.5 and 19.25 days into the pumping test. The water level rises averaged

1.8 cm which gives and average recharge of 0.3 cm which is approximately 15% of the 2.08 cm of precipitation reported for this period.

6.3.3 T10

Trench 10 is a replacement for T19 which was abandoned when the pump and discharge equipment plugged up with precipitated salts a few hours into pumping. Trench 10 was constructed from July 28, 2018 to August 5, 2018. The observed brine inflow was reported as moderate to high.

A pumping test was conducted on this trench from August 20, 2018 to September 19, 2018 followed by three days of recovery. One minor precipitation event (0.3 mm on August 31, 2018) was reported during the test and one significant precipitation event (8.9 mm on September 21, 2018) was reported from the pilot pond weather station during the test recovery period.

The reported pumping rate for the test ranged from 4.8 L/s to 22.5 L/s.

The numerical model results using PEST indicated an effective hydraulic conductivity of 171 m/day, a specific yield of 0.116, and a specific storage of 8.76 x 10^{-4} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 10.

6.3.4 T11

Trench 11 was constructed from October 30, 2017 to November 3, 2017. The observed brine inflow was reported as moderate to high primarily by conduit flow between 1.5 and 3 m bgs.

A pumping test was conducted on this trench from January 12, 2018 to February 24, 2018. Approximately 62 mm of precipitation was reported from the pilot pond weather station in the five days prior to the test (January 9, 2018 to January 13, 2018). Eleven precipitation events were recorded during the test at the pilot pond weather station. Six of these reported more than 1.0 mm of precipitation (2.5 mm on January 20, 2018, 20.6 mm on January 28, 2018, 6.7 mm on February 12, 2018, 3.6 mm on February 27, 2018, and 3.2 mm on February 28, 2018.

The reported pumping rate for the test started at approximately 3 L/s. This rate slowly dropped over time with the final reported pumping rate being 1 L/s on February 24, 2018 or greater for all but one day of the test. A 0 L/s pumping rate was recorded on January 17, 2018 due to pump problems. The test was calibrated to the period before the January 28, 2018 precipitation event.

The numerical model results using PEST indicated an effective hydraulic conductivity of 6.57 m/day, a specific yield of 0.163, and a specific storage of 5.00 x 10^{-3} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 11.

An estimate of the percentage of recharge can be made using the estimated specific yield, precipitation amounts, and recorded rises in water level. For the January 28, 2018 event with 20.6 mm of precipitation, eight of the nine piezometers recorded an average rise in water level for the period between 15.00 and

16.25 days into the test of 5.0 cm. Piezometer 20mS had the water level drop slightly. Multiplying the 5.0 cm water level rise by the estimated specific yield of 0.163 give an average recharge volume of 0.81 cm which is approximately 39% of the 2.06 cm of the precipitation reported for this period.

The February 1, 2018 event with 20.8 mm of precipitation was reflected in a rise in water level in five of the nine piezometers between 19.25 and 20.25 days into the pumping test. The water level rises averaged 2.6 cm which gives and average recharge of 0.42 cm which is approximately 20% of the 2.08 cm of precipitation reported for this period.

6.3.5 T23

Trench 23 was constructed from August 30, 2018 to September 2, 2018. The observed brine inflow was reported as low.

A pumping test was conducted on this trench from September 6, 2018 to September 22, 2018 followed by five days of recovery. One precipitation event (8.9 mm on September 21, 2018) was reported from the pilot pond weather station during the test.

The pumping rate for the test started at approximately 2 L/s for four days with short periods when the pump was not on. The rate was set to approximately 0.8 L/s for the end of the test. The pumping was turned off on September 22, 2018, and the water levels were allowed to recover.

The numerical model results using PEST indicated an effective hydraulic conductivity of 6.86 m/day, a specific yield of 0.11, and a specific storage of 2.31×10^{-4} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 23.

6.4 TRENCH LOCATIONS WITHOUT PUMPING TESTS

This group consists of trenches that were not completed or where tests were not conducted, or testing was abandoned during the test. This group comprises T04, T07, T12, T15, T17, T19, and T21.

6.4.1 T04

Trench 04 want not constructed. There are no files to include in Attachment 4.

6.4.2 T07

Trench 07 construction began on August 30, 2017. Only minor seepage observed in the first 20 m constructed. The full trench excavation was not continued. The completion report for this trench is included in Attachment 7.

6.4.3 T12

The construction report for trench 12 is included in Attachment 12. The trench was constructed, but no pumping test was conducted. Brine ingress was reported in the form of diffusive flow on the contact of the upper sand horizon and lower clay margins. Almost no brine inflow was observed deeper than 2 m. The collective brine ingress for this trench was recorded as very low to low. The upper 1 m sequence is likely to have high specific yield properties.

6.4.4 T15

Trench 15 was abandoned due to very sloppy conditions making construction difficult. The trench total length was about 30 m. Water and precipitated salts are visible in the trench construction photographs. No further work was done on this trench and Attachment 15 is empty. Trench 21 was constructed as a replacement for Trench 15 in the test program.

6.4.5 T17

Trench 17 was constructed from July 28, 2017 to July 31, 2017. Low brine inflow was reported for the trench and it was not pump tested. The completion report for Trench 17 is included in Attachment 17.

6.4.6 T19

Trench 19 was constructed from July 15, 2018 to July 19, 2018. Very low brine inflow was reported, and no pumping test was conducted. The completion report for Trench 19 is included in Attachment 19.

6.4.7 T21

Trench 21 was constructed from August 15, 2017 to August 19, 2017 as a replacement for Trench 15. The completion report states it was in an area of very soft ground with soil failures during construction. Approximately 1 m of very loose unconsolidated silt sand and gypsum sand overlays a very firm homogeneous red brown clay. Inflows were surprising low given the nature of the surface features, but the trench and surrounding bucket depressions from the excavator did make water.

A pumping test was attempted, but salt precipitation blocked the pump inlet and values within 2 to 3 hours, and the test was abandoned. The completion report for this trench is included in Attachment 21.

6.5 LONG-TERM TRENCH TESTS

Two long-term trench tests are currently ongoing at the Mackay Potash Project at locations T02A and T13. Groundwater flow models were constructed for these tests for a preliminary assessment of bulk hydraulic properties of the shallow lakebed sediments at these locations. Results of this preliminary modeling is described below. Detailed analyses of testing at the T02A and T13 locations including flow and mass transport modeling in the unsaturated zone and analysis of recharge and evapotranspiration will be described in a separate report.

6.5.1 T2A

Trench 02A was constructed from November 17, 2018 to November 19, 2018. Approximately 0.5 m of clayey evaporitic silty sand with a thin (1 mm) evaporitic crust overlays a moderately firm clay at this location. Brine ingress was observed from small conduit features at approximately 2.5 m bgs. The rate on ingress was low, yet consistent, and the trench filled in under 48 hours post-construction.

Trench pumping began on December 2, 2018, and the test was shut in on June 27, 2019. The initial pumping rate was approximately 2.8 L/s reducing to a sustained long term pumping on the order of 0.6 L/s.

Preliminary numerical model results using PEST indicate an effective hydraulic conductivity of 5.22 m/day, a specific yield of 0.023, and a specific storage of 2.16 x 10^{-4} m^{-1}. The trench construction report, processed data spreadsheet, model setup spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 02A.

6.5.2 T13

Trench 13 was constructed from August 18, 2018 to August 20, 2018. Approximately 1 m of evaporitic coarse grained sand overlays 0.5 m of evaporitic sand with a silty-clay matrix overlaying a clay with cobble grade evaporite nodules at this location. Moderate to high brine ingress was observed from distinct conduit associated with the evaporite nodules at about 2 m bgs.

Trench pumping began on December 3, 2018, and the test was shut in on June 2, 2019. The initial pumping rate was approximately 2 L/s reducing to a sustained long term pumping on the order of 1 to 1.2 L/s.

Preliminary numerical model results using PEST indicate an effective hydraulic conductivity of 6.76 m/day, a specific yield of 0.112, and a specific storage of 1.61 x 10^{-4} m^{-1}. The trench construction report, processed data spreadsheet, drawdown target spreadsheet, model file, and calibration plots are included in Attachment 13.

7.0 CONCLUSIONS

Local scale groundwater flow models were constructed to analyze trench pumping tests conducted by Agrimin personnel at the Mackay Potash Project. Models were discretized to represent the area and aquifer thickness affected by trench pumping. The models were calibrated to drawdowns observed in nearby piezometers, and trench tests were analyzed for bulk hydraulic properties (hydraulic conductivity, specific yield, and specific storage) of the shallow lakebed sediments.

Hydraulic conductivity estimates from the trench test analyses ranged from 0.45 m/d to 171 m/d; specific yield estimates ranged from 0.013 to 0.295, with most estimates on the order of 0.10 to 0.15; and specific storage estimates ranged from $4x10^{-6}$ m^{-1} to $5x10^{-3}$ m^{-1}.

A high-level assessment was conducted to compare spatial distribution of hydraulic conductivity and specific yield with the assumptions for these parameters used in the PFS groundwater modeling. The PFS groundwater model assumed a uniform spatial distribution of hydraulic conductivity and specific yield based on the geometric mean of available data at specific depth intervals. The models developed to analyze the trench test data in this report assume bulk hydraulic conductivity and specific yield for the upper 6 m of lakebed sediments to develop site specific values for these parameters at each trench location.

To compare the results of the local scale trench modeling with the PFS model results, the layered aquifer formula for hydraulic conductivity and a thickness weighted average of specific yield from the PFS over the saturated interval from 0.5 m to 6 m depth were applied (hydraulic conductivity = 7.8 m/day and specific yield = 6.2%). A preliminary spatial distribution of these parameters from the trench test analyses was developed by projecting the results on a 200 m x 200 m grid spacing over an area roughly covering the outline of the trench tests within the lake boundary (note that this preliminary projection does not incorporate information such as geologic boundaries and gradations or the island outlines which will be incorporated in the final distribution of parameters in the DFS groundwater and mine planning models).

The area in which the specific yield and hydraulic conductivity in the preliminary spatial parameter distribution exceeds the PFS thickness weight averages for these parameters over an area approximately 84% of the area which would be drained by the PFS trench network assuming an area of influence extending one kilometer from the PFS trenches. These areas are on the order of 20% to 25% of the total area encompassing the 12 Agrimin Exploration Licenses.

The percentage recharge estimates were derived based on water level changes due to rainfall events and specific yield results at the trench location. These estimates are on the same order as the PFS assumption of recharge (37% of rainfall).

This high-level assessment using the data and inputs noted above suggests that the DFS mine planning effort will be able to meet or exceed the production predicted in the PFS modeling. Additional work remains to complete the DFS groundwater model and mine planning. The hydraulic property estimates from these trench test analyses along with ongoing long-term trench testing, field and lab recharge experiments, resource drilling and sampling, and lab estimates of physical properties will inform the construction of a lake-scale groundwater flow and mass transport model for use in mine planning and reserves estimates for the current program to bring the project to DFS level of accuracy.

8.0 MODEL LIMITATIONS

The trench pumping test models were based on the available data and with the objective of identifying larger-scale bulk hydrogeologic parameters that reasonably matched the test observations. The models are well-calibrated within the objectives of the analysis. Even with this, there is always uncertainty associated with the numerical simulation of groundwater flow. The simulated systems represent simplified versions of the conceptual model of a complex hydrogeologic system. Therefore, even though the trench pump test models are considered calibrated, prudence should be used in the application of the results as a planning tool. For predictive simulations, there is a potential that the forecasting information used to evaluate future scenarios may be insufficient.

It is expected that some the trench pump test models may be revisited following the completion and analysis of the recharge field work being conducted on the lake. In addition, if data becomes available that was not utilized in this analysis, the interpretation of the pumping tests could change and should be revisited.

9.0 REFERENCES

Knight Piesold, 2018. Mackay SOP Project – Pre-Feasibility Study.

APPENDIX A
TABLES

5-1. Trenches and Testing Periods

6-1. Trench Tests and Estimated Parameters

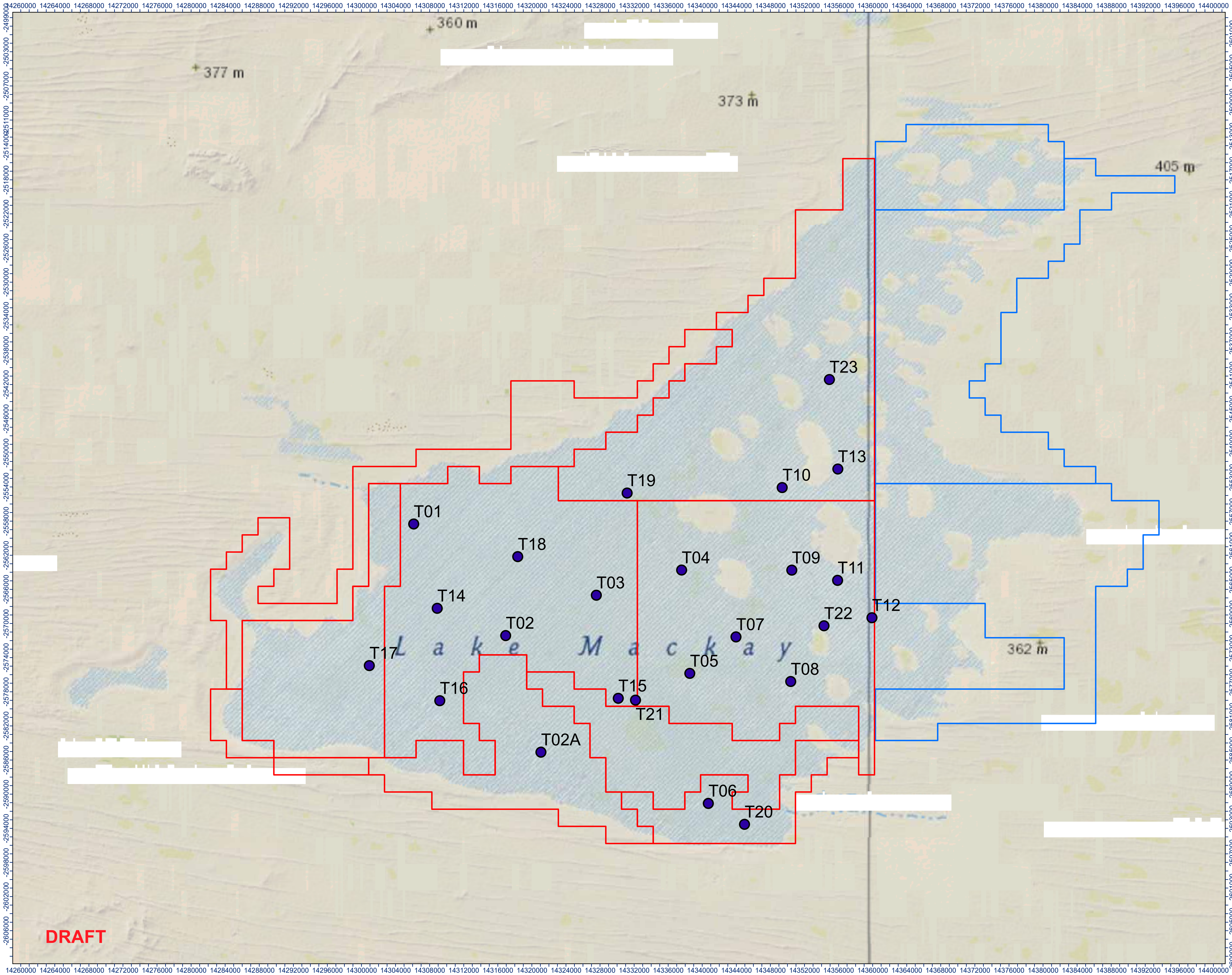
Table 5-1. Draft Trenches and Testing Periods

Trench	Trench Construction	Testing Period		Notes
		Start	End	
T01	June 17-23, 2018	August 6, 2018	August 9, 2018	
T02	August 6-11, 2017	September 4, 2017	September 9, 2017	"Pump out test completed but data of little value"
T02A		December 2, 2018	June 5, 2019	Long term pumping test
T03		July 6, 2018	July 15, 2018	
T04	Not constructed - Replaced by T23			
T05	August 21-26, 2017	August 21, 2017	November 6, 2017	
T06	October 22-28, 2017	March 11, 2018	April 7, 2018	
T07	August 30, 2017	n/a	n/a	absence of inflow in first 20 meters, abandoned trench
T08	September 2-9, 2017	January 8, 2018	January 28, 2018	
T09	October 2-9, 2017	January 13, 2018	February 24, 2018	
T10	July 28-August 5, 2018	August 20, 2018	September 19, 2018	
T11	September 30 - October 3, 2017	January 12, 2018	February 26, 2018	
T12	September 24-27, 2017	n/a	n/a	not pumped
T13	September 18-20, 2018	December 3, 2018	May 28, 2019	Long term pumping test
T14	August 1-5, 2017	November 26, 2017	December 17, 2017	Dates are for second pumping test
T15	July 15-19, 2018	n/a	n/a	Abandoned due to very sloppy conditions. Total length was about 30 m.
T16	July 24-26, 2017	August 4, 2017	September 30, 2017	
T17	July 28-31, 2017	n/a	n/a	not pumped
T18	June 17-23, 2018	July 18, 2018	August 8, 2018	
T19	July 15-19, 208			not pumped
T20	October 28-30, 2018	March 11, 2018	April 20, 2018	
T21	August 15-19, 2017			Replaced T15. Tried to pump it but salt precipitation blocked the pump inlet and valves within 2-3hrs. Test abandoned.
T22	September 9-15, 2017	October 12, 2017	November 6, 2017	Dates are for first pumping test.
T23	August 30 to September 2, 2018	September 6, 2018	September 28, 2018	

Table 6-1. Draft Trench Test Summary and Parameter Estimates

Trench	**Approximate Volume Pumped (m^3)**	**Observed Brine Inflow Rate (Low/Moderate/High)**	**Model Scaled RMS (%)**	**Estimated Parameters**		
				Horizontal Conductivity (m/day)	**Specific Yield (-)**	**Specific Storage (m^{-1})**
Group 1 - Standard Length Without Significant Precipitation Reported						
T01	450	Low	37.5	0.46	0.013	1.28×10^{-4}
T03	350	n/a	9.97	1.53	0.122	4.95×10^{-3}
T06	5,050	High	6.54	24.3	0.025	4.04×10^{-6}
T18	1,200	Low	5.93	6.34	0.140	6.54×10^{-4}
T20	3,000	Low/Moderate	7.27	2.85	0.150	1.50×10^{-3}
Group 2 - Earlier Tests Without Precipitation Information						
T02	unknown	Moderate	n/a	n/a	n/a	n/a
T05	950	Moderate/Low	4.5	2.81	0.109	5.00×10^{-3}
T14	900	Moderate/High	13.6	17.3	0.167	3.23×10^{-3}
T16	7,800	Moderate	10.6	19.5	0.062	2.34×10^{-4}
T22	4,500	Moderate/High	6.2	9.33	0.295	5.44×10^{-4}
Group 3 - Standard Length With Significant Precipitation Reported						
T08	1,500	Low	19.6	6.69	0.082	2.37×10^{-4}
T09	17,500	Moderate/High	12.9	65.92	0.17	1.05×10^{-4}
T10	20,000	Moderate/High	13.9	171	0.116	8.76×10^{-4}
T11	6,800	Moderate/High	4.7	6.57	0.163	5.00×10^{-3}
T23	1,650	Low	8.2	6.86	0.11	2.31×10^{-4}
Group 4 - Longer Term Tests						
T02A	1,500	Low	13.1	5.22	0.023	2.16×10^{-4}
T13	13	Moderate/High	3.6	6.76	0.112	1.61×10^{-4}

APPENDIX B
FIGURES



Stantec

CLIENT LOGO - MUST NOT EXTEND BEYOND THE LEFT & RIGHT EDGES OF THIS BOX

AGRIMIN WA TENEMENTS

AGRIMIN NT TENEMENTS

Trench Locations

0 8,700 17,400 metres

(At original document size of 11x17)
1:459,097

Notes
1. Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
2. Data Sources:
3. Background: Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Project Location
T11N, R12E, S05
T. of Dane, Dane Co., WI

Prepared by SKB on 2019-06-17
TR by SO on 2019-06-17

Client/Project
Client: Agrimin
Project: Lake Mackay
Report

Figure No.
2-1 **DRAFT**

Title
Trench Test Program Locations

V:\2274\active\210218001\Agrium_108510855-1_LakeMackayFS\Disc\Water\GIS\MXDs\Figure 2-1 Trench Test Program Locations.mxd Revised: 2019-07-18 By: mreinke

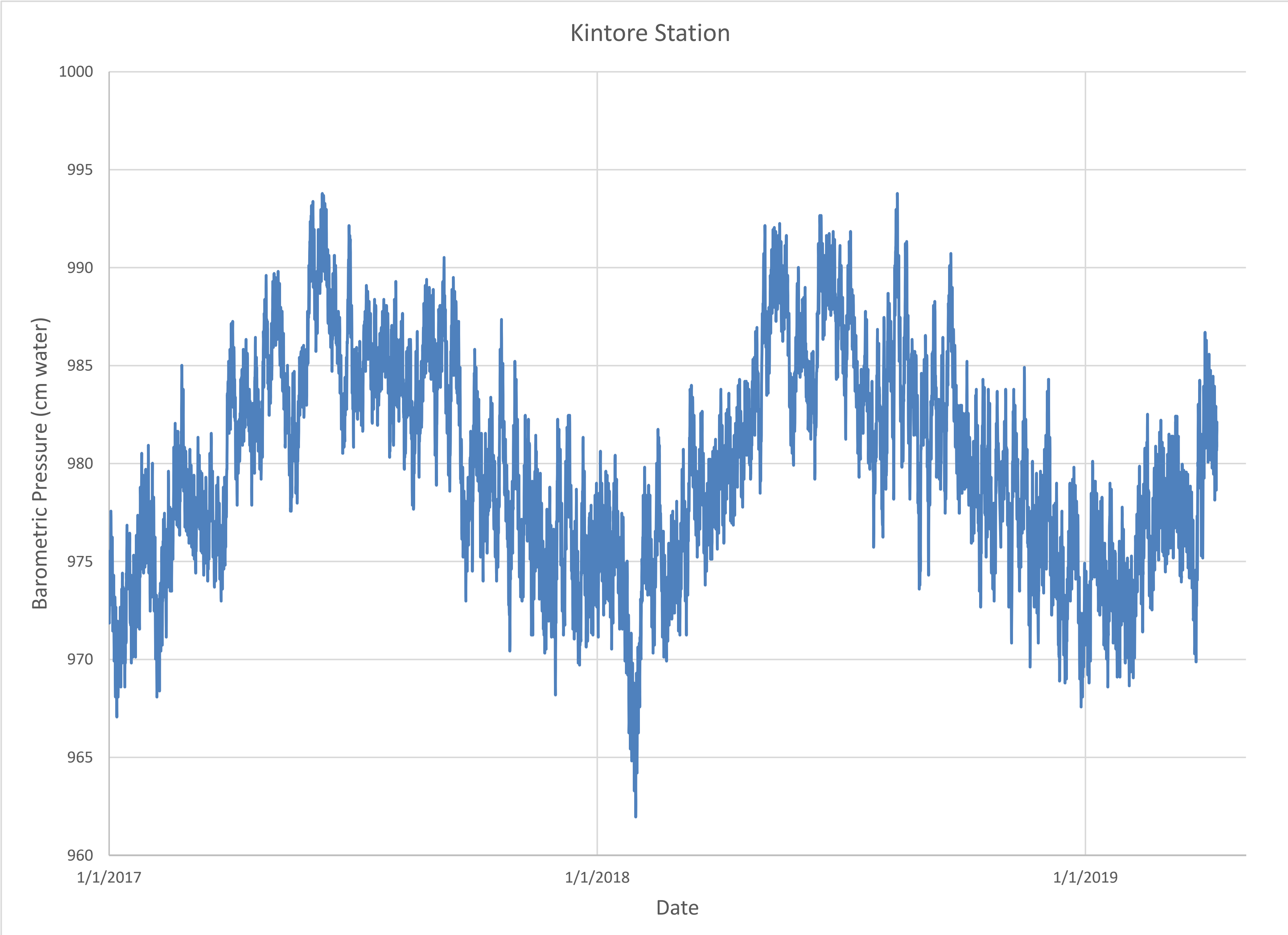


Figure 3-1. Barometric Pressure at Kintore Station

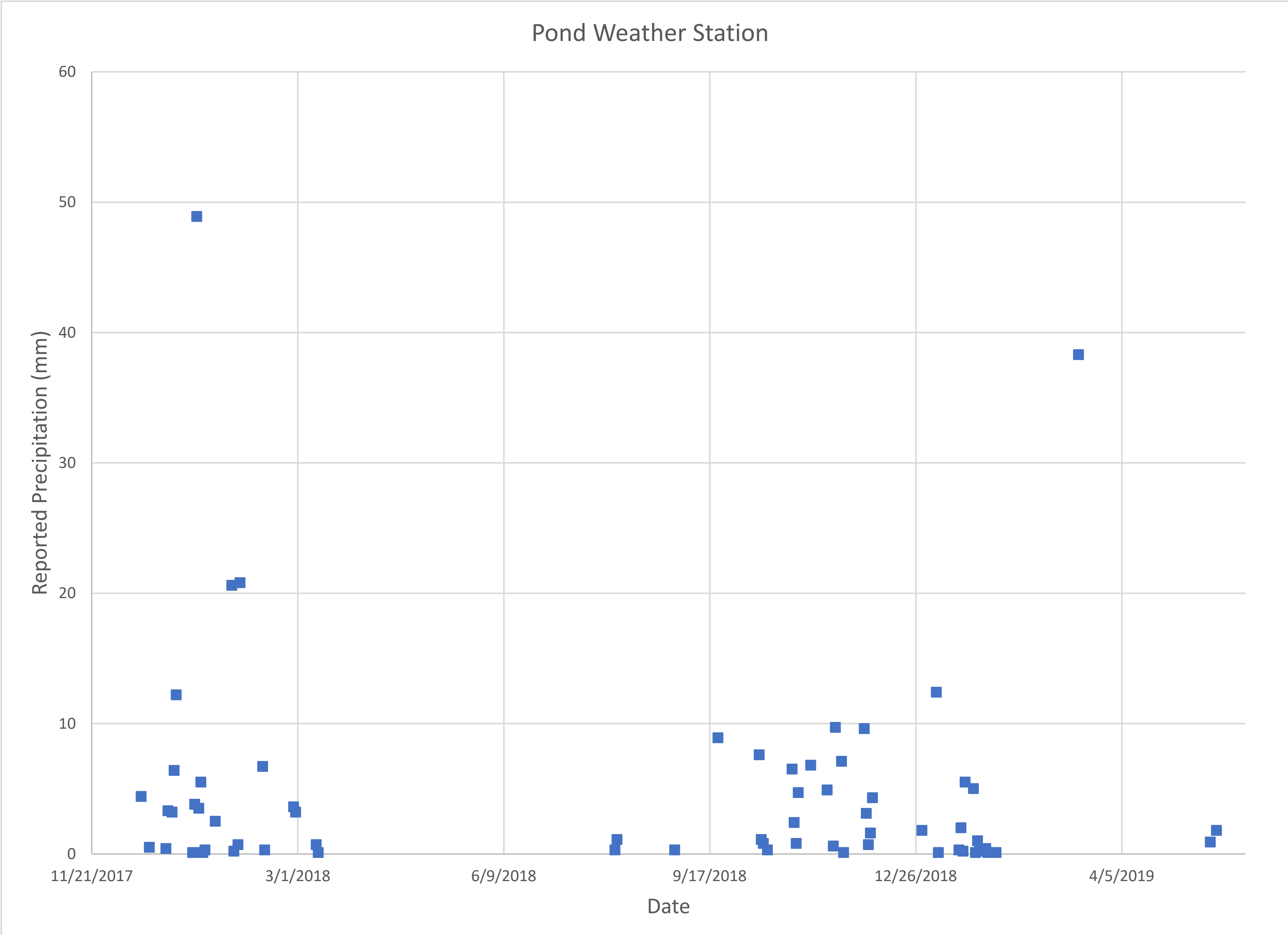


Figure 3-2. Pond Weather Station Precipitation Events

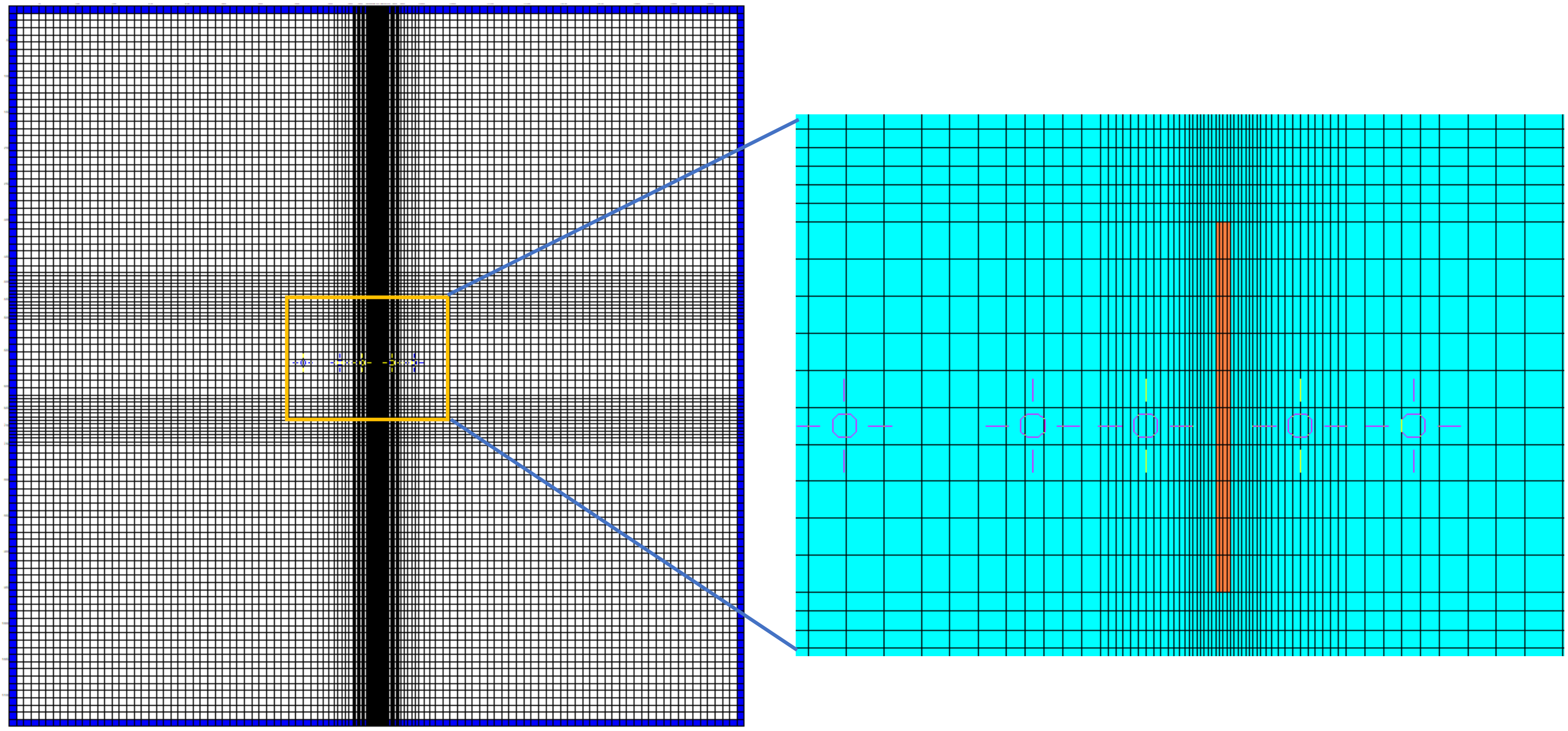


Figure 4-1. Model Grid and Trench Layout

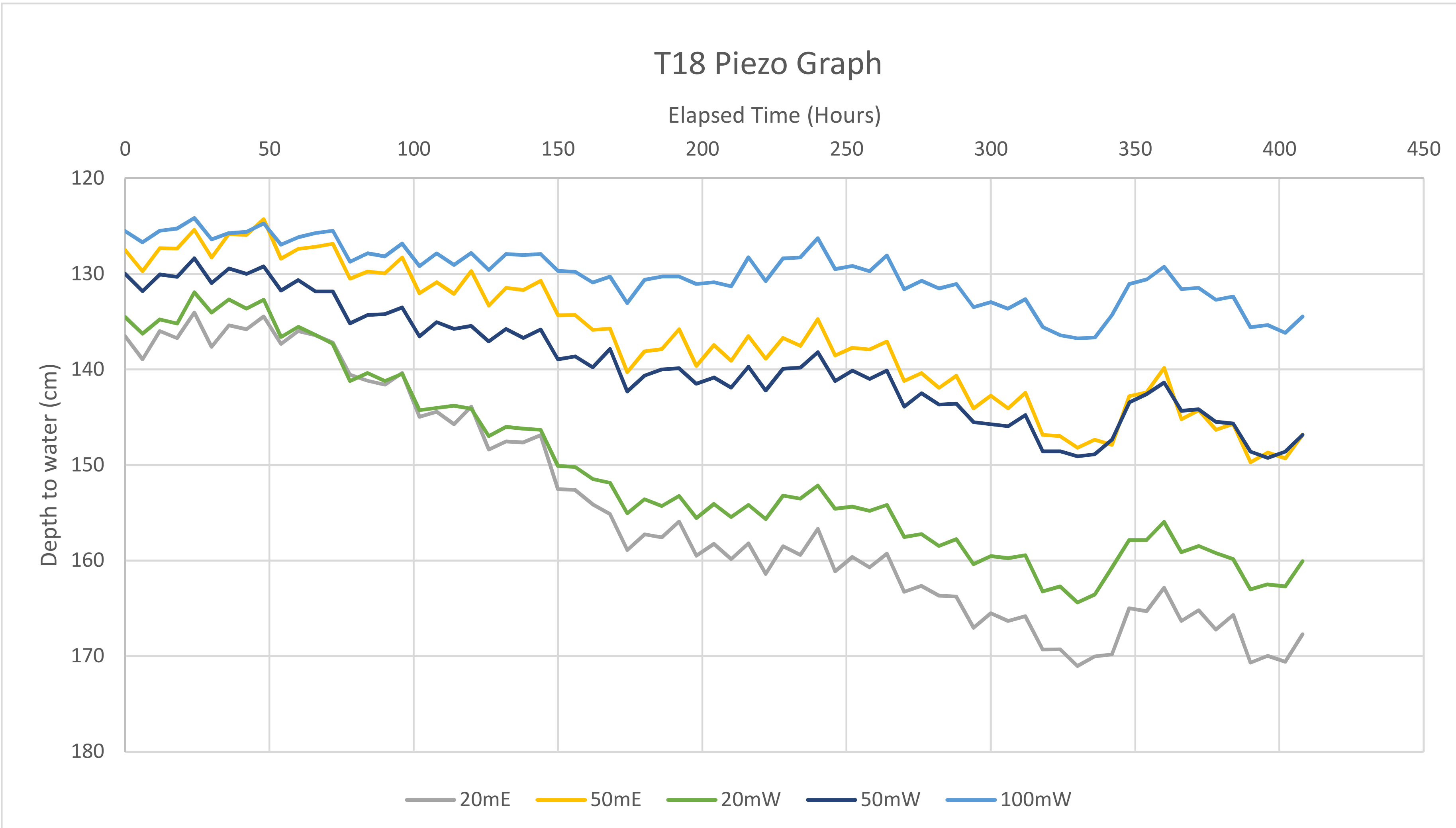


Figure 4-2. Monitoring Data Without Barometric Adjustment

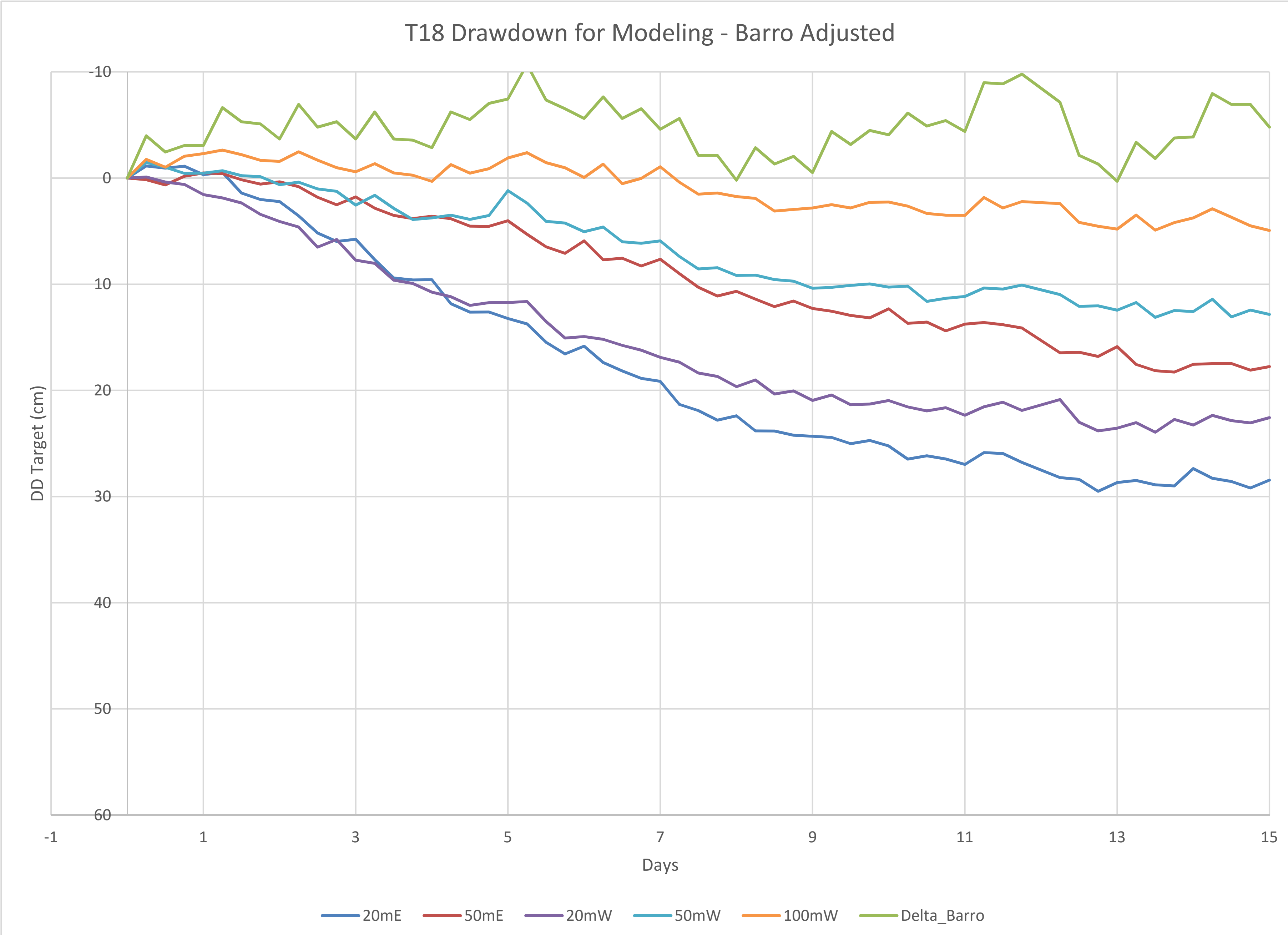


Figure 4-3. Monitoring Data With Barometric Adjustment

Appendix E RECHARGE AND EVAPORATION ANALYSIS TECHNICAL MEMO

Stantec

Techical Memo

To:	Michael Hartley Agrimin	From:	Dean Lanyon Stantec, Adelaide
File:	TM Recharge assessment program	Date:	January 23, 2020

Reference: **Recharge assessment program for Lake MacKay**

Recharge assessment overview

Recharge has been identified as a key variable in the Agrimin Mackay Potash Project that impacts the brine concentration and sustained flows to extraction trenches over the life of the mine. Annual net recharge to the groundwater is variable and is dependent on:

- Soil physical properties of the surface and the unsaturated zone
- Rainfall and seasonal distribution
- Evaporation and seasonal distribution
- Depth to groundwater
- Dispersion/diffusion characteristics and concentration of solutes

An assessment regime was developed to provide the necessary recharge inputs to a regional groundwater flow and transport model (MODFLOW-SURFACT) that will result in a robust quantification of the likely impact that recharge will have on groundwater flow and solute concentration during harvesting and depletion of brine over the mining life. The assessment regime consisted of both infield measurements and laboratory analysis of intact profile cores of the top 0.5 meters. The assessment regime aimed to quantify profile hydraulic and solute transport properties that could be used to assess recharge at various groundwater depletion levels expected during mining operations.

The assessment regime broadly consisted of the following:

1. Infield infiltrometer assessments
    - defines the rate of rainfall infiltration
2. Infield closed lysimeters
    - allows for evaporation calibration
3. Lab initial conditions assessment
    - defines the bulk physical properties of the top 0.5m
    - defines the bulk solute properties of the top 0.5m
4. Lab column leaching tests
    - defines profile saturated conductivity
    - defines solute leaching behavior
5. Lab core multi step outflow curves with inverse modelling using Hydrus 1D
    - defines the pore distribution function
    - defines the unsaturated hydraulic function
6. Recharge modelling using Hydrus 1D
    - defines the average level of recharge at different groundwater depletion levels

Sampling regime

It's acknowledged that the surface properties of Lake MacKay are variable. Hence, the assessment regime included sampling across the playa as shown in Figure 1. Not all sites were used for each assessment method. The following summarizes the sites selected for each assessment method.

1. Infield infiltrometer assessments
    - all 40 sites
2. Infield closed lysimeters
    - 2 sites (T2AH-001, T13H-001)
3. Initial conditions assessment[1]

[1] refer to *Recharge Assessment Perth Laboratory Program (Stantec 2019) for results*

- 16 sites (T2AH-001, T13H-001, T13H-006, CTH-001, CTH-002, CTH-003, CTH-004, CTH-005, CTH-006, CTH-008, CTH-009, CTH-011, CTH-013, CTH-014, CTH-017, CTH-018)

4. Column leaching tests
    - 16 sites (T2AH-001, T13H-001, T13H-006, CTH-001, CTH-002, CTH-003, CTH-004, CTH-005, CTH-006, CTH-008, CTH-009, CTH-011, CTH-013, CTH-014, CTH-017, CTH-018)
5. Core multi step outflow curves with inverse modelling using Hydrus 1D
    - 16 sites (T2AH-001, T13H-001, T13H-006, CTH-001, CTH-002, CTH-003, CTH-004, CTH-005, CTH-006, CTH-008, CTH-009, CTH-011, CTH-013, CTH-014, CTH-017, CTH-018)

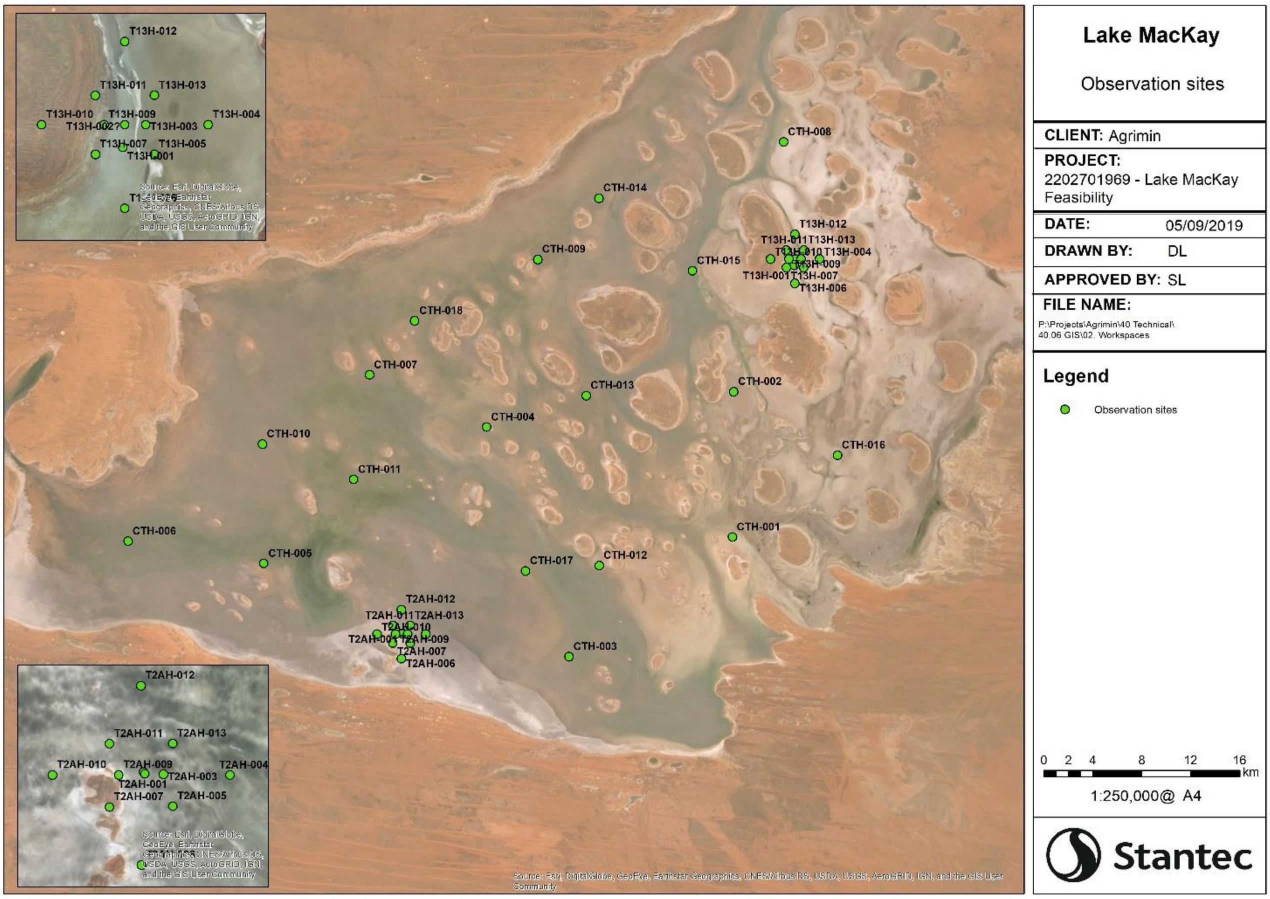


Figure 1: Distribution of profile sampling and assessment sites across Lake MacKay

Surface infiltration

300-320mm diameter single ring infiltrometers were used at each of the assessment sites to determine the infiltration rate variation across the playa. Each infiltration ring was inserted 50mm into the profile with a 100mm head of water controlled by a Mariotte chamber. Infiltration across the Lake varied by orders of magnitude from 1.8 to > 2500 mm/h. The average coefficient of variation of replicate infiltration rates at each assessment site was 51%, which is on the lower side of typical variability experienced with infiltration measurements (Peck 1983). A summary of average infiltration rates is presented in Table 1. Infiltration rates were converted to saturated conductivities based on the insertion depth, head of water and capillary length parameter (Reynolds *et al* 2002).

Table 1: Average infiltration rates (I) at each assessment site across Lake MacKay

Site	I (mm/h)	Site	I (mm/h)	Site	I (mm/h)	Site	I (mm/h)
T2AH-001	26.2	T2AH-013	6.3	T13H-012	2287.5	CTH-009	40.4
T2AH-003	2.7	T13H-001	1794.0	T13H-013	1683.5	CTH-010	8.9
T2AH-004	7.6	T13H-003	2435.7	CTH-001	81.6	CTH-011	14.4

Site	I (mm/h)	Site	I (mm/h)	Site	I (mm/h)	Site	I (mm/h)
T2AH-005	18.9	T13H-004	2816.7	CTH-002	1285.3	CTH-012	42.3
T2AH-006	8.2	T13H-005	4688.0	CTH-003	70.7	CTH-013	543.0
T2AH-007	414.7	T13H-006	5753.0	CTH-004	246.7	CTH-014	21.6
T2AH-009	287.7	T13H-007	2649.7	CTH-005	1.8	CTH-015	24.3
T2AH-010	7.2	T13H-009	2010.5	CTH-006	3.4	CTH-016	5000.0
T2AH-011	22.0	T13H-010	258.3	CTH-007	38.7	CTH-017	49.1
T2AH-012	16.8	T13H-011	223.3	CTH-008	4429.0	CTH-018	42.5

Column leaching

Undisturbed 100mm diameter 0.5m length Shelby tube cores were collected in duplicate at selected sampling sites. The column leaching methodology and data are used is described in "*Recharge Assessment Perth Laboratory Program (Stantec 2019)*". The percentage reduction in retained salts after leaching (L) from the 0-0.5m profile as a function of pore volume leached (P) was modelled using an exponential decay function given by the following:

$L = R(1 - e^{-c.P})$, where c is a rate constant and R is the maximum reduction in salts.

An example of the fit is given in Figure 2 with all fitting parameters presented in Table 2.

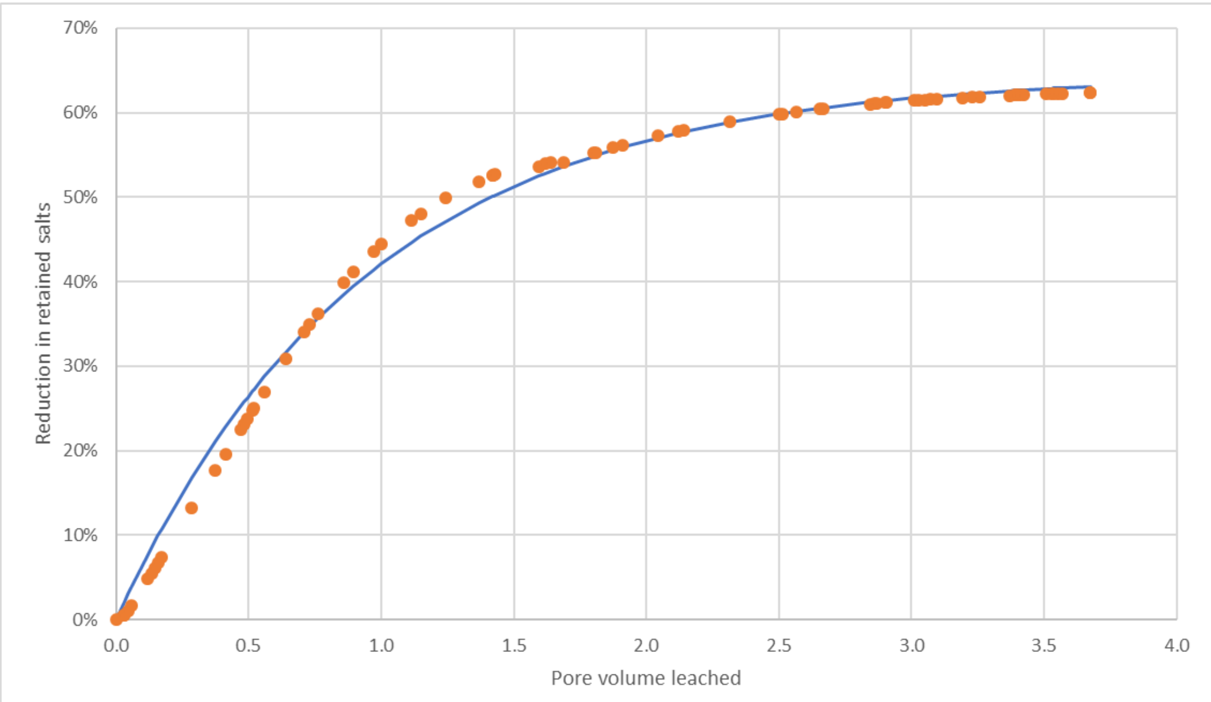


Figure 2: Example (CTH-001) of TDS variation in leachate as a function of leached volume expressed in pore volumes

Table 2: Salt reduction fitting parameters derived from the column leaching test data (R% is the maximum reduction in salts and C defines the rate of salt reduction)

Site	*R (%)*	*C (-)*	Site	*R (%)*	*C (-)*
T2AH-001	100	0.789	CTH-006*	-	-
T13H-001	93.4	1.125	CTH-008	63.7	1.257

Site	R (%)	C (-)	Site	R (%)	C (-)
T13H-006	75.9	1.677	CTH-009*	-	-
CTH-001	64.4	1.060	CTH-011*	-	-
CTH-002	60.3	1.367	CTH-013*	-	-
CTH-003	85.1	0.496	CTH-014*	-	-
CTH-004	61.9	1.088	CTH-017	100	1.060
CTH-005	82.7	1.050	CTH-018	58.2	0.805

* core was compromised during leaching procedure

The saturated hydraulic conductivity of the 0-0.5m profile was split into two depths for calculation purposes, 0-0.2m and 0.2-0.5m. The saturated hydraulic conductivities of the 0-0.2m was derived from the infiltration data. The 0.2-0.5m saturated hydraulic conductivities were then derived from the flow rates observed during the column leaching tests under variable head conditions. The saturated hydraulic conductivity over the 0-0.5m unsaturated interval for each site is shown in Table 3.

Table 3: Average profile saturated hydraulic conductivities (K_{sat}) based on infiltration data and column leaching tests

Site	Depth (cm)	K_{sat} (mm/h)	Site	Depth (cm)	K_{sat} (mm/h)
T2AH-001	0-20	13.9	T2AH-001	20-50	0.25
T13H-001	0-20	950	T13H-001	20-50	43.0
T13H-006	0-20	3050	T13H-006	20-50	135.4
CTH-001	0-20	43.2	CTH-001	20-50	0.35
CTH-002	0-20	681	CTH-002	20-50	3.9
CTH-003	0-20	37.5	CTH-003	20-50	4.9
CTH-004	0-20	131	CTH-004	20-50	12.3
CTH-005	0-20	0.9	CTH-005	20-50	8.4
CTH-006	0-20	1.8	CTH-006	20-50	0.05
CTH-008	0-20	2300	CTH-008	20-50	127
CTH-009	0-20	21.4	CTH-009	20-50	0.55
CTH-011	0-20	7.6	CTH-011	20-50	0.9
CTH-013	0-20	-	CTH-013	20-50	80.2
CTH-014	0-20	11.5	CTH-014	20-50	0.15
CTH-017	0-20	26.0	CTH-017	20-50	0.5
CTH-018	0-20	22.5	CTH-018	20-50	7.0

Multi-step outflow and inverse modelling

Undisturbed 3.5 inch (90mm) diameter soil plugs were sampled from selected depth of each Shelby profile core. The core sampling and tempe cell setup and methodology used are described in "*Recharge Assessment Perth Laboratory Program (Stantec 2019)*". Hydrus inverse modelling (Tuli *et al* 2001) was used to fit modelled water fluxes at the base of the core to observed fluxes (Figure 3). The porosity characteristics were modelled using a dual porosity van Genuchten function with the saturated hydraulic conductivity defined as reported in Table 3. The total porosity was also pre-defined from the initial condition assessment of the profile (see *Recharge Assessment Perth Laboratory Program, Stantec 2019*). The fitted parameters are summarized in Table 4.

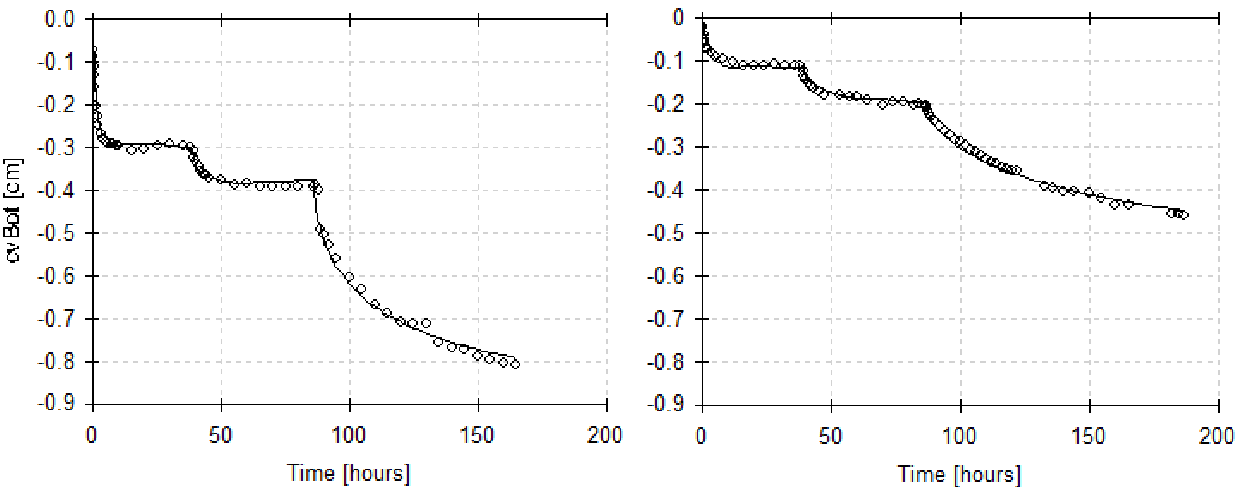


Figure 3: Examples of Hydrus inverse modelling fits to observed multi step outflow data for two contrasting sites, CTH-008 (left) and CTH-005 (right)

Table 4: Average fitted van Genuchten parameters for the Hydrus dual porosity model for the 0-20cm depth

Site	Qr (v/v)	α_1 (1/cm)	n_1 (-)	α_2 (1/cm)	n_2 (-)	w_2 (%)	l (-)
T2AH-001	0.151	0.0051	2.170	0.3831	2.070	36.4	0.3933
T13H-006	0.138	0.0068	1.633	0.0392	4.889	93.6	0.8500
CTH-001	0.130	0.0043	2.555	0.1014	6.872	38.3	3.3750
CTH-003	0.131	0.0051	1.450	0.0938	45.150	45.9	0.7846
CTH-006	0.121	0.0009	1.513	0.0216	5.942	51.8	0.0000
CTH-009	0.245	0.0035	1.244	0.0612	47.530	44.4	1.5790
CTH-011	0.250	0.0118	1.787	0.0277	44.900	58.7	0.0001
CTH-014	0.241	0.0158	1.300	0.0571	13.200	53.1	0.0325
CTH-017	0.250	0.0154	1.397	0.0611	42.990	61.3	0.3095
CTH-018	0.145	0.0066	1.394	0.0635	4.595	48.2	0.3033

Qr is the residual water content, α defines the air-entry value, n defines the shape of the water retention function, w is macro porosity the portion, l is the tortuosity parameter and the subscripts 1 and 2 notates micro and macro porosity, respectively

Table 5: Average fitted van Genuchten parameters for the Hydrus dual porosity model for the 20-50cm depth

Site	Qr (v/v)	α_1 (1/cm)	n_1 (-)	α_2 (1/cm)	n_2 (-)	w_2 (%)	l (-)
T2AH-001	0.257	0.0043	6.210	0.0255	7.499	48.9	0.1611
T13H-001	0.242	0.0113	1.559	0.1004	54.883	58.9	0.2189
T13H-006	0.182	0.0072	1.386	0.0914	41.669	47.0	7.0030
CTH-001	0.137	0.0038	7.495	0.1350	1.385	37.0	0.0000
CTH-002	0.277	0.0069	1.663	0.0258	9.932	55.3	0.0001
CTH-003	0.298	0.0037	6.104	0.0645	7.810	51.0	0.4943
CTH-004	0.118	0.0102	1.873	0.0392	17.980	50.5	0.0000
CTH-005	0.225	0.0030	2.891	0.0469	23.000	57.6	1.1830
CTH-006	0.306	0.0047	23.700	0.0294	6.087	38.3	0.4672
CTH-008	0.269	0.0024	2.062	0.1108	2.969	47.5	1.7160
CTH-009	0.210	0.0045	31.770	0.0776	2.306	16.4	3.2740
CTH-011	0.316	0.0037	1.567	0.0303	34.360	27.3	2.8750
CTH-013	0.188	0.0050	2.864	0.2955	52.800	53.9	0.5258
CTH-014	0.235	0.0017	1.957	0.0279	5.819	81.1	0.0000
CTH-017	0.204	0.0041	3.240	0.0526	4.737	16.3	1.0500

Site	Qr (v/v)	α_1 (1/cm)	n_1 (-)	α_2 (1/cm)	n_2 (-)	w_2 (%)	l (-)
CTH-018	0.216	0.0015	1.455	0.0220	5.142	51.3	0.0000

Qr is the residual water content, α defines the air-entry value, n defines the shape of the water retention function, w is macro porosity the portion, l is the tortuosity parameter and the subscripts 1 and 2 notates micro and macro porosity, respectively

Zonation of playa

Modeling of the recharge potential across the playa was split into zones according to surface infiltration characteristics. Zonation of the playa is show in Figure 4 along with assessment points within each zone. Each zone represents an order of magnitude change in infiltration rate.
These zones are used to define the profile physical properties and the salt reduction function based on the above assessments. Average values were taken for all the assessments metrics that were located within each zone as shown for the reduction in salts as a function of pore volume leached (Figure 5).

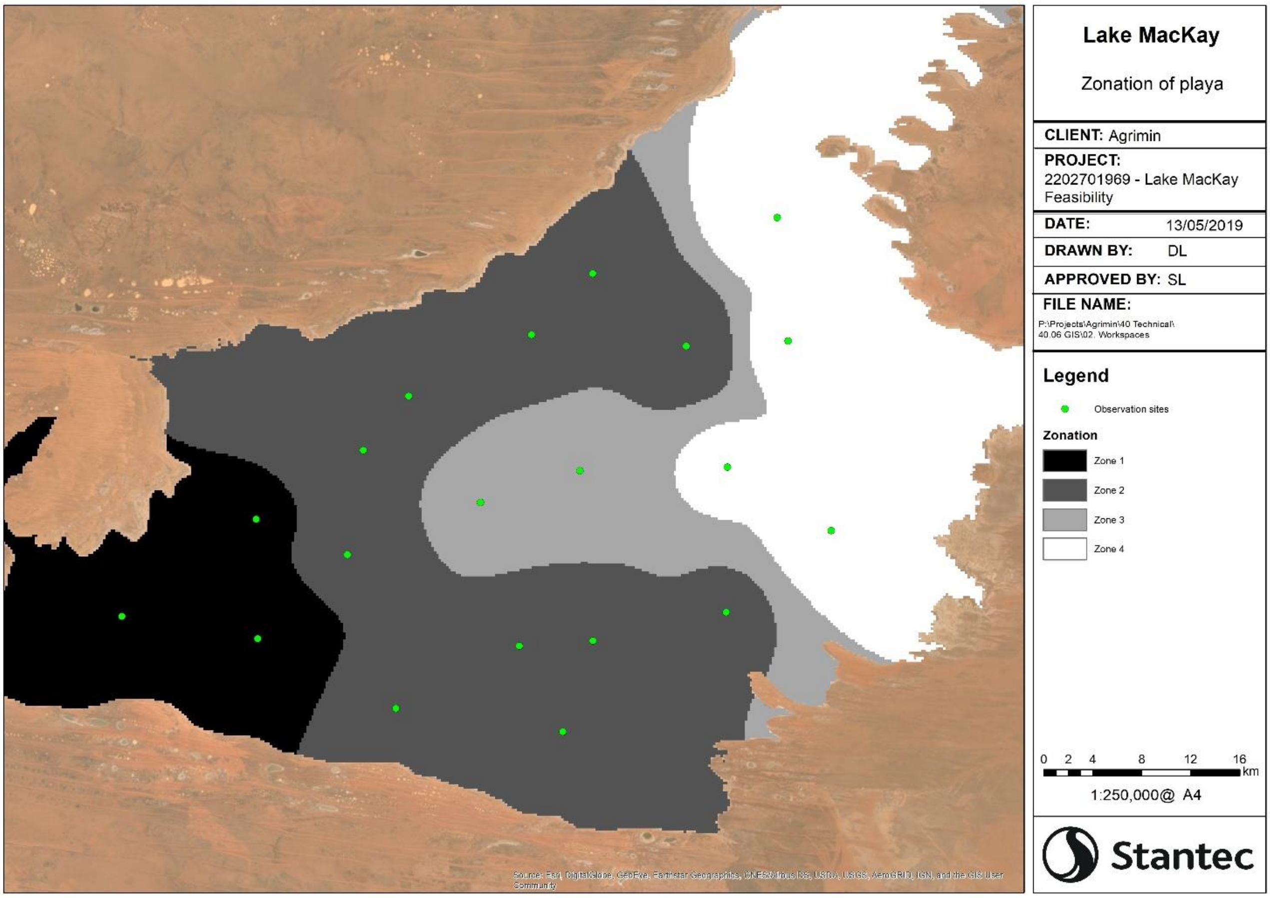


Figure 4: Zonation of Lake MacKay based on variation in surface infiltration data

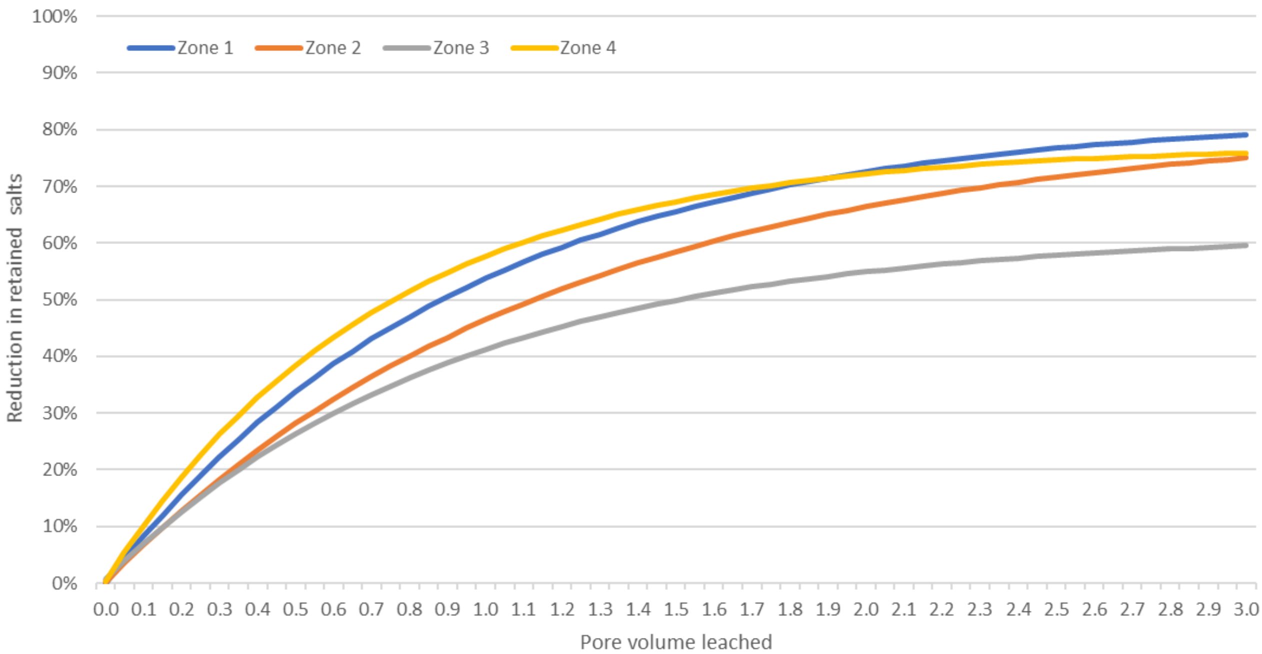


Figure 5: Resultant salt reduction function for each zone based on the percentage reduction in retained salts observed during the column leaching test

Recharge modelling

Hydrus 1D modelling (Šimůnek *et al* 2013) was used to determine the net recharge to the groundwater for each zone. Net recharge was defined as the net downward flux past the groundwater equilibrium depth.
A five metre profile was created with five different material properties with a lower boundary of 0.2, 0.5, 1.0, 3.0 and 5.0 metres. The physical properties of the layers were derived from the above field and lab assessments, data from the preliminary feasibility study and specific yield (S_y) from long-term trench pumping tests. The vertical saturated hydraulic conductivity of the layers below 0.5 metres were taken as 2 orders of magnitude smaller than the horizontal hydraulic conductivity observed in the trench pumping tests based on the anisotropic nature of the profile sediments and consistent with hydraulic conductivity for this interval used in the regional groundwater flow and transport modeling. Table 8 is a summary of the physical properties of the profile for each zone.
The surface boundary condition was set as an atmospheric boundary. The surface conditions were based on daily rainfall and pan evaporation derived from a patch point query[2] of the nearest Bureau of Metrology (BoM) weather station (15664) at Kintore (approximately 100 km distance from Lake Mackay) from 1st January 1993 to 27th October 2019, representing the period of actual weather data collection at the Kintore station. The evaporation rate from the soil surface was calibrated against the closed lysimeter data to set the maximum matric suction at the soil surface (125cm).
The bottom boundary condition was set as a constant head boundary. The head at the bottom boundary was calibrated so that the groundwater (GW) level equilibrated to the target groundwater depth below ground level (bgl). The required head at the bottom boundary is summarized in Table 6.

Table 6: Head requirement at the bottom boundary to maintain the required equilibrium groundwater level

Equilibrium GW depth bgl (m)	0.5	1.0	1.5	2.0	2.5	3.0
Zone 1	455	400	350	300	250	200
Zone 2	453	400	350	300	250	200
Zone 3	465	400	350	300	250	200
Zone 3	452	400	350	300	250	200

[2] https://www.longpaddock.qld.gov.au/silo/

Recharge modeling outcomes

Table 7 summarises the average recharge into the groundwater as a function of zone and groundwater depth below ground level. As groundwater levels drop the amount of recharge increases. The most recharge is experienced in zones 1 and 2 with the least in zone 4. Whilst infiltration is high in zone 4 evaporation of stored water in the profile is quickly evaporated reducing the amount of time for perched water to migrate past the groundwater reference depth.

Recharge and ET boundary conditions in the regional groundwater flow and transport model were then established based on the net recharge versus groundwater depth in Table 7.

Table 7: Average annual recharge (mm) into the groundwater as a function of groundwater depth and zone

Equilibrium GW depth bgl (m)	0.5	1.0	1.5	2.0	2.5	3.0
Zone 1	-32.7	84.1	99.5	111.8	118.6	122.6
Zone 2	-31.6	88.8	109.0	121.4	129.6	138.7
Zone 3	-433.8	41.9	54.2	57.2	58.4	59.0
Zone 4	-51.8	36.3	39.8	40.9	41.4	41.7

Table 8: Physical properties of the profile for each zone used in Hydrus 1D to assess recharge

Zone	Depth (cm)	Qr (v/v)	Qs (v/v)	Ks (cm/d)	α_1 (1/cm)	n_1 (-)	α_2 (1/cm)	n_2 (-)	w_2 (%)	l (-)
Zone 1	0-20	0.132	0.551	3.1	0.0033	1.732	0.0359	12.590	50.7	0.563
	20-50	0.266	0.557	1.6	0.0039	13.296	0.0381	14.544	48.0	0.825
	50-100	0.385	0.439	2.2	0.0039	13.296	0.0381	14.544	48.0	0.825
	100-300	0.398	0.455	2.2	0.0039	13.296	0.0381	14.544	48.0	0.825
	300-500	0.352	0.417	2.2	0.0039	13.296	0.0381	14.544	48.0	0.825
Zone 2	0-20	0.188	0.497	45.9	0.0081	1.718	0.1369	23.264	47.0	0.797
	20-50	0.237	0.495	1.6	0.0035	7.334	0.0512	8.506	42.0	0.891
	50-100	0.353	0.420	3.8	0.0035	7.334	0.0512	8.506	42.0	0.891
	100-300	0.417	0.479	3.8	0.0035	7.334	0.0512	8.506	42.0	0.891
	300-500	0.407	0.425	3.8	0.0035	7.334	0.0512	8.506	42.0	0.891
Zone 3	0-20	0.199	0.569	314.4	0.0102	1.553	0.0479	24.344	65.4	0.366
	20-50	0.153	0.515	75.4	0.0076	2.369	0.1674	35.390	52.2	0.263
	50-100	0.362	0.432	4.1	0.0076	2.369	0.1674	35.390	52.2	0.263
	100-300	0.393	0.457	4.1	0.0076	2.369	0.1674	35.390	52.2	0.263
	300-500	0.392	0.440	4.1	0.0076	2.369	0.1674	35.390	52.2	0.263
Zone 4	0-20	0.141	0.642	3687.2	0.0068	1.633	0.0392	4.889	93.6	0.850
	20-50	0.233	0.550	53.6	0.0077	1.602	0.0867	34.334	52.4	2.693
	50-100	0.346	0.433	5.9	0.0077	1.602	0.0867	34.334	52.4	2.693
	100-300	0.393	0.472	5.9	0.0077	1.602	0.0867	34.334	52.4	2.693
	300-500	0.392	0.453	5.9	0.0077	1.602	0.0867	34.334	52.4	2.693

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Appendix F SOILS LAB RESULTS TECHNICAL MEMO

Memo

To:	Michael Hartley	From:	Mine Closure and Geosciences Team Stantec, Perth
	2C Loch Street, Nedlands, Western Australia		41 Bishop street, Jolimont, Western Australia
File:	LMKA-SS-19001 Recharge Lab Assessment Memo	Date:	December 3, 2019

Lake Mackay Potash Project: Recharge Assessment Perth Laboratory Program

Dear Michael,

Please see below a brief summary of methods and accompanying data in relation to the recharge laboratory assessment that Stantec was commissioned to perform for Agrimin Limited (Agrimin). This laboratory program was part of an assessment intended to inform the likely variation in groundwater recharge as part of the regional modelling of the Lake Mackay Potash Project (the Project). This summary now contains the appendix with data

Sampling Regime and field collection

Agrimin field personnel conducted the field work and delivered four-inch Shelby soil core samples to Stantec Perth laboratory. Thirty- five Shelby cores were analysed including samples from three 'trench' locations and 14 other locations at the Lake Mackay study site (Table 1). Shelby cores were sealed with end caps to preserve *in situ* soil moisture at the time of collection and kept upright. Samples from 0-50 cm depth were delivered to Stantec's Perth in-house laboratory for testing between June and August 2019. Three replicate samples were received for the Trench sites, and two replicates from other sites. Additional replicates and depths obtained at the same time were analysed at other laboratories or kept at Agrimin for part of the larger project.

Table 1. Sample List

Sample ID	Replicate	Date received	Laboratory Analysis
*T2AH-001=T02AH	A and B	5/8/19	Column and Tempe
	C	5/8/19	Initial Conditions
T13H-001	A and B	5/8/19	Column and Tempe
	C	5/8/19	Initial Conditions
T13H-006	A and B	12/8/19	Column and Tempe
	C	12/8/19	Initial Conditions
CTH-001	A	26/6/19	Column and Tempe
	C	26/6/19	Initial Conditions
CTH-002	A	12/6/19	Column and Tempe
	C	12/6/19	Initial Conditions
^CTH-003	B	24/8/19	Column and Tempe
	C	24/8/19*	Initial Conditions
CTH-004	A	12/6/19	Column and Tempe
	C	12/6/19	Initial Conditions
CTH-005	A	26/6/19	Column and Tempe
	C	26/6/19	Initial Conditions
CTH-006	A	12/6/19	Column and Tempe
	C	12/6/19	Initial Conditions
CTH-008	A	12/6/19	Column and Tempe
	C	12/6/19	Initial Conditions
CTH-009	A	12/6/19	Column and Tempe
	C	12/6/19	Initial Conditions
CTH-011	A	12/6/19	Column and Tempe
	C	12/6/19	Initial Conditions
CTH-013	A	12/6/19	Column and Tempe
	C	12/6/19	Initial Conditions
CTH-014	A	12/6/19	Column and Tempe
	C	12/6/19	Initial Conditions

CTH-017	A	12/6/19	Column and Tempe
	C	12/6/19	Initial Conditions
CTH-018	A	8/7/19	Column and Tempe
	B	8/8/19	Initial Conditions

^Location was resampled as original samples were transported upside down and were unusable.

* checked with Agrimin, same site number, just different labels.

Note: Where replicate A was compromised (eg had been bumped or the surface smeared) then the alternate replicate was used for column leaching. Replicates used are indicated in Table 1.

Laboratory Analyses

The laboratory program was conducted using the Shelby tube field replicates supplied as outlined in Table 1.

1. **Soil column leaching tests**
   The column leaching test setup is depicted in Figure 1. Each Shelby core had their cap seals removed and were placed on a sand bed. These beds had an outflow tube connected to a high range electrical conductivity (EC) meter that logged pH and EC of the leachate. These pH/EC meters were re-calibrated before each use with a 20˚C temperature coefficient and were set to log readings every five minutes. A 70 cm head of deionised (DI) water was placed in a water column on top of the Shelby cores (equivalent to approximately 3.5 pore volumes) to pass through the sample. Leachate samples (approximately 100 mL) were collected at the beginning of leaching and then during each pore volume (20 cm, 40 cm and 60 cm) and these were stored in a refrigerator at approximately 4ºC prior to sending to an external lab for EC, TDS, and specific gravity analysis. Water levels within the columns were monitored and recorded several times a day. The head of water was allowed to flow freely through the Shelby cores until approximately 70 cm of DI water had passed through the Shelby soil tubes, a period which ranged from hours to weeks. The Shelby tubes were then placed in a 30 cm bed of sand to drain for 3 to 5 days.

2. **Soil water release and hydraulic characteristics**
   The Tempe cell multi-step outflow procedure used a modified process outlined by Green et al (1998)[1]. Cores for the Tempe cell were collected from the leaching columns once drained. Columns were cut into sections representative of 5-15 cm and 30-40 cm depths. Three-inch brass rings were pressed into these sections to extract an undisturbed core. The ends were trimmed, weighed and placed in a tempe cell. The Tempe cell was then connected to a gas pressure regulator to apply set pressure points of 0.1, 0.2 and 0.8 bar. At each pressure increment water displacement from the core to a burette was measured manually (periodically) and logged using pressure transducers attached to the burette base. Transducers were set to log pressure level and temperature every minute as well as the incoming set pressure. The pressure was increased at intervals to track the rate of water discharge as a function of time for each incremental pressure step. The pressure increments were applied at 0.1 bar for 24 hours, 0.2 bars for 48 hours, then 0.8 bar for four days. Final weight of each core was recorded.

3. **Initial conditions testing**
   Shelby cores were cut into 0 to 5 cm, 5 to 10 cm, 10 to 20 cm, 30 to 40 cm and 40+ cm sections. Soil in each core segments was photographed and used to determine moisture contents and bulk densities. After drying in an oven at 40˚C for 24 to 48 hours, a sub-sample (20 g) was removed and analysed for EC (1:5 water solution). The remaining sample was oven dried at 80˚C for at least a further 36 hours or until weights were consistent indicating the sample was dry. Final weights of dried samples were recorded and used to calculate soil moisture content and bulk density correcting for salt content. Dried samples from chosen depths were sent to ALS for determination of Particle Size Distribution and Particle Density.

[1] Green TW, Paydar Z, Cresswell HP and Drinkwater RJ (1998) Laboratory outflow technique for measurement of soil water diffusivity and hydraulic conductivity, Technical Report No. 12/98, CSIRO

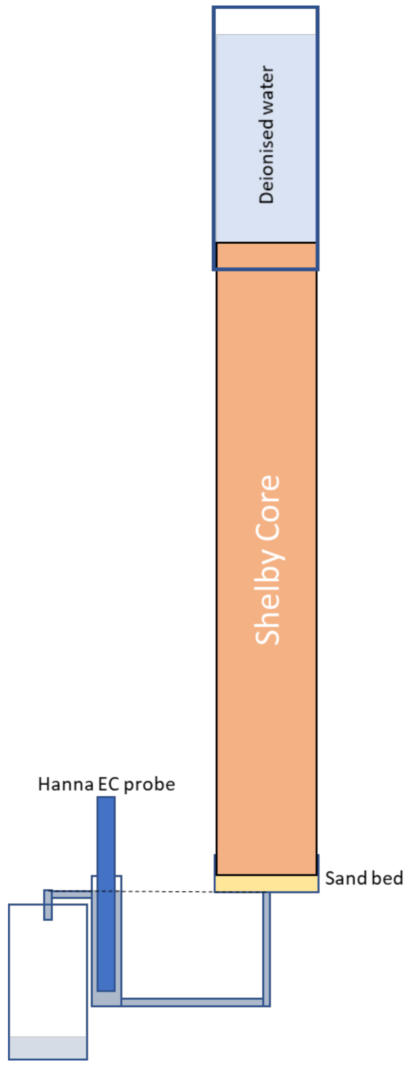

Figure 1 Schematic of column leaching test setup

Data collation

All data collected at the Perth Stantec Laboratory was collated, reviewed, processed and tabulated. The tabulated data and are summarised in the attached appendix.

If you have any queries or require further information about the laboratory program, please do not hesitate to get in touch.

Kind regards,

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Mine Closure and Geosciences Group
Stantec, Jolimont WA

Cc. Dr Dean Lanyon

Appendix: Tabulated data

1. Soil column leaching tests

CTH001			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.1	50.0	23.2	0.227
9.2	49.1	25.2	0.228
20.7	48.1	28.5	0.229
23.2	47.9	43.6	0.228
25.2	47.7	53.2	0.229
28.5	47.5	71.5	0.228
43.6	47.3	81.2	0.228
53.2	45.5	92.7	0.226
71.5	44.1	94.7	0.226
81.2	43.5	98.5	0.227
92.7	42.6	101.4	0.227
94.7	42.4	104.2	0.226
98.5	42.2	116.0	0.222
101.4	41.9	127.4	0.216
104.2	41.8	141.0	0.203
116.0	41.2	144.7	0.199
127.4	39.9	150.2	0.193
141.0	38.8	166.2	0.170
144.7	38.5	174.4	0.159
150.2	38.0	188.2	0.141
166.2	36.5	193.2	0.132
174.4	35.9	214.0	0.111
188.2	34.7	220.2	0.104
193.2	34.3	236.8	0.088
214.0	32.4	259.8	0.070
220.2	31.9	269.0	0.064
236.8	30.4	269.5	0.064
259.8	28.4	270.9	0.063
269.0	27.6	291.3	0.050
269.5	27.6	293.9	0.049
270.9	27.5	307.4	0.043
287.7	24.9	309.2	0.042
291.3	24.5	314.3	0.041
293.9	44.2	318.5	0.040
296.5	43.4	331.8	0.035
307.4	41.6	339.7	0.032
309.2	41.5	342.2	0.031
314.3	40.5	360.5	0.026

318.5	39.9	382.7	0.021
331.8	37.8	384.7	0.021
339.7	36.6	389.8	0.020
342.2	36.3	405.4	0.017
360.5	33.5	413.4	0.016
382.7	30.6	427.9	0.014
384.7	30.4	431.7	0.013
389.8	29.6	433.4	0.013
405.4	28.2	436.4	0.013
413.4	28.0	439.2	0.012
427.9	25.2	453.0	0.010
431.7	24.9	454.6	0.010
433.4	24.8	456.6	0.010
436.4	24.3	459.8	0.010
439.2	24.2	463.2	0.009
453.0	22.6	475.9	0.008
454.6	22.3	482.3	0.007
456.6	21.9	487.2	0.007
459.8	21.6	501.7	0.006
463.2	21.2	503.9	0.006
475.9	19.7	506.1	0.006
482.3	19.1	507.7	0.006
487.2	18.7	509.4	0.006
501.7	16.9	523.8	0.005
503.9	16.6	526.6	0.005
506.1	16.5	528.4	0.005
507.7	16.3	530.7	0.005
509.4	16.1	532.7	0.005
523.8	14.7	550.7	0.004
526.6	14.4	551.1	0.004
528.4	14.3		
530.7	14.0		
532.7	13.8		
550.7	12.1		
551.1	12.1		

CTH002			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.0	50.0	1.8	0.283
0.1	49.4	2.7	0.270
0.3	48.7	3.6	0.256
5.3	37.7	4.5	0.246
5.8	36.8	5.4	0.230

7.0	35.8	6.3	0.213
9.3	33.4	7.2	0.202
20.8	30.4	8.1	0.191
23.3	35.4	9.0	0.184
25.3	32.1	9.9	0.162
28.6	49.4	10.8	0.135
43.7	23.6	11.7	0.114
53.3	16.6	12.6	0.099
		13.5	0.091
		14.4	0.082
		15.3	0.075
		16.2	0.068
		17.1	0.063
		18.0	0.059
		18.9	0.056
		19.8	0.053
		20.7	0.050
		21.6	0.047
		22.5	0.044
		23.4	0.041
		24.9	0.040
		26.4	0.034
		27.9	0.031
		29.4	0.027
		30.9	0.026
		32.4	0.025
		33.9	0.024
		35.4	0.022
		36.9	0.020
		39.3	0.017
		41.7	0.016
		44.1	0.015
		46.5	0.015
		48.9	0.014
		51.3	0.014
		53.3	0.013

CTH003			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.4	48.9	0.7	0.133
0.5	48.8	1.3	0.129
1.6	45.2	2.3	0.107
3.3	40.8	3.3	0.096

4.2	38.6	4.3	0.091
5.2	36.9	5.3	0.086
7.0	45.5	6.3	0.078
7.2	45.0	9.3	0.068
8.3	42.5	10.3	0.063
10.3	39.8	11.3	0.059
12.3	37.1	12.3	0.057
14.3	34.5	13.3	0.054
16.3	31.8	14.3	0.051
18.3	29.1	15.3	0.048
20.3	26.4	28.3	0.037
22.3	23.7	29.3	0.035
23.6	22.0	30.3	0.035
26.6	19.3	31.3	0.035
31.3	15.5	32.3	0.036
34.1	13.5	33.3	0.036
		34.1	0.036

CTH004			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.01	50.00		
0.33	47.30	0.40	0.191
0.95	44.10	0.70	0.191
1.40	41.90	1.00	0.165
1.50	41.40	1.30	0.147
1.83	38.40	1.60	0.131
2.00	38.20	1.90	0.115
2.25	36.80	2.20	0.103
2.33	35.20	2.50	0.092
3.33	32.23	2.80	0.088
4.33	29.25	3.10	0.084
5.33	26.28	3.40	0.077
6.33	23.31	3.70	0.072
7.33	20.34	4.00	0.067
8.33	17.36	4.30	0.065
9.33	14.39	4.60	0.063
10.33	11.42	4.90	0.060
11.33	8.44	5.70	0.055
11.58	7.70	6.50	0.052
11.83	27.70	7.30	0.050
13.00	24.80	8.10	0.048
13.33	24.00	8.90	0.046
14.33	20.60	9.70	0.045

17.33	12.80	10.50	0.043
19.33	9.20	11.30	0.042
		12.10	0.039
		12.90	0.037
		13.70	0.035
		14.50	0.034
		15.30	0.032
		16.10	0.031
		16.90	0.030
		17.70	0.030
		18.50	0.029
		19.30	0.028

CTH005			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.00	50.00	0.00	0.000
10.00	48.50	10.00	0.197
25.50	42.20	25.50	0.185
30.63	41.10	30.63	0.189
33.50	40.50	33.50	0.189
49.25	37.70	49.25	0.182
53.67	36.50	53.67	0.185
58.50	35.80	58.50	0.181
73.08	32.40	73.08	0.137
81.00	30.10	81.00	0.114
96.00	23.80	96.00	0.059
104.00	20.50	104.00	0.042
121.25	15.90	121.25	0.011

CTH006			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.01	50.00	18.28	0.000
1.98	49.90	25.15	0.049
18.28	49.70	27.37	0.053
21.13	49.60	28.62	0.053
24.03	49.60	42.38	0.123
25.15	49.50	44.20	0.124
27.37	49.50	45.62	0.126
28.62	49.50	67.07	0.145
42.38	49.40	68.72	0.146

44.20	49.40	90.37	0.152
45.62	49.30	92.22	0.165
67.07	49.30	94.22	0.167
68.72	49.10	98.00	0.170
90.37	48.90	114.33	0.182
92.22	48.80	119.02	0.190
94.22	48.80	122.18	0.194
98.00	48.70	138.38	0.195
114.33	48.50	162.12	0.203
119.02	48.40	186.18	0.207
122.18	48.40	211.08	0.208
138.38	48.40	235.22	0.217
162.12	48.10	258.53	0.220
186.18	47.80	267.93	0.230
211.08	47.40	284.12	0.216
235.22	47.30	306.62	0.226
258.53	47.00	316.07	0.228
267.93	47.00	330.57	0.229
284.12	46.90	337.87	0.217
306.62	46.60	340.87	0.215
316.07	44.10	353.50	0.214
330.57	44.10	362.62	0.227
337.87	44.00	378.78	0.222
340.87	44.00	387.12	0.229
353.50	44.00	402.32	0.231
362.62	43.80	410.45	0.226
378.78	43.50	428.12	0.227
387.12	43.50	430.12	0.229
402.32	43.40	432.53	0.232
410.45	43.30	436.65	0.231
428.12	43.10	450.12	0.230
430.12	43.10		
432.53	43.10		
436.65	43.00		
450.12	42.80		

CTH008			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.01	50.00	0.01	0.184
0.33	45.00	0.61	0.097
0.61	36.10	0.71	0.070
0.71	32.00	0.79	0.059

0.79	48.10	1.04	0.025
1.04	34.40	1.21	0.019
1.21	28.20	1.29	0.015
1.29	21.20	1.46	0.011
1.46	13.20	1.71	0.011
1.71	9.00		

CTH009			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.00	50.00	0.00	0.000
1.37	49.60	0.50	0.000
2.78	49.00	0.92	0.000
24.23	45.60	1.33	0.011
25.88	45.20	1.75	0.019
47.53	43.00	2.17	0.048
49.38	42.80	2.58	0.071
51.38	42.50	3.42	0.105
53.25	42.30	4.25	0.127
55.17	42.10	5.08	0.137
71.50	40.40	5.92	0.143
76.18	39.90	6.75	0.145
79.35	39.50	7.58	0.147
95.55	37.50	8.42	0.148
119.28	34.80	9.25	0.147
143.35	32.00	10.08	0.147
168.25	22.90	10.92	0.149
192.38	10.00	13.42	0.149
		15.08	0.149
		16.75	0.149
		18.42	0.149
		20.08	0.149
		21.75	0.148
		23.42	0.148
		25.08	0.148
		26.75	0.147
		28.42	0.147
		30.08	0.147
		31.75	0.146
		33.42	0.146
		35.08	0.146
		40.08	0.145
		43.42	0.144
		46.75	0.144

		50.08	0.143
		53.41	0.143
		56.74	0.142
		60.08	0.142
		66.74	0.141
		73.42	0.141
		80.03	0.142
		86.70	0.141
		93.36	0.137
		100.03	0.140
		106.70	0.140
		113.36	0.138
		120.03	0.136
		126.70	0.138
		133.36	0.135
		140.03	0.132
		146.69	0.133
		153.36	0.138
		160.03	0.130
		166.69	0.128
		173.36	0.146
		180.03	0.045
		186.69	0.032
		192.36	0.031

CTH0011			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.00	50.00	0.00	
3.20	48.80	3.20	
17.70	46.10	17.70	0.195
25.00	44.20	25.00	0.197
28.00	43.90	28.00	0.197
40.63	43.30	40.63	0.189
49.75	41.70	49.75	0.195
65.92	39.90	65.92	0.180
74.25	39.00	74.25	0.189
89.45	37.60	89.45	0.178
97.58	36.90	97.58	0.181
115.25	35.50	115.25	0.167
119.67	35.40	119.67	0.169
123.78	33.90	123.78	0.169
137.25	33.40	137.25	0.150
142.75	33.40	142.75	0.151

162.75	29.90	162.75	0.124
167.75	29.60	167.75	0.116
170.75	47.20	170.75	0.069
186.55	36.30	186.55	0.020
190.75	31.20	190.75	0.018
195.75	28.60	195.75	0.017
218.25	18.20	218.25	0.010
233.50	11.40	233.50	0.009
241.25	7.60	241.25	0.008

CTH0014			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
2.22	49.60	2.22	0.127
3.47	49.40	3.47	0.167
17.23	44.70	17.23	0.197
19.05	44.30	19.05	0.197
20.47	44.10	20.47	0.198
41.92	42.00	41.92	0.202
43.57	41.80	43.57	0.202
65.22	40.70	65.22	0.212
67.07	40.70	67.07	0.212
69.07	40.60	69.07	0.212
72.85	40.50	72.85	0.212
89.18	39.70	89.18	0.218
93.87	42.20	93.87	0.219
97.03	39.50	97.03	0.220
113.23	39.10	113.23	0.221
136.97	38.30	136.97	0.222
161.03	37.60	161.03	0.223
185.93	36.60	185.93	0.225
210.07	35.70	210.07	0.224
233.38	35.00	233.38	0.224
242.78	34.80	242.78	0.224
258.97	34.40	258.97	0.224
281.47	33.90	281.47	0.223
305.42	33.30	305.42	0.224
312.72	33.20	312.72	0.225
316.72	33.20	316.72	0.223
328.35	32.90	328.35	0.223
337.47	32.60	337.47	0.224
353.63	32.40	353.63	0.223
361.97	32.10	361.97	0.223
377.17	31.90	377.17	0.222

385.30	31.70	385.30	0.223
402.97	31.50	402.97	0.225
407.38	31.40	407.38	0.222
411.50	31.30	411.50	0.222
424.97	31.10	424.97	0.222
430.47	31.00	430.47	0.222
450.47	30.30	450.47	0.216
455.47	30.20	455.47	0.221
458.47	30.00	458.47	0.222
474.13	29.70	474.13	0.215
478.47	29.50	478.47	0.222
483.47	29.50	483.47	0.214
505.97	29.00	505.97	0.213
521.22	28.70	521.22	0.203
528.97	28.60	528.97	0.207
552.85	28.00	552.85	0.203
570.47	27.70	570.47	0.197
573.97	27.70	573.97	0.205
580.47	27.60	580.47	0.210

CTH0017			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.01	50	0.00	0.000
0.58	49.7	50.08	0.242
2.00	49	53.42	0.243
23.45	46.2	56.75	0.242
25.10	46	60.08	0.242
46.75	43.9	63.42	0.242
48.60	43.2	66.75	0.238
50.60	42.8	70.08	0.235
54.38	42.3	78.33	0.230
70.72	41	94.73	0.224
75.40	39.5	118.43	0.208
78.57	39.2	142.50	0.184
94.77	36.9	167.31	0.131
118.50	34	183.58	0.090
142.57	30.5	188.58	0.083
167.47	25.7	169.64	0.120
191.60	23.2	174.64	0.106
214.92	40.3	179.64	0.096
224.32	37.5	184.64	0.088
240.50	32	189.64	0.081
244.73	30	194.64	0.070

		199.64	0.059
		204.64	0.050
		209.64	0.043
		214.64	0.037
		219.64	0.034
		224.64	0.030
		229.64	0.028
		234.64	0.025
		239.64	0.022
		244.73	0.020

CTH0018			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.00	50.00	0.00	0.000
1.38	46.60	0.92	0.136
3.98	38.90	1.33	0.134
6.00	37.88	1.75	0.119
9.00	36.37	2.17	0.101
12.00	34.86	2.58	0.087
15.00	33.35	3.00	0.078
18.00	31.83	3.42	0.070
21.00	30.32	3.83	0.065
22.23	29.70	4.25	0.060
24.23	28.30	4.67	0.055
26.22	22.40	5.08	0.051
27.23	21.40	5.50	0.047
29.32	16.50	5.92	0.045
32.00	14.09	6.75	0.045
35.00	11.41	7.58	0.043
38.00	8.72	8.42	0.042
41.00	6.03	9.25	0.041
44.00	3.34	10.08	0.038
44.93	2.50	10.92	0.037
		11.75	0.035
		12.58	0.034
		13.42	0.032
		14.25	0.031
		15.08	0.030
		15.92	0.029
		17.58	0.027
		18.83	0.027
		20.08	0.026
		21.33	0.026

		22.58	0.026
		23.83	0.025
		25.08	0.025
		26.33	0.022
		27.58	0.019
		28.83	0.017
		30.08	0.016
		31.33	0.016
		32.58	0.015
		33.83	0.015
		35.08	0.014
		36.33	0.014
		37.58	0.014
		38.83	0.014
		40.08	0.014
		41.33	0.014
		42.58	0.014
		43.83	0.014
		44.92	

T2AH001B			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.01	50.00	125.00	0.120
22.23	44.50	135.00	0.114
24.23	44.20	145.00	0.115
26.22	43.90	160.00	0.113
29.32	43.90	180.00	0.113
44.93	41.40	200.00	0.113
67.40	39.70	220.00	0.113
71.23	39.50	240.00	0.117
72.90	39.40	260.00	0.118
75.90	39.30	280.00	0.120
78.73	40.20	310.00	0.093
92.48	39.70	320.00	0.069
94.07	39.70	330.00	0.053
96.07	39.70	340.00	0.046
102.73	39.40	350.00	0.042
115.40	38.70	360.00	0.038
121.77	38.40	370.00	0.037
126.73	38.40	380.00	0.035
141.23	36.50	390.00	0.034
143.40	36.50	400.00	0.032

145.57	36.40	410.00	0.032
147.23	36.40	480.00	0.028
148.93	36.40	490.00	0.025
163.27	36.10	500.00	0.023
166.10	36.10	510.00	0.023
167.87	36.10	520.00	0.022
170.15	36.00	530.00	0.023
172.23	36.00	540.00	0.023
190.23	35.60	550.00	0.022
190.82	35.60	560.00	0.020
212.48	35.10	570.00	0.018
220.63	35.00	580.00	0.017
235.50	34.70	590.00	0.016
237.23	34.60	600.00	0.016
239.23	34.60	610.00	0.015
241.77	34.60	620.00	0.015
260.62	34.30	624.72	0.015
264.58	34.20		
267.15	34.30		
271.53	34.20		
283.43	34.00		
287.90	34.00		
290.35	53.90		
307.23	51.20		
310.43	50.60		
313.65	50.00		
317.40	49.50		
331.47	46.90		
339.35	45.60		
356.67	42.70		
362.63	41.70		
380.03	39.00		
388.48	37.80		
403.17	36.00		
413.23	35.00		
427.43	33.70		
431.07	33.40		
438.82	32.80		
451.35	31.40		
459.37	30.40		
461.03	30.30		
475.67	28.50		
479.90	27.90		
480.82	27.90		

482.67	27.60		
483.93	27.50		
499.27	25.60		
502.28	25.20		
506.97	24.60		
509.73	24.30		
525.63	22.80		
548.90	20.40		
556.73	19.20		
571.23	17.60		
576.55	16.90		
581.82	16.30		
594.15	15.00		
601.23	14.20		
603.23	14.00		
620.73	12.50		
622.23	12.40		
624.72	12.20		

T2AH001C			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.00	50.00	4.85	0.143
5.25	48.00	390.00	0.136
8.67	48.00	410.00	0.131
21.33	45.90	430.00	0.108
27.70	43.80	450.00	0.089
32.67	43.00	470.00	0.080
47.17	41.30	490.00	0.076
49.33	41.00	510.00	0.073
51.50	40.80	530.00	0.071
53.17	40.60	550.00	0.070
54.87	40.40	570.00	0.069
69.20	39.00	590.00	0.068
72.03	38.70	610.00	0.067
73.80	38.60	630.00	0.067
76.08	38.40	650.00	0.066
78.17	38.30	670.00	0.065
96.17	37.10	690.00	0.064
96.50	37.10	710.00	0.062
118.42	36.00	724.27	0.061
126.57	35.70		
141.43	35.00		
143.17	35.00		

145.17	34.80		
147.70	34.80		
166.53	34.00		
170.52	33.90		
172.83	33.90		
173.08	33.80		
177.47	33.60		
189.37	33.30		
196.28	33.00		
199.67	33.00		
213.17	32.70		
216.37	32.60		
219.58	32.50		
223.33	32.40		
237.40	32.10		
245.28	31.90		
262.60	31.50		
268.57	31.30		
285.97	30.90		
294.42	30.90		
309.10	30.60		
319.17	30.50		
333.37	30.10		
337.00	30.10		
344.75	29.90		
357.28	29.60		
365.30	29.50		
366.97	29.50		
381.60	29.20		
385.67	48.30		
386.75	48.30		
389.87	48.10		
405.20	47.40		
408.22	47.00		
412.90	46.70		
415.67	46.60		
431.40	45.90		
454.83	44.60		
466.90	44.10		
477.17	43.20		
482.48	43.00		
487.75	42.60		
500.08	42.10		
507.17	41.80		

509.17	41.60		
526.67	41.00		
528.17	41.00		
536.32	40.70		
549.25	40.00		
552.67	39.90		
558.17	39.70		
559.67	39.70		
573.17	39.00		
576.37	38.90		
577.70	38.80		
578.27	38.80		
580.58	38.70		
583.17	38.70		
600.50	38.00		
605.92	37.90		
624.90	37.20		
629.98	36.90		
645.33	36.30		
648.98	36.20		
651.15	36.20		
653.00	36.20		
654.07	36.20		
669.28	35.70		
673.50	35.60		
676.02	35.50		
676.67	35.50		
693.48	34.90		
700.47	34.70		
717.28	34.20		
724.27	33.90		

T13H001A			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.01	50.00	95.00	0.145
2.45	49.50	100.00	0.147
5.83	49.40	105.00	0.147
19.33	48.20	110.00	0.148
22.53	48.00	115.00	0.148
25.75	47.70	120.00	0.149
29.50	47.50	125.00	0.150
43.57	46.50	130.00	0.149
51.45	46.10	135.00	0.149

68.43	44.90	140.00	0.149
74.73	44.60	145.00	0.150
92.13	43.60	150.00	0.150
100.58	43.00	160.00	0.149
115.23	41.80	170.00	0.150
125.33	41.80	180.00	0.149
139.53	40.90	190.00	0.149
143.17	40.80	200.00	0.149
150.92	40.70	210.00	0.147
163.45	39.80	220.00	0.146
171.47	39.50	230.00	0.146
173.13	39.40	240.00	0.142
187.77	38.80	250.00	0.139
192.00	38.70	260.00	0.135
192.92	38.60	270.00	0.127
194.97	38.60	280.00	0.117
196.03	38.50	290.00	0.106
211.37	37.80	300.00	0.093
214.38	37.70	310.00	0.081
219.07	37.50	320.00	0.070
221.83	37.40	330.00	0.060
237.57	36.70	340.00	0.049
261.00	35.60	350.00	0.040
261.07	55.90	360.00	0.032
268.83	55.30	370.00	0.026
283.33	54.20	380.00	0.021
288.33	54.00	390.00	0.018
291.60	53.60	400.00	0.015
293.92	53.50	410.00	0.012
306.25	52.80	420.00	0.010
307.80	52.70	430.00	0.009
313.33	52.10	440.00	0.008
315.33	52.10	450.00	0.007
332.83	51.00	460.00	0.006
334.33	50.90	470.00	0.005
339.77	50.50	480.00	0.005
342.48	50.30	490.00	0.005
355.42	49.30	500.00	0.004
358.83	49.10	510.00	0.004
364.33	48.80	520.00	0.004
365.83	48.70	530.43	0.004
379.33	47.60		
382.53	47.50		
383.87	47.30		

384.43	47.20		
386.75	47.10		
389.33	47.10		
406.67	45.70		
412.08	45.50		
431.07	44.10		
436.15	43.90		
451.50	42.90		
455.15	42.60		
457.32	42.50		
459.17	42.40		
460.23	42.35		
475.45	41.40		
479.67	41.10		
482.18	41.00		
482.83	40.90		
499.65	39.90		
506.63	39.40		
523.45	38.30		
530.43	37.90		

T13H001C			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.00	50.00	0.06	0.123
0.02	49.00	0.32	0.073
0.07	47.00	0.48	0.058
0.15	44.50	0.65	0.046
0.27	41.00	0.82	0.036
0.38	37.00	0.98	0.027
0.55	33.40	1.15	0.022
0.72	29.60	1.32	0.019
0.77	50.20	1.48	0.018
0.95	44.50	1.65	0.017
1.18	37.70	1.82	0.017
1.40	32.30	1.98	0.015
1.90	21.30	2.15	0.014
2.30	13.80	2.32	0.013
2.77	6.00	2.48	0.012
		2.65	0.011
		2.77	0.011

T13H006A			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.00	50.00	0.05	0.103
0.07	45.40	0.07	0.092
0.23	31.80	0.08	0.079
0.25	51.00	0.10	0.065
0.35	41.80	0.12	0.050
0.43	30.90	0.13	0.037
0.53	24.90	0.15	0.028
0.70	12.90	0.17	0.022
		0.18	0.018
		0.20	0.016
		0.22	0.016
		0.23	0.016
		0.25	0.016
		0.27	0.016
		0.28	0.015
		0.30	0.015
		0.32	0.013
		0.33	0.011
		0.35	0.010
		0.37	0.008
		0.38	0.007
		0.40	0.007
		0.42	0.006
		0.43	0.006
		0.45	0.006
		0.47	0.006
		0.48	0.005
		0.50	0.005
		0.52	0.005
		0.53	0.005
		0.55	0.005
		0.57	0.005
		0.58	0.005
		0.60	0.004
		0.62	0.004
		0.63	0.004
		0.65	0.004
		0.67	0.004
		0.68	0.004
		0.70	0.004

T13H006B			
Surface water head		Drainage solute observations	
Time (hrs)	Head (cm)	Time (hrs)	Solute conc. (g/cc)
0.00	50.00	0.40	0.189
0.10	48.40	0.70	0.176
0.20	47.80	1.00	0.133
0.40	45.30	1.30	0.100
0.50	44.80	1.60	0.078
0.70	42.20	1.90	0.064
2.30	31.30	2.20	0.054
2.90	28.30	2.50	0.051
3.30	44.20	2.80	0.047
3.60	40.30	3.10	0.040
4.30	35.20	3.40	0.036
4.50	33.50	3.70	0.031
5.40	28.60	4.00	0.028
		4.30	0.026
		4.60	0.023
		4.90	0.023
		5.20	0.025
		5.40	0.024

2. Soil water release and hydraulic characteristics

CTH001 5-15cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-98.06	0.10	-0.038
0.2	-97.55	0.20	-0.047
0.3	-96.85	0.30	-0.058
0.5	-95.90	0.50	-0.071
1.0	-94.77	1.00	-0.095
1.5	-93.85	1.50	-0.107
2.0	-93.55	2.00	-0.116
3.0	-92.91	3.00	-0.125
4.0	-92.48	4.00	-0.131
5.0	-92.13	5.00	-0.134
7.0	-93.56	7.00	-0.137
9.0	-95.32	9.00	-0.140
11.0	-96.55	11.00	-0.142
13.0	-95.98	13.00	-0.144
15.0	-95.56	15.00	-0.145
19.0	-96.69	19.00	-0.146
23.0	-94.25	23.00	-0.148
24.0	-200.49	24.00	-0.172
24.5	-199.58	24.50	-0.186
25.0	-198.90	25.00	-0.195
26.0	-197.58	26.00	-0.214
27.0	-196.50	27.00	-0.230
30.0	-193.90	30.00	-0.261
33.0	-195.41	33.00	-0.282
36.0	-193.64	36.00	-0.302
39.0	-195.36	39.00	-0.312
42.0	-196.88	42.00	-0.323
45.0	-195.60	45.00	-0.330
48.0	-192.31	48.00	-0.335
54.0	-191.32	54.00	-0.344
60.0	-191.08	60.00	-0.347
66.0	-192.41	66.00	-0.352
69.0	-190.99	69.00	-0.356
70.0	-801.72	70.00	-0.370
71.0	-803.51	71.00	-0.376
72.0	-806.21	72.00	-0.381
73.0	-808.26	73.00	-0.384
75.0	-805.37	75.00	-0.393
77.0	-810.41	77.00	-0.402

79.0	-810.96	79.00	-0.408
81.0	-807.69	81.00	-0.416
83.0	-806.54	83.00	-0.421
85.0	-802.24	85.00	-0.432
87.0	-800.93	87.00	-0.439
89.0	-799.22	89.00	-0.446
92.0	-795.85	92.00	-0.455
95.0	-794.47	95.00	-0.464
98.0	-793.88	98.00	-0.472
101.0	-789.93	101.00	-0.476
104.0	-788.76	104.00	-0.485
107.0	-801.72	107.00	-0.487
110.0	-800.53	110.00	-0.495
113.0	-813.71	113.00	-0.500
116.0	-808.52	116.00	-0.512
119.0	-794.13	119.00	-0.519
122.0	-793.65	122.00	-0.524
123.0	-792.86	123.00	-0.525

CTH001 30-40cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-105.25	0.10	-0.002
0.2	-105.39	0.20	-0.002
0.3	-105.14	0.30	-0.005
0.5	-105.46	0.50	-0.003
1.0	-105.06	1.00	-0.011
1.5	-104.65	1.50	-0.016
2.0	-104.55	2.00	-0.022
3.0	-104.17	3.00	-0.028
4.0	-103.80	4.00	-0.035
5.0	-103.42	5.00	-0.040
7.0	-103.65	7.00	-0.045
9.0	-103.99	9.00	-0.057
11.0	-104.58	11.00	-0.061
13.0	-104.25	13.00	-0.066
15.0	-103.98	15.00	-0.070
18.0	-103.94	18.00	-0.072
22.0	-103.14	22.00	-0.081
23.6	-102.83	23.50	-0.083
23.7	-206.02	23.60	-0.083
25.0	-205.50	23.80	-0.088
26.0	-205.19	25.00	-0.093
27.0	-204.95	27.00	-0.101
30.0	-204.20	30.00	-0.112

33.0	-203.30	33.00	-0.122
36.0	-203.06	36.00	-0.133
39.0	-202.82	39.00	-0.141
42.0	-202.69	42.00	-0.150
45.0	-202.46	45.00	-0.157
48.0	-200.78	48.00	-0.162
54.0	-199.93	54.00	-0.178
60.0	-199.04	60.00	-0.189
66.0	-198.71	66.00	-0.201
69.0	-198.56	69.00	-0.208
70.0	-808.85	70.00	-0.211
71.0	-808.56	71.00	-0.214
72.0	-808.51	72.00	-0.219
73.0	-808.91	73.00	-0.222
75.0	-803.93	75.00	-0.228
77.0	-805.54	77.00	-0.237
79.0	-804.98	79.00	-0.243
81.0	-805.59	81.00	-0.251
83.0	-797.05	83.00	-0.258
85.0	-799.71	85.00	-0.265
87.0	-798.97	87.00	-0.272
89.0	-797.82	89.00	-0.278
92.0	-797.73	92.00	-0.288
95.0	-800.31	95.00	-0.296
98.0	-801.30	98.00	-0.306
101.0	-791.91	101.00	-0.313
104.0	-794.47	104.00	-0.323
107.0	-799.15	107.00	-0.331
110.0	-787.83	110.00	-0.342
113.0	-800.29	113.00	-0.350
116.0	-807.53	116.00	-0.358
119.0	-796.35	119.00	-0.368
122.0	-795.91	122.00	-0.376
123.0	-795.46	123.00	-0.379

CTH002 30-40cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.05	-87.62	0.05	-0.026
0.1	-81.41	0.10	-0.135
0.3	-85.62	0.30	-0.244
0.5	-83.93	0.50	-0.275
1	-82.21	1.00	-0.306
2	-81.22	2.00	-0.322
3.5	-81.39	3.50	-0.326

5	-98.97	5.00	-0.337
7	-100.69	7.00	-0.344
9	-102.92	9.00	-0.347
11	-103.75	11.00	-0.347
14	-105.73	14.00	-0.351
18	-97.10	18.00	-0.354
21	-95.82	21.00	-0.355
23	-95.22	23.00	-0.353
24	-94.91	24.00	-0.355
25	-201.88	25.00	-0.386
26	-200.76	26.00	-0.405
28	-200.05	28.00	-0.423
30	-200.20	30.00	-0.433
32	-203.39	32.00	-0.440
35	-204.46	35.00	-0.449
40	-204.97	40.00	-0.459
45	-198.38	45.00	-0.466
50	-194.10	50.00	-0.467
55	-200.47	55.00	-0.467
60	-205.26	60.00	-0.468
65	-206.95	65.00	-0.471
70	-200.33	70.00	-0.478
72	-198.91	72.00	-0.479
73	-802.72	73.00	-0.493
74	-806.34	74.00	-0.498
76	-808.46	76.00	-0.505
78	-803.40	78.00	-0.518
80	-821.36	80.00	-0.527
85	-821.46	85.00	-0.550
90	-12.52	90.00	-0.567
95	-866.47	95.00	-0.582
100	-811.31	100.00	-0.604
105	-822.60	105.00	-0.623
110	-825.89	110.00	-0.634
115	-814.55	115.00	-0.639
120	-808.85	120.00	-0.645
125	-798.88	125.00	-0.657
130	-814.92	130.00	-0.672
135	-818.79	135.00	-0.683
140	-798.06	140.00	-0.692
145	-792.08	145.00	-0.699
150	-790.72	150.00	-0.704
155	-799.82	155.00	-0.718
160	-805.61	160.00	-0.726
164	-790.96	164.00	-0.729
167	-794.77	167.00	-0.381

170	-794.77	170.00	-0.381
173	-794.77	173.00	-0.381
176	-794.77	176.00	-0.381
123	-795.46	123.00	-0.379

CTH003 5-15cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.01	-90.74	0.05	-0.016
0.12	-126.13	0.12	-0.047
0.30	-86.83	0.30	-0.076
0.50	-84.93	0.40	-0.103
1.00	-94.18	0.50	-0.120
1.50	-92.78	0.80	-0.160
2.20	-92.09	1.00	-0.180
2.30	-83.94	1.20	-0.194
4.00	-87.78	1.50	-0.212
5.00	-87.58	2.00	-0.228
7.00	-98.27	3.00	-0.236
9.00	-99.69	4.00	-0.239
11.00	-100.16	5.00	-0.241
13.00	-99.37	7.00	-0.255
15.00	-101.34	10.00	-0.257
18.00	-97.27	15.00	-0.263
22.00	-77.94	20.00	-0.257
24.00	-77.46	25.00	-0.255
24.50	-77.34	30.00	-0.257
25.00	-77.24	35.00	-0.264
26.00	-76.86	40.00	-0.265
27.00	-77.57	42.00	-0.259
30.00	-82.47	42.50	-0.260
33.00	-85.72	42.90	-0.270
36.00	-86.89	43.00	-0.271
39.00	-86.15	44.00	-0.290
42.25	-80.97	45.00	-0.300
45.00	-175.17	47.00	-0.310
48.00	-192.62	48.00	-0.318
54.00	-196.68	54.00	-0.338
60.00	-201.97	58.00	-0.348
66.00	-198.72	60.00	-0.352
69.00	-193.60	65.00	-0.358
70.00	-193.36	70.00	-0.360
71.00	-193.02	75.00	-0.361
72.00	-192.58	80.00	-0.361
73.00	-191.43	85.00	-0.361

75.00	-192.02	90.00	-0.364
77.00	-193.14	91.00	-0.365
79.00	-193.85	91.20	-0.392
81.00	-194.94	91.50	-0.396
83.00	-196.40	91.80	-0.401
85.00	-198.57	92.00	-0.404
87.00	-198.54	93.00	-0.415
89.00	-196.38	95.00	-0.433
92.00	-796.93	100.00	-0.462
95.00	-788.56	105.00	-0.488
98.00	-784.36	110.00	-0.507
101.00	-781.21	115.00	-0.523
104.00	-797.13	120.00	-0.535
107.00	-797.05	125.00	-0.543
110.00	-793.29	130.00	-0.552
113.00	-786.38	136.50	-0.576
116.00	-777.77	140.57	-0.581
119.00	-778.44	143.23	-0.586
122.00	-787.02	148.55	-0.596
125.00	-787.84	160.72	-0.615
128.00	-802.17	165.35	-0.622
131.00	-800.37	167.75	-0.625
134.00	-796.65	184.52	-0.646
137.00	-792.77	190.00	-0.644
140.00	-793.50	195.00	-0.650
143.00	-779.56	200.00	-0.655
146.00	-773.83	205.00	-0.662
149.00	-778.55	210.00	-0.669
152.00	-785.88	215.00	-0.677

CTH003 30-40cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.0	-92.37	0.02	-0.023
0.3	-88.05	0.20	-0.060
0.3	-88.05	0.30	-0.083
0.5	-87.38	0.50	-0.109
1.0	-98.14	1.00	-0.144
1.5	-97.44	1.50	-0.166
2.2	-96.55	2.20	-0.189
2.3	-88.40	2.30	-0.190
4.0	-91.10	4.00	-0.213
5.0	-90.83	5.00	-0.218
7.0	-101.73	7.00	-0.230
9.0	-103.16	9.00	-0.231

11.0	-103.64	11.00	-0.233
13.0	-102.78	13.00	-0.236
15.0	-105.03	15.00	-0.238
18.0	-99.60	18.00	-0.252
22.0	-79.95	22.00	-0.253
23.0	-79.63	24.00	-0.257
24.0	-79.16	24.50	-0.257
25.0	-78.76	25.00	-0.260
26.0	-78.28	26.00	-0.259
27.0	-80.08	27.00	-0.245
30.0	-85.46	30.00	-0.238
33.0	-89.18	33.00	-0.237
36.0	-90.14	36.00	-0.241
41.0	-82.82	41.00	-0.249
43.0	-180.30	42.00	-0.250
45.0	-178.22	43.00	-0.260
48.0	-193.43	44.00	-0.271
54.0	-198.09	45.00	-0.280
60.0	-203.59	47.00	-0.291
66.0	-200.04	50.00	-0.307
69.0	-194.50	55.00	-0.309
70.0	-194.16	65.00	-0.325
71.0	-193.62	70.00	-0.336
72.0	-193.27	75.00	-0.336
73.0	-191.83	80.00	-0.332
75.0	-192.91	85.00	-0.333
77.0	-194.13	90.00	-0.339
79.0	-195.05	91.00	-0.342
81.0	-196.13	92.00	-0.381
83.0	-197.49	94.00	-0.395
85.0	-199.66	96.00	-0.410
87.0	-199.54	98.00	-0.424
91.0	-195.14	100.00	-0.429
92.0	-797.74	105.00	-0.455
95.0	-789.88	110.00	-0.473
98.0	-785.47	115.00	-0.496
101.0	-782.70	120.00	-0.512
104.0	-798.61	125.00	-0.517
107.0	-798.64	130.00	-0.528
110.0	-794.87	135.00	-0.542
113.0	-787.49	140.00	-0.554
116.0	-778.87	145.00	-0.563
119.0	-779.44	150.00	-0.564
122.0	-788.03	155.00	-0.574
125.0	-788.90	160.00	-0.581
128.0	-803.03	165.00	-0.589

131.0	-801.32	170.00	-0.593
134.0	-797.49	175.00	-0.598
137.0	-793.25	180.00	-0.608
140.0	-793.89	185.00	-0.621
143.0	-779.73	190.00	-0.625
146.0	-774.12	195.00	-0.625
149.0	-778.58	200.00	-0.627
152.0	-786.11	205.00	-0.634
155.0	-787.06	210.00	-0.648
158.0	-791.37	213.00	-0.651

CTH004 30-40cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.05	-84.65	0.05	-0.099
0.10	-81.41	0.10	-0.157
0.20	-89.36	0.20	-0.204
0.40	-86.67	0.40	-0.254
0.60	-85.30	0.60	-0.282
0.80	-83.66	0.80	-0.305
1.00	-82.57	1.00	-0.324
2.00	-80.18	2.00	-0.363
3.00	-101.14	3.00	-0.381
4.00	-100.77	4.00	-0.398
5.00	-100.47	5.00	-0.407
7.00	-102.28	7.00	-0.413
9.00	-104.39	9.00	-0.417
11.00	-104.81	11.00	-0.424
14.00	-106.49	14.00	-0.432
18.00	-97.69	18.00	-0.441
22.00	-95.53	22.00	-0.449
24.00	-94.99	24.00	-0.449
24.20	-203.89	24.20	-0.456
24.30	-204.00	24.30	-0.461
24.50	-203.63	24.50	-0.467
25.00	-202.45	25.00	-0.481
26.00	-201.34	26.00	-0.499
27.00	-200.98	27.00	-0.514
28.00	-200.03	28.00	-0.528
30.00	-200.00	30.00	-0.544
32.00	-202.37	32.00	-0.561
35.00	-202.67	35.00	-0.584
40.00	-202.37	40.00	-0.605
45.00	-194.94	45.00	-0.626
50.00	-190.74	50.00	-0.630

55.00	-196.75	55.00	-0.635
60.00	-201.18	60.00	-0.642
65.00	-202.94	65.00	-0.646
70.00	-196.07	70.00	-0.655
72.00	-194.73	72.00	-0.654
72.50	-805.33	72.50	-0.666
73.00	-802.88	73.00	-0.676
74.00	-806.42	74.00	-0.689
75.00	-807.01	75.00	-0.698
76.00	-807.75	76.00	-0.707
78.00	-802.49	78.00	-0.721
80.00	-820.13	80.00	-0.741
82.00	-821.79	82.00	-0.757
85.00	-818.70	85.00	-0.787
96.07	-793.25	96.07	-0.836
110.23	-812.37	110.23	-0.872
113.07	-794.96	113.07	-0.877
113.80	-793.51	113.80	-0.878
115.07	-792.18	115.07	-0.878
115.13	-792.18	115.13	-0.878
116.52	-790.50	116.52	-0.880
117.02	-789.32	117.02	-0.880
118.87	-789.30	118.87	-0.883
119.72	-787.98	119.72	-0.883
121.63	-789.06	121.63	-0.885
134.22	-799.26	134.22	-0.899
135.65	-791.65	135.65	-0.900
136.55	-790.06	136.55	-0.902
139.85	-789.46	139.85	-0.907

CTH005 30-40cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.01	-96.25	0.05	-0.019
0.10	-94.91	0.10	-0.024
0.20	-94.34	0.20	-0.037
0.30	-93.94	0.40	-0.051
0.40	-93.34	0.60	-0.059
0.50	-93.21	1.00	-0.069
0.60	-92.94	1.50	-0.073
1.10	-92.19	3.00	-0.080
1.60	-91.78	5.00	-0.090
2.10	-92.89	8.00	-0.094
2.60	-93.76	12.00	-0.105
3.10	-94.43	16.00	-0.110

4.10	-95.68	20.00	-0.113
5.10	-96.36	24.00	-0.110
6.10	-97.01	28.00	-0.108
7.10	-97.29	32.00	-0.111
8.10	-98.05	36.00	-0.111
10.10	-99.64	38.00	-0.112
12.10	-100.27	39.00	-0.122
14.10	-94.19	39.50	-0.135
16.10	-91.54	40.00	-0.142
18.10	-90.71	41.00	-0.151
22.10	-88.89	42.00	-0.159
26.10	-94.62	43.00	-0.165
30.10	-98.37	45.00	-0.172
34.10	-99.06	47.00	-0.178
38.90	-96.00	53.00	-0.180
39.00	-132.62	57.00	-0.185
39.29	-198.03	60.00	-0.185
39.39	-197.28	64.00	-0.191
39.49	-197.01	70.00	-0.202
39.59	-196.64	74.00	-0.197
40.09	-195.05	78.00	-0.196
40.59	-194.34	82.00	-0.203
41.09	-193.59	84.00	-0.199
41.59	-192.88	86.40	-0.203
42.09	-192.34	87.00	-0.208
43.09	-191.54	87.50	-0.217
44.09	-190.32	88.00	-0.223
45.09	-193.19	89.00	-0.231
46.09	-193.48	90.00	-0.239
47.09	-193.64	92.00	-0.252
49.09	-196.42	94.00	-0.265
51.09	-198.91	96.00	-0.273
53.09	-200.98	98.00	-0.283
55.09	-200.80	100.00	-0.289
57.09	-201.46	102.00	-0.297
61.09	-197.57	104.00	-0.307
65.09	-193.77	106.00	-0.313
68.04	-198.00	108.00	-0.318
68.14	-197.76	110.00	-0.329
68.24	-197.34	112.00	-0.334
68.34	-197.14	114.00	-0.340
68.44	-197.15	116.00	-0.346
68.54	-197.18	118.00	-0.350
69.04	-196.62	120.00	-0.354
69.54	-196.52	122.00	-0.357
70.04	-195.87	133.00	-0.391

70.54	-196.17	136.00	-0.396
71.04	-196.41	140.00	-0.403
72.04	-197.39	144.00	-0.406
73.04	-198.54	150.00	-0.410
74.04	-199.12	155.00	-0.421
75.04	-199.77	160.00	-0.437
76.04	-201.34	165.50	-0.438
78.04	-202.13	181.87	-0.455
80.04	-201.68	184.95	-0.457
82.04	-199.67	187.02	-0.460
84.04	-201.07		
86.80	-199.36		
87.90	-802.96		
94.04	-811.54		
98.04	-815.71		
102.04	-817.85		
106.04	-817.80		
112.04	-810.63		
118.04	-807.64		
124.04	-809.81		
130.04	-809.81		
136.04	-802.99		
142.04	-793.70		
148.04	-810.44		
154.04	-816.60		
160.04	-796.34		
187.00	-794.82		

CTH006 5-15cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.01	-90.70	0.05	-0.011
0.10	-89.20	0.10	-0.022
0.20	-88.46	0.20	-0.038
0.30	-87.88	0.30	-0.050
0.40	-87.30	0.40	-0.059
0.50	-86.99	0.60	-0.072
0.60	-86.59	0.80	-0.080
1.10	-85.78	1.10	-0.091
1.60	-85.03	1.60	-0.104
2.10	-84.08	2.10	-0.117
2.60	-83.95	2.60	-0.125
3.10	-83.49	3.10	-0.131
4.10	-82.77	4.10	-0.140
5.10	-83.50	5.10	-0.147

6.10	-85.69	6.10	-0.149
7.10	-87.57	7.10	-0.154
8.10	-88.87	8.10	-0.158
10.10	-90.14	10.10	-0.167
12.10	-91.38	12.10	-0.171
14.10	-90.63	14.10	-0.175
16.10	-89.45	16.10	-0.179
18.10	-89.20	18.10	-0.180
22.10	-84.35	22.00	-0.182
24.46	-95.29	24.20	-0.180
24.56	-192.16	24.50	-0.189
24.66	-191.85	24.80	-0.203
24.76	-191.55	25.00	-0.208
24.86	-191.38	25.50	-0.216
24.96	-191.24	26.00	-0.222
25.46	-190.36	27.00	-0.232
25.96	-189.76	28.00	-0.237
26.46	-189.48	29.00	-0.241
26.96	-188.91	30.00	-0.243
27.46	-188.81	32.00	-0.248
28.46	-187.96	34.00	-0.252
29.46	-187.52	36.00	-0.253
30.46	-193.74	38.00	-0.257
31.46	-195.73	40.00	-0.255
32.46	-195.43	44.00	-0.256
34.46	-196.60	48.00	-0.265
36.46	-196.45	52.00	-0.262
38.46	-195.84	55.00	-0.261
40.46	-197.10	57.00	-0.258
42.46	-197.65	60.00	-0.257
46.46	-191.41	65.00	-0.260
50.46	-194.05	68.00	-0.264
54.46	-194.25	68.50	-0.264
58.46	-196.44	69.00	-0.276
62.46	-199.77	69.10	-0.287
68.96	-198.98	69.70	-0.302
69.06	-690.32	70.00	-0.307
69.16	-673.21	71.00	-0.322
69.26	-823.00	72.00	-0.330
69.36	-822.69	73.00	-0.339
69.46	-823.04	74.00	-0.345
69.96	-824.12	75.00	-0.352
70.46	-823.71	76.00	-0.357
70.96	-822.72	78.00	-0.364
71.46	-822.80	80.00	-0.369
71.96	-821.72	82.00	-0.371

72.96	-820.22	85.00	-0.381
73.96	-819.04	88.00	-0.390
74.96	-817.27	92.00	-0.407
75.96	-816.36	94.95	-0.415
76.96	-814.63	97.47	-0.418
78.96	-818.81	100.32	-0.420
80.96	-824.45	101.52	-0.423
82.96	-829.16	115.00	-0.423
84.96	-831.70		
86.96	-835.08		
90.96	-840.26		
115.00	-850.47		

CTH006 30-40 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.01	-95.69	0.05	-0.030
0.10	-92.81	0.10	-0.048
0.20	-92.45	0.20	-0.057
0.30	-92.05	0.50	-0.076
0.40	-91.44	0.80	-0.091
0.50	-91.20	1.00	-0.099
0.60	-90.84	2.00	-0.115
1.10	-89.68	3.00	-0.133
1.60	-88.66	4.00	-0.154
2.10	-89.44	5.00	-0.161
2.60	-89.79	7.00	-0.173
3.10	-90.14	10.00	-0.181
4.10	-90.75	12.00	-0.185
5.10	-90.90	15.00	-0.198
6.10	-91.44	20.00	-0.194
7.10	-91.51	25.00	-0.193
8.10	-92.16	30.00	-0.192
10.10	-93.51	35.00	-0.197
12.10	-94.33	38.50	-0.200
14.10	-88.56	39.00	-0.207
16.10	-85.12	40.00	-0.225
18.10	-84.20	41.00	-0.236
22.10	-83.22	43.00	-0.257
26.10	-88.75	45.00	-0.268
30.10	-92.55	47.00	-0.282
34.10	-93.13	50.00	-0.290
38.10	-92.36	55.00	-0.306
39.09	-198.18	60.00	-0.313
39.19	-197.63	65.00	-0.326

39.29	-197.47	70.00	-0.332
39.39	-196.82	75.00	-0.330
39.49	-196.65	80.00	-0.332
39.59	-196.07	85.00	-0.331
40.09	-194.58	86.00	-0.334
40.59	-193.77	87.00	-0.333
41.09	-192.92	88.00	-0.353
41.59	-192.11	89.00	-0.368
42.09	-191.36	90.00	-0.381
43.09	-190.25	92.00	-0.404
44.09	-188.93	94.00	-0.423
45.09	-191.80	96.00	-0.439
46.09	-191.78	98.00	-0.455
47.09	-191.74	100.00	-0.473
49.09	-194.29	105.00	-0.506
51.09	-196.36	110.00	-0.534
53.09	-198.14	115.00	-0.554
55.09	-198.03	118.00	-0.566
57.09	-198.27	120.00	-0.575
61.09	-194.28	121.00	-0.579
65.09	-190.03	133.00	-0.623
69.09	-186.96	135.00	-0.624
73.09	-188.85	140.00	-0.634
77.09	-192.10	145.00	-0.645
86.50	-190.74	150.00	-0.657
86.85	-797.79	155.00	-0.666
86.95	-804.17	160.00	-0.673
87.05	-806.75	162.00	-0.674
87.15	-806.42		
87.25	-805.12		
87.35	-804.34		
87.85	-802.00		
88.35	-801.56		
88.85	-800.67		
89.35	-801.67		
89.85	-801.16		
90.85	-799.66		
91.85	-798.57		
92.85	-798.14		
93.85	-808.52		
94.85	-809.77		
96.85	-810.44		
98.85	-811.90		
100.85	-812.19		
102.85	-812.13		
104.85	-811.51		

108.85	-812.77		
112.85	-804.38		
116.85	-801.47		
120.85	-802.59		
124.85	-802.56		
130.85	-802.56		
136.85	-794.46		
142.85	-785.34		
148.85	-802.65		
154.85	-808.20		
160.85	-786.80		
162.24	-786.11		

CTH008 30-40 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-91.67	0.05	-0.070
0.1	-90.56	0.10	-0.088
0.2	-89.28	0.20	-0.113
0.3	-88.06	0.30	-0.132
0.5	-86.41	0.50	-0.158
1.0	-83.37	1.00	-0.203
1.5	-81.83	1.50	-0.229
2.0	-96.19	2.00	-0.247
3.0	-96.70	3.00	-0.269
4.0	-98.13	4.00	-0.279
5.0	-98.64	5.00	-0.286
6.0	-98.94	6.00	-0.290
7.0	-99.22	7.00	-0.291
8.0	-99.88	8.00	-0.293
9.0	-100.39	9.00	-0.295
10.0	-101.15	10.00	-0.297
15.0	-94.76	15.00	-0.307
20.0	-92.00	20.00	-0.303
25.0	-95.47	25.00	-0.294
30.0	-101.44	30.00	-0.292
35.0	-101.89	35.00	-0.295
38.0	-101.18	38.00	-0.299
39.0	-135.41	39.00	-0.307
39.5	-196.65	39.50	-0.324
40.0	-194.89	40.00	-0.333
41.0	-193.23	41.00	-0.343
42.0	-191.74	42.00	-0.356
43.0	-190.66	43.00	-0.362
44.0	-189.54	44.00	-0.365

45.0	-192.27	45.00	-0.371
50.0	-196.42	50.00	-0.377
55.0	-199.74	55.00	-0.386
60.0	-200.88	60.00	-0.385
65.0	-192.57	65.00	-0.392
70.0	-192.61	70.00	-0.392
75.0	-192.61	75.00	-0.392
80.0	-192.61	80.00	-0.392
86.0	-192.61	86.00	-0.392
87.0	-815.79	87.00	-0.386
88.0	-810.74	88.00	-0.401
89.0	-805.01	89.00	-0.491
90.0	-804.94	90.00	-0.504
92.0	-802.73	92.00	-0.527
95.0	-814.21	95.00	-0.559
100.0	-815.80	100.00	-0.603
105.0	-816.27	105.00	-0.635
110.0	-807.58	110.00	-0.668
115.0	-807.07	115.00	-0.688
120.0	-805.92	120.00	-0.708
125.0	-806.06	125.00	-0.713
130.0	-806.06	130.00	-0.713
135.0	-799.40	135.00	-0.759
140.0	-797.06	140.00	-0.768
145.0	-798.20	145.00	-0.774
150.0	-806.44	150.00	-0.790
155.0	-812.76	155.00	-0.799
160.0	-792.21	160.00	-0.807
165.0	-790.48	165.00	-0.810

CTH009 20-30 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.0	-91.07	0.10	-0.016
0.1	-95.50	0.20	-0.021
0.2	-94.99	0.40	-0.028
0.3	-94.65	0.60	-0.036
0.4	-94.45	0.80	-0.043
0.5	-94.25	1.00	-0.049
0.6	-93.91	1.50	-0.060
1.1	-92.81	2.00	-0.070
1.6	-92.37	2.50	-0.079
2.1	-91.04	3.00	-0.089
2.6	-90.67	3.50	-0.093
3.1	-89.92	4.00	-0.100

4.1	-89.05	5.00	-0.109
5.1	-88.13	6.00	-0.115
6.1	-87.56	7.00	-0.121
7.1	-86.76	8.00	-0.124
8.1	-86.17	9.00	-0.125
10.1	-85.39	10.00	-0.125
12.1	-88.72	12.00	-0.125
14.1	-90.98	15.00	-0.129
16.1	-92.61	18.00	-0.132
18.1	-92.49	20.00	-0.129
22.1	-92.74	23.00	-0.127
26.1	-88.83	26.00	-0.127
28.3	-95.13	28.30	-0.126
28.4	-208.18	28.40	-0.143
28.5	-208.21	29.00	-0.150
28.6	-198.02	30.00	-0.159
28.7	-198.26	31.00	-0.168
28.8	-198.12	32.00	-0.171
29.3	-197.89	34.00	-0.178
29.8	-197.59	36.00	-0.183
30.3	-197.31	38.00	-0.181
30.8	-196.91	40.00	-0.184
31.3	-196.46	48.00	-0.194
32.3	-195.72	52.00	-0.194
33.3	-195.86	56.00	-0.192
34.3	-195.62	60.00	-0.184
35.3	-195.55	64.00	-0.184
36.3	-195.24	68.00	-0.184
38.3	-198.26	72.00	-0.184
40.3	-199.53	76.00	-0.193
42.3	-198.71	80.00	-0.192
44.3	-197.92	84.00	-0.187
46.3	-198.27	88.00	-0.186
50.3	-195.97	92.00	-0.189
54.3	-194.73	96.00	-0.185
58.3	-197.00	100.00	-0.185
62.3	-198.15	102.40	-0.191
66.3	-198.15	102.50	-0.205
72.3	-198.15	104.00	-0.210
78.3	-199.33	106.00	-0.217
84.3	-199.20	108.00	-0.222
90.3	-199.84	110.00	-0.231
96.3	-199.88	115.00	-0.246
102.5	-776.22	120.00	-0.256
102.6	-775.85	125.00	-0.270
102.7	-775.65	130.00	-0.276

102.8	-775.65	133.00	-0.284
102.9	-775.45	146.00	-0.311
103.0	-775.50	153.00	-0.316
103.5	-777.94	170.62	-0.341
104.0	-777.46	173.60	-0.345
104.5	-777.73	177.75	-0.350
105.0	-775.75		
105.5	-773.91		
106.5	-775.86		
107.5	-778.71		
108.5	-780.52		
109.5	-780.09		
110.5	-781.17		
112.5	-781.23		
114.5	-781.56		
116.5	-780.61		
118.5	-781.21		
120.5	-778.35		
124.5	-770.09		
128.5	-768.34		
132.5	-777.15		
136.5	-780.75		
140.5	-780.75		
146.5	-805.59		
177.8	-803.98		

CTH009 30-40 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-93.95	0.10	-0.053
0.2	-92.81	0.20	-0.070
0.3	-91.99	0.30	-0.083
0.5	-90.65	0.50	-0.103
1.0	-88.78	1.00	-0.131
1.5	-87.74	1.50	-0.147
2.0	-86.80	1.60	-0.152
3.0	-89.09	2.08	-0.187
4.0	-91.17	16.28	-0.241
5.0	-92.34	24.53	-0.243
7.0	-93.84	40.00	-0.243
9.0	-94.73	40.47	-0.255
11.0	-95.75	40.58	-0.255
13.0	-96.54	6.00	-0.304
15.0	-97.11	65.72	-0.335
19.0	-90.18	69.10	-0.334

23.0	-88.95	70.00	-0.337
24.0	-88.53	73.00	-0.334
24.5	-88.14	74.00	-0.345
25.0	-88.08	76.00	-0.362
26.0	-89.10	81.00	-0.407
27.0	-90.45	86.00	-0.437
30.0	-92.56	91.00	-0.459
33.0	-92.96	96.00	-0.467
36.0	-93.24	101.00	-0.504
40.0	-93.49	106.00	-0.528
40.1	-192.35	111.00	-0.546
45.0	-193.90	116.00	-0.558
48.0	-192.81	121.00	-0.566
54.0	-196.41	142.00	-0.613
60.0	-196.41	147.00	-0.622
66.0	-196.41	152.00	-0.641
69.0	-196.41	157.00	-0.650
70.0	-208.44	162.00	-0.656
71.0	-208.66	167.00	-0.648
72.0	-208.77	172.00	-0.657
73.0	-208.67	177.00	-0.673
74.0	-811.12	182.00	-0.683
77.0	-808.73	183.00	-0.685
82.0	-806.10		
87.0	-804.14		
92.0	-802.82		
97.0	-801.67		
102.0	-808.93		
107.0	-807.45		
112.0	-806.17		
117.0	-805.53		
122.0	-805.01		
127.0	-804.40		
132.0	-804.40		
137.0	-804.40		
142.0	-801.92		
147.0	-801.31		
152.0	-800.00		
157.0	-799.38		
162.0	-798.97		
183.0	-796.96		

CTH011 5-15 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)

0.1	-100.64	0.11	-0.067
0.2	-94.27	0.20	-0.092
0.3	-93.31	0.30	-0.107
0.5	-91.78	0.50	-0.131
1.0	-89.11	0.90	-0.163
1.5	-87.74	1.50	-0.190
2.0	-86.00	2.50	-0.216
3.0	-84.89	4.50	-0.237
4.0	-84.12	9.00	-0.251
5.0	-83.76	13.00	-0.272
7.0	-82.88	18.00	-0.288
9.0	-81.35	23.00	-0.291
11.0	-97.15	26.00	-0.297
13.0	-98.57	6.00	-0.297
15.0	-100.46	28.50	-0.317
19.0	-100.36	29.00	-0.329
23.0	-100.32	30.00	-0.348
24.0	-100.57	31.00	-0.362
24.5	-100.53	35.00	-0.391
25.0	-99.91	40.00	-0.405
26.0	-95.93	45.00	-0.415
28.3	-93.42	50.00	-0.428
28.4	-207.54	58.00	-0.431
33.0	-199.04	75.00	-0.430
36.0	-197.88	82.00	-0.435
39.0	-201.01	90.00	-0.436
42.0	-200.90	98.00	-0.438
45.0	-200.84	102.00	-0.439
48.0	-200.01	105.02	-0.460
54.0	-195.74	120.75	-0.521
60.0	-198.57	125.25	-0.534
66.0	-198.57	129.75	-0.545
69.0	-198.57	146.00	-0.575
70.0	-198.57	153.00	-0.587
71.0	-198.57	170.62	-0.609
72.0	-198.57	173.60	-0.614
73.0	-198.57	177.75	-0.619
75.0	-198.57		
77.0	-197.65		
79.0	-199.95		
81.0	-199.19		
83.0	-199.33		
85.0	-199.61		
87.0	-198.85		
89.0	-199.29		
92.0	-199.88		

95.0	-200.23		
98.0	-199.54		
102.4	-197.49		
102.5	-774.56		
105.5	-773.07		
108.5	-780.44		
111.5	-780.69		
114.5	-782.36		
117.5	-781.13		
120.5	-780.55		
123.5	-772.04		
126.5	-770.47		
129.5	-770.69		
132.5	-780.43		
135.5	-784.31		
138.5	-784.31		
141.5	-784.31		
144.5	-784.31		
147.5	-781.46		
150.5	-781.18		
153.5	-781.09		
156.5	-781.09		
159.5	-781.09		
162.5	-781.09		
165.5	-781.09		
168.5	-781.09		
171.5	-781.09		
174.5	-781.09		
178.0	-781.09		

CTH011 30-40 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-84.29	0.10	-0.014
0.2	-83.07	0.20	-0.028
0.3	-82.64	0.30	-0.036
0.5	-81.94	0.50	-0.047
1.0	-80.52	0.90	-0.064
1.5	-79.78	1.50	-0.079
2.0	-78.46	2.50	-0.093
3.0	-78.07	4.50	-0.103
4.0	-77.41	7.00	-0.109
5.0	-77.26	15.00	-0.117
7.0	-76.29	19.00	-0.120
9.0	-75.38	23.00	-0.120

11.0	-76.69	26.00	-0.123
13.0	-79.58	6.00	-0.124
15.0	-81.62	28.50	-0.137
19.0	-81.97	29.00	-0.149
23.0	-82.03	30.00	-0.160
24.0	-82.37	31.00	-0.172
24.5	-82.44	35.00	-0.187
25.0	-81.84	40.00	-0.199
26.0	-77.82	45.00	-0.208
28.3	-75.52	50.00	-0.213
28.4	-192.91	58.00	-0.210
33.0	-182.26	66.00	-0.210
36.0	-181.72	74.00	-0.210
39.0	-185.07	82.00	-0.217
42.0	-184.84	90.00	-0.221
45.0	-184.67	98.00	-0.223
48.0	-184.40	102.00	-0.225
54.0	-180.50	103.00	-0.234
60.0	-182.41	104.00	-0.239
66.0	-182.41	106.00	-0.250
69.0	-182.41	108.00	-0.258
70.0	-182.41	112.00	-0.277
71.0	-182.41	115.00	-0.289
72.0	-182.41	120.00	-0.306
73.0	-182.41	125.00	-0.321
75.0	-182.41	130.00	-0.334
77.0	-184.40	135.00	-0.341
79.0	-184.21	147.00	-0.364
81.0	-184.16	155.00	-0.376
83.0	-184.56	165.00	-0.393
85.0	-184.62	170.00	-0.399
87.0	-183.67	178.00	-0.404
89.0	-183.62		
92.0	-184.30		
95.0	-185.24		
98.0	-184.48		
103.0	-188.98		
103.5	-764.10		
106.5	-761.40		
109.5	-767.75		
112.5	-767.52		
115.5	-768.20		
118.5	-766.71		
121.5	-765.67		
124.5	-755.95		
127.5	-754.00		

130.5	-754.40		
133.5	-763.45		
136.5	-764.52		
139.5	-764.52		
142.5	-764.52		
145.5	-764.10		
148.5	-178.97		
151.5	-178.82		
154.5	-178.56		
157.5	-178.28		
160.5	-177.84		
163.5	-177.60		
166.5	-177.21		
169.5	-176.91		
172.5	-176.85		
175.5	-176.72		
178.0	-176.63		

CTH013 30-40 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-89.96	0.05	-0.017
0.1	-86.20	0.07	-0.081
0.1	-84.68	0.10	-0.108
0.1	-81.73	0.12	-0.155
0.2	-89.05	0.20	-0.207
0.3	-86.35	0.30	-0.252
0.4	-84.12	0.40	-0.288
0.5	-83.10	0.50	-0.307
0.8	-80.43	0.80	-0.347
1.5	-101.97	1.50	-0.395
2.0	-101.02	2.00	-0.412
3.0	-100.28	3.00	-0.426
4.0	-100.51	4.00	-0.432
6.0	-101.15	6.00	-0.438
9.0	-104.41	9.00	-0.446
11.0	-105.24	11.00	-0.446
13.0	-107.02	13.00	-0.452
15.0	-105.86	15.00	-0.452
18.0	-98.44	18.00	-0.456
20.0	-97.45	20.00	-0.458
22.0	-96.58	22.00	-0.459
24.0	-95.93	24.00	-0.461
24.1	-95.74	24.10	-0.461
24.5	-204.50	24.50	-0.470

25.0	-203.51	25.00	-0.479
26.0	-202.80	26.00	-0.492
27.0	-202.73	27.00	-0.502
28.5	-201.28	28.50	-0.516
30.0	-201.98	30.00	-0.523
32.0	-204.67	32.00	-0.537
35.0	-205.03	35.00	-0.557
37.0	-204.87	37.00	-0.565
40.0	-204.91	40.00	-0.576
43.0	-198.84	43.00	-0.585
46.0	-194.25	46.00	-0.593
50.0	-193.18	50.00	-0.599
55.0	-198.26	55.00	-0.617
60.0	-202.40	60.00	-0.628
65.0	-203.56	65.00	-0.639
70.0	-197.18	70.00	-0.642
72.0	-195.65	72.00	-0.644
72.1	-195.34	72.10	-0.646
72.5	-804.88	72.50	-0.658
73.0	-803.14	73.00	-0.661
74.0	-806.87	74.00	-0.664
76.0	-808.70	76.00	-0.676
78.0	-803.55	78.00	-0.689
80.0	-821.20	80.00	-0.703
82.0	-822.86	82.00	-0.716
85.0	-820.57	85.00	-0.736
90.0	-816.89	90.00	-0.749
90.5	-815.43	90.50	-0.767
120.5	-809.42	91.00	-0.768
122.0	-809.55	120.50	-0.805
125.0	-800.48	122.00	-0.803
130.0	-817.39	125.00	-0.799
135.0	-821.58	130.00	-0.801
140.0	-801.13	135.00	-0.807
145.0	-795.47	140.00	-0.812
150.0	-794.27	145.00	-0.813
155.0	-804.13	150.00	-0.814
160.0	-809.23	155.00	-0.817
164.0	-794.76	160.00	-0.831

CTH014 5-15 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.01	-89.72	0.05	-0.029
0.10	-92.22	0.10	-0.038

0.20	-89.86	0.20	-0.072
0.30	-89.43	0.30	-0.081
0.40	-88.95	0.50	-0.097
0.50	-88.82	0.70	-0.107
0.60	-88.41	1.00	-0.121
1.10	-87.19	1.50	-0.140
1.60	-86.14	2.00	-0.155
2.10	-85.28	2.50	-0.167
2.60	-84.44	3.00	-0.178
3.10	-84.01	4.00	-0.192
4.10	-82.89	5.00	-0.204
5.10	-82.58	6.00	-0.215
6.10	-84.31	9.00	-0.238
7.10	-86.03	11.00	-0.248
8.10	-87.33	13.00	-0.256
10.10	-88.57	15.00	-0.261
12.10	-89.33	18.00	-0.264
14.10	-88.46	20.00	-0.269
16.10	-87.56	22.00	-0.271
18.10	-86.59	24.60	-0.274
24.60	-81.07	24.70	-0.281
24.70	-193.47	25.00	-0.287
25.66	-191.98	25.50	-0.296
25.76	-191.88	26.00	-0.302
25.86	-191.68	27.00	-0.314
25.96	-191.58	28.00	-0.323
26.06	-191.48	30.00	-0.332
26.56	-190.80	32.00	-0.344
27.06	-190.39	35.00	-0.355
27.56	-190.12	38.00	-0.361
28.06	-189.44	41.00	-0.366
28.56	-189.18	44.00	-0.371
29.56	-188.53	47.00	-0.375
30.56	-194.02	50.00	-0.376
31.56	-196.13	54.00	-0.379
32.56	-196.14	58.00	-0.383
33.56	-196.31	62.00	-0.384
35.56	-196.31	66.00	-0.385
37.56	-196.44	69.10	-0.389
39.56	-196.78	69.20	-0.397
41.56	-196.46	69.80	-0.400
43.56	-197.11	70.00	-0.401
47.56	-191.34	72.00	-0.409
51.56	-193.14	74.00	-0.420
55.56	-193.40	76.00	-0.426
59.56	-195.18	79.00	-0.434

69.10	-191.97	82.00	-0.442
69.20	-692.36	85.00	-0.452
70.06	-827.83	88.00	-0.459
70.16	-827.23	91.00	-0.465
70.26	-827.62	95.00	-0.472
70.36	-827.72	97.85	-0.478
70.46	-827.91	100.70	-0.478
70.56	-827.72	101.90	-0.487
71.06	-826.84	115.38	-0.511
71.56	-826.84	118.17	-0.511
72.06	-825.67		
72.56	-824.69		
73.06	-824.46		
74.06	-823.48		
75.06	-821.62		
76.06	-820.90		
77.06	-819.10		
78.06	-820.79		
80.06	-827.28		
82.06	-831.70		
84.06	-835.05		
86.06	-838.63		
88.06	-839.42		
118.00	-839.42		

CTH014 30-40 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.01	-95.37	0.10	-0.014
0.10	-94.63	0.50	-0.018
0.50	-94.55	1.00	-0.025
1.00	-93.87	1.50	-0.029
3.00	-94.75	2.00	-0.047
6.00	-96.36	3.00	-0.053
10.00	-97.93	4.20	-0.062
14.00	-94.37	5.00	-0.067
18.00	-89.29	5.20	-0.081
22.00	-87.43	7.00	-0.091
26.00	-92.79	8.00	-0.093
30.00	-96.40	10.00	-0.099
34.00	-97.03	12.00	-0.103
38.00	-96.29	6.00	-0.110
38.50	-95.32	16.00	-0.112
39.00	-130.76	18.00	-0.115
39.50	-195.82	20.00	-0.119

41.00	-193.32	22.00	-0.119
44.00	-190.66	24.00	-0.118
48.00	-195.47	26.00	-0.120
52.00	-200.20	28.00	-0.120
56.00	-201.27	30.00	-0.123
60.00	-203.38	32.00	-0.125
64.00	-193.17	34.00	-0.124
68.00	-192.70	36.00	-0.127
72.00	-191.74	38.00	-0.128
76.00	-195.23	38.80	-0.128
80.00	-195.53	39.00	-0.132
84.00	-195.05	40.00	-0.141
86.80	-193.34	42.00	-0.148
86.90	-767.09	44.00	-0.152
88.00	-801.37	46.00	-0.155
90.00	-801.88	48.00	-0.155
95.00	-814.21	50.00	-0.158
100.00	-818.16	52.00	-0.165
105.00	-819.97	54.00	-0.163
110.00	-812.16	56.00	-0.165
115.00	-812.58	60.87	-0.177
120.00	-812.45	70.00	-0.183
125.00	-813.36	79.00	-0.185
130.00	-813.36	80.00	-0.187
135.00	-807.53	81.00	-0.191
140.00	-805.28	84.00	-0.186
145.00	-807.18	86.00	-0.191
150.00	-815.69	86.80	-0.192
155.00	-821.96	88.00	-0.213
160.00	-801.49	90.00	-0.216
162.00	-800.23	92.00	-0.222
		93.00	-0.227
		96.00	-0.229
		99.00	-0.233
		102.00	-0.238
		105.00	-0.244
		108.00	-0.247
		111.00	-0.256
		114.00	-0.266
		117.00	-0.271
		122.00	-0.275
		133.00	-0.298
		136.00	-0.298
		140.00	-0.304
		144.00	-0.304
		151.00	-0.314

		155.00	-0.320
		160.00	-0.325
		162.00	-0.328

CTH017 5-15 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-91.29	0.10	-0.066
0.2	-90.16	0.20	-0.078
0.3	-89.62	0.30	-0.087
0.5	-88.71	0.50	-0.101
1.0	-87.18	0.90	-0.118
1.5	-85.92	1.50	-0.140
2.0	-84.28	2.50	-0.169
3.0	-82.76	4.50	-0.212
4.0	-80.96	7.00	-0.231
5.0	-80.09	15.00	-0.252
7.0	-78.29	19.00	-0.255
9.0	-77.18	23.00	-0.258
11.0	-77.98	26.00	-0.257
13.0	-80.78	6.00	-0.258
15.0	-82.73	28.50	-0.284
19.0	-83.07	29.00	-0.292
23.0	-82.94	30.00	-0.301
24.0	-83.47	31.00	-0.308
24.5	-83.44	35.00	-0.331
25.0	-82.85	40.00	-0.346
26.0	-79.03	45.00	-0.361
28.3	-76.61	50.00	-0.381
28.4	-204.20	58.00	-0.387
33.0	-191.21	66.00	-0.391
36.0	-190.16	74.00	-0.391
39.0	-193.23	82.00	-0.396
42.0	-193.00	90.00	-0.408
45.0	-192.41	98.00	-0.414
48.0	-192.01	102.00	-0.420
54.0	-187.20	103.00	-0.423
60.0	-188.66	104.00	-0.422
66.0	-188.66	106.00	-0.429
69.0	-188.66	108.00	-0.433
70.0	-188.66	112.00	-0.446
71.0	-188.66	115.00	-0.454
72.0	-188.66	120.00	-0.465
73.0	-188.66	125.00	-0.469
75.0	-188.66	130.00	-0.476

77.0	-188.44	135.00	-0.490
79.0	-190.37	147.00	-0.503
81.0	-189.96	155.00	-0.512
83.0	-190.14	165.00	-0.538
85.0	-189.96	170.00	-0.542
87.0	-189.12	178.00	-0.548
89.0	-189.34		
92.0	-189.51		
95.0	-189.74		
98.0	-189.17		
102.4	-186.83		
102.5	-763.94		
105.5	-770.23		
108.5	-776.74		
111.5	-776.74		
114.5	-777.87		
117.5	-776.72		
120.5	-774.87		
123.5	-766.67		
126.5	-764.97		
129.5	-764.71		
132.5	-773.89		
135.5	-777.28		
138.5	-777.28		
141.5	-777.28		
144.5	-777.28		
147.5	-776.36		
150.5	-775.99		
153.5	-775.91		
156.5	-775.43		
159.5	-774.80		
162.5	-774.47		
165.5	-774.11		
168.5	-773.60		
171.5	-773.81		
174.5	-773.76		
178.0	-773.47		

CTH017 30-40 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-71.75	0.02	-0.05
0.2	-69.70	0.05	-0.07
0.3	-68.68	0.10	-0.12
0.5	-67.47	0.50	-0.19

1.0	-80.96	0.80	-0.21
1.5	-80.73	1.20	-0.22
2.0	-80.63	1.90	-0.23
3.0	-82.93	2.08	-0.25
4.0	-85.01	16.28	-0.24
5.0	-86.18	24.53	-0.27
7.0	-87.67	40.00	-0.27
9.0	-88.57	40.47	-0.28
11.0	-89.58	40.58	-0.28
13.0	-90.37	6.00	-0.38
15.0	-90.94	48.02	-0.38
19.0	-84.01	65.72	-0.50
23.0	-82.78	69.03	-0.50
24.0	-82.36	73.00	-0.48
24.5	-81.98	74.00	-0.49
25.0	-81.91	75.00	-0.52
26.0	-82.93	80.00	-0.60
27.0	-84.28	85.00	-0.65
30.0	-86.40	90.00	-0.72
33.0	-86.79	95.00	-0.76
36.0	-87.08	99.00	-0.75
40.0	-87.32	104.00	-0.78
40.1	-186.18	109.00	-0.80
45.0	-187.73	114.00	-0.82
48.0	-186.64	119.00	-0.84
49.0	-185.34	122.00	-0.85
67.0	-188.69	147.00	-0.92
68.0	-188.69	152.00	-0.95
69.0	-190.25	157.00	-0.97
70.0	-185.37	162.00	-0.97
71.0	-185.29	167.00	-0.98
72.0	-184.99	172.00	-0.99
74.0	-184.29	177.00	-1.01
75.0	-786.53	182.00	-1.03
77.0	-784.43	183.00	-1.03
82.0	-780.44		
87.0	-777.09		
92.0	-791.25		
97.0	-789.39		
102.0	-789.41		
107.0	-788.02		
112.0	-786.62		
117.0	-785.52		
122.0	-784.42		
127.0	-784.08		
132.0	-784.08		

137.0	-784.08		
142.0	-784.08		
147.0	-779.94		
152.0	-778.54		
157.0	-777.42		
162.0	-776.99		
183.0	-773.51		

CTH018 5-15 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-96.85	0.10	-0.033
0.2	-96.06	0.20	-0.048
0.3	-95.50	0.30	-0.056
0.5	-94.88	0.50	-0.070
1.0	-93.44	1.00	-0.094
1.5	-92.20	1.50	-0.113
2.0	-91.58	2.00	-0.128
3.0	-90.37	3.00	-0.147
4.0	-89.68	4.00	-0.159
5.0	-89.10	5.00	-0.167
7.0	-89.29	7.00	-0.174
9.0	-90.09	9.00	-0.179
11.0	-90.71	11.00	-0.183
13.0	-90.35	6.00	-0.189
15.0	-90.06	15.00	-0.192
18.0	-90.37	18.00	-0.190
22.0	-89.47	22.00	-0.201
23.5	-89.32	24.00	-0.223
24.0	-197.13	24.50	-0.236
25.0	-195.85	25.00	-0.244
26.0	-194.92	26.00	-0.259
27.0	-194.26	27.00	-0.269
30.0	-192.15	30.00	-0.299
33.0	-192.65	33.00	-0.290
36.0	-192.13	36.00	-0.306
39.0	-192.04	39.00	-0.310
42.0	-192.67	42.00	-0.309
45.0	-192.58	45.00	-0.315
48.0	-191.14	48.00	-0.318
54.0	-190.88	54.00	-0.325
60.0	-190.81	60.00	-0.325
66.0	-191.00	66.00	-0.325
69.0	-190.98	69.00	-0.331
70.0	-199.82	70.00	-0.338

71.0	-799.41	71.00	-0.364
72.0	-799.23	72.00	-0.380
73.0	-798.44	73.00	-0.396
75.0	-793.04	75.00	-0.421
77.0	-782.70	77.00	-0.441
79.0	-792.20	79.00	-0.457
81.0	-792.63	81.00	-0.475
83.0	-784.56	83.00	-0.476
85.0	-785.95	85.00	-0.499
87.0	-785.03	87.00	-0.506
89.0	-784.04	89.00	-0.514
92.0	-782.66	92.00	-0.524
95.0	-786.05	95.00	-0.539
98.0	-787.25	98.00	-0.546
101.0	-779.19	101.00	-0.545
104.0	-781.10	104.00	-0.558
107.0	-787.44	107.00	-0.549
110.0	-775.54	110.00	-0.555
113.0	-788.57	113.00	-0.562
116.0	-795.21	116.00	-0.576
119.0	-794.48	119.00	-0.582
122.0	-783.96	122.00	-0.587
123.0	-783.62	123.00	-0.589

CTH018 30-40 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-89.59	0.06	-0.030
0.2	-96.11	0.10	-0.058
0.3	-95.51	0.20	-0.082
0.5	-94.64	0.30	-0.093
1.0	-93.17	0.50	-0.113
1.5	-91.69	1.00	-0.141
2.2	-90.65	1.50	-0.161
2.3	-90.52	2.30	-0.182
4.0	-89.83	4.00	-0.206
5.0	-101.77	5.00	-0.226
7.0	-103.22	7.00	-0.234
9.0	-105.36	9.00	-0.239
11.0	-104.55	11.00	-0.267
13.0	-106.64	6.00	-0.267
15.0	-105.13	15.00	-0.276
18.0	-97.81	18.00	-0.275
22.0	-96.05	22.00	-0.276
24.2	-99.82	24.00	-0.274

24.2	-203.63	24.20	-0.277
24.4	-204.11	24.50	-0.282
24.5	-204.00	25.00	-0.289
24.7	-203.67	26.00	-0.299
25.2	-203.09	27.00	-0.308
25.7	-202.59	28.00	-0.314
26.4	-201.81	30.00	-0.322
26.5	-201.81	32.00	-0.325
28.2	-201.70	35.00	-0.333
29.2	-202.25	38.00	-0.336
31.2	-203.30	42.00	-0.344
33.2	-207.00	46.00	-0.343
35.2	-207.24	50.00	-0.338
37.2	-207.28	55.00	-0.331
39.2	-207.85	60.00	-0.330
42.2	-202.70	65.00	-0.325
46.2	-197.90	70.00	-0.331
52.2	-199.91	72.00	-0.330
58.2	-207.84	72.80	-0.347
64.2	-211.10	73.00	-0.359
70.2	-204.61	73.50	-0.384
72.2	-202.68	74.00	-0.402
72.2	-202.68	75.00	-0.424
72.4	-808.77	76.00	-0.440
72.5	-817.82	77.00	-0.451
72.7	-802.56	78.00	-0.461
73.2	-797.73	80.00	-0.472
73.7	-799.23	82.00	-0.482
74.4	-799.61	84.00	-0.486
74.5	-799.30	86.00	-0.489
76.2	-800.00	88.00	-0.490
77.2	-796.70	90.00	-0.490
79.2	-808.16	91.20	-0.488
81.2	-813.54		
83.2	-814.46		
85.2	-812.91		
87.2	-810.07		
91.2	-810.07		

T02AH001B 5-15 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.0	-92.80	0.02	-0.003
0.1	-92.59	0.05	-0.005
0.1	-92.29	0.10	-0.008

0.4	-91.05	0.40	-0.021
1.0	-90.25	1.00	-0.035
2.0	-89.45	2.00	-0.049
5.0	-87.93	5.00	-0.075
8.0	-87.50	8.00	-0.091
10.0	-87.07	10.00	-0.097
15.0	-89.85	13.00	-0.110
20.0	-89.88	16.00	-0.117
24.2	-90.15	19.00	-0.124
24.5	-194.59	24.20	-0.132
30.0	-191.89	6.00	-0.081
35.0	-190.64	27.00	-0.165
40.0	-191.33	30.00	-0.183
45.0	-193.26	35.00	-0.206
50.0	-191.13	40.00	-0.224
55.0	-188.57	43.00	-0.233
60.0	-188.53	46.00	-0.240
65.0	-190.30	49.00	-0.248
70.0	-192.23	52.00	-0.255
72.4	-187.80	55.00	-0.261
73.0	-800.26	60.00	-0.268
80.0	-790.80	65.00	-0.275
85.0	-780.98	70.00	-0.282
90.0	-785.86	72.40	-0.284
95.0	-785.72	73.00	-0.296
100.0	-785.14	75.00	-0.315
105.0	-783.84	80.00	-0.342
110.0	-779.46	85.00	-0.361
115.0	-778.74	90.00	-0.379
120.0	-777.08	95.00	-0.394
125.0	-770.19	98.00	-0.403
130.0	-771.21	104.00	-0.410
135.0	-780.41	110.00	-0.423
140.0	-776.94	115.00	-0.435
145.0	-772.27	120.00	-0.443
150.0	-769.96	125.00	-0.450
155.0	-766.93	129.00	-0.456
160.0	-761.91	138.00	-0.462
165.0	-761.58	140.00	-0.465
168.5	-770.21	145.00	-0.470
		150.00	-0.475
		155.00	-0.481
		160.00	-0.485
		165.00	-0.491
		168.47	-0.494

TO2AH001B 30-40 cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.0	-96.50	0.02	-0.008
0.1	-95.25	0.05	-0.016
0.1	-95.14	0.10	-0.031
0.1	-94.53	0.20	-0.052
0.2	-93.76	0.40	-0.074
0.3	-93.02	0.80	-0.102
0.4	-92.51	1.50	-0.129
0.5	-91.69	2.50	-0.145
0.8	-90.41	3.50	-0.155
1.5	-88.52	5.00	-0.158
2.0	-87.74	8.00	-0.160
3.0	-86.90	10.00	-0.163
4.0	-86.87	12.00	-0.163
6.0	-78.79	6.00	-0.164
9.0	-79.47	18.00	-0.170
11.0	-80.03	20.00	-0.170
13.0	-80.72	22.00	-0.170
15.0	-80.04	23.00	-0.171
18.0	-89.13	24.00	-0.202
20.0	-90.49	26.00	-0.229
22.0	-89.82	29.00	-0.246
23.0	-104.72	33.00	-0.258
23.2	-190.43	38.00	-0.265
24.0	-193.46	42.00	-0.270
25.0	-195.19	46.00	-0.273
26.0	-192.43	50.00	-0.274
27.0	-191.53	55.00	-0.274
28.5	-190.86	60.00	-0.274
30.0	-190.65	65.00	-0.280
32.0	-190.44	70.00	-0.281
35.0	-190.58	71.00	-0.309
37.0	-190.44	72.00	-0.325
40.0	-189.26	73.50	-0.337
43.0	-189.40	88.00	-0.420
46.0	-189.79	90.00	-0.425
50.0	-191.52	93.00	-0.433
55.0	-191.52	97.70	-0.442
60.0	-191.52	110.00	-0.473
65.0	-191.26	115.00	-0.479
70.5	-189.59	120.00	-0.486
71.0	-805.31	121.77	-0.487
72.1	-803.65	134.40	-0.508
72.5	-803.99	138.00	-0.509

73.0	-803.68	142.00	-0.512
74.0	-810.76	147.00	-0.515
76.0	-810.76	156.44	-0.521
78.0	-810.76	160.00	-0.528
80.0	-810.76	164.00	-0.533
82.0	-810.76	168.28	-0.534
85.0	-810.76		
90.0	-803.44		
95.0	-801.00		
100.0	-809.85		
105.0	-809.85		
110.0	-815.23		
115.0	-806.86		
120.5	-804.70		
122.0	-803.57		
125.0	-803.57		
130.0	-803.57		
135.0	-810.76		
140.0	-802.16		
145.0	-802.54		
150.0	-798.49		
155.0	-798.49		
160.0	-798.27		
164.0	-792.99		
168.3	-795.29		

TO2AH001C 5-15cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.0	-92.22	0.02	-0.006
0.1	-91.61	0.05	-0.016
0.1	-91.31	0.10	-0.021
0.4	-89.28	0.40	-0.047
1.0	-88.03	1.00	-0.066
2.0	-87.02	2.00	-0.083
5.0	-85.20	5.00	-0.114
8.0	-84.63	8.00	-0.132
10.0	-84.31	10.00	-0.136
15.0	-87.66	13.00	-0.137
20.0	-87.78	16.00	-0.149
24.3	-97.58	20.00	-0.155
24.4	-194.78	24.30	-0.166
30.0	-190.78	6.00	-0.179
35.0	-189.70	26.00	-0.208
40.0	-190.48	30.00	-0.235

45.0	-191.56	35.00	-0.255
50.0	-188.73	40.00	-0.272
55.0	-186.08	43.00	-0.293
60.0	-186.13	46.00	-0.305
65.0	-188.18	49.00	-0.313
70.0	-189.85	52.00	-0.328
72.4	-184.70	55.00	-0.334
72.5	-769.95	60.00	-0.340
78.0	-790.76	65.00	-0.343
85.0	-780.17	70.00	-0.353
90.0	-785.04	72.00	-0.364
95.0	-784.59	73.00	-0.378
100.0	-780.28	75.00	-0.394
105.0	-781.90	80.00	-0.419
110.0	-777.49	85.00	-0.438
115.0	-776.58	90.00	-0.457
120.0	-774.63	95.00	-0.476
125.0	-767.74	98.00	-0.490
130.0	-767.83	104.00	-0.498
135.0	-774.97	110.00	-0.519
140.0	-773.65	115.00	-0.533
145.0	-772.35	120.00	-0.546
150.0	-771.45	125.00	-0.553
155.0	-765.04	129.00	-0.561
160.0	-759.03	138.00	-0.579
165.0	-758.70	140.00	-0.582
168.4	-767.16	160.00	-0.595
		165.00	-0.601
		168.42	-0.604

TO2AH001C 30-40cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.01	-97.26	0.02	-0.040
0.10	-92.67	0.10	-0.070
0.20	-91.29	0.20	-0.090
0.30	-90.35	0.30	-0.104
0.40	-89.75	0.40	-0.115
0.50	-88.94	0.50	-0.124
0.60	-88.39	0.60	-0.132
1.10	-86.31	1.10	-0.161
1.60	-85.07	1.60	-0.179
2.10	-83.90	2.10	-0.191
2.60	-83.71	2.60	-0.199
3.10	-83.22	3.10	-0.204

4.10	-99.95	4.10	-0.211
5.10	-92.99	5.10	-0.222
6.10	-92.82	6.10	-0.228
7.10	-92.85	7.10	-0.232
8.10	-93.22	8.10	-0.233
10.10	-93.79	10.10	-0.235
12.10	-93.95	12.10	-0.236
14.10	-94.06	14.10	-0.238
16.10	-101.21	16.10	-0.242
18.10	-102.07	18.10	-0.249
22.10	-104.07	22.10	-0.248
26.10	-191.65	26.10	-0.323
30.10	-189.89	30.10	-0.346
34.10	-189.55	34.10	-0.356
39.09	-188.94	39.09	-0.362
39.19	-189.04	39.19	-0.362
39.29	-188.94	39.29	-0.362
39.39	-188.84	39.39	-0.362
39.49	-188.74	39.49	-0.363
39.59	-188.74	39.59	-0.363
40.09	-188.31	40.09	-0.363
40.59	-188.31	40.59	-0.365
41.09	-191.58	41.09	-0.361
41.59	-191.30	41.59	-0.366
42.09	-189.74	42.09	-0.365
43.09	-188.34	43.09	-0.368
44.09	-190.27	44.09	-0.367
45.09	-191.01	45.09	-0.369
46.09	-188.84	46.09	-0.370
47.09	-188.81	47.09	-0.369
49.09	-189.99	49.09	-0.369
49.89	-190.66	49.89	-0.369
62.19	-190.66	62.19	-0.369
65.09	-190.00	65.09	-0.383
68.04	-189.33	68.04	-0.384
68.14	-189.33	68.14	-0.384
68.44	-188.79	68.44	-0.385
68.54	-189.09	68.54	-0.384
69.04	-189.10	69.04	-0.384
69.54	-188.72	69.54	-0.384
70.04	-188.49	70.04	-0.385
70.54	-188.02	70.54	-0.385
71.04	-806.15	71.04	-0.394
72.04	-804.60	72.04	-0.410
73.04	-804.44	73.04	-0.422
73.89	-811.53	73.89	-0.426

85.90	-824.54	85.90	-0.517
86.04	-818.34	86.04	-0.519
90.04	-802.10	90.04	-0.541
94.04	-796.89	94.04	-0.553
97.88	-807.89	97.88	-0.562
108.74	-808.00	109.74	-0.593
112.04	-807.72	112.04	-0.599
118.04	-802.38	118.04	-0.613
121.89	-800.81	121.89	-0.620
134.29	-800.81	134.80	-0.640
136.04	-806.57	136.04	-0.641
142.04	-797.91	142.04	-0.650
147.28	-795.24	147.28	-0.655
156.43	-805.13	156.43	-0.667
160.04	-794.50	160.04	-0.671
168.28	-791.43	168.28	-0.682

T13H001A 20-30cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-93.84	0.02	-0.005
0.1	-92.31	0.04	-0.037
0.1	-91.90	0.07	-0.063
0.1	-91.36	0.10	-0.068
0.2	-90.55	0.20	-0.087
0.3	-89.88	0.40	-0.111
0.4	-89.03	0.60	-0.127
0.5	-88.22	1.10	-0.156
0.8	-86.93	2.00	-0.185
1.5	-84.94	3.00	-0.204
2.0	-83.86	6.00	-0.217
3.0	-82.40	10.00	-0.221
4.0	-82.17	13.00	-0.221
6.0	-73.98	15.00	-0.229
9.0	-74.56	17.00	-0.226
11.0	-75.12	20.00	-0.229
13.0	-75.98	22.00	-0.232
15.0	-74.87	22.90	-0.240
18.0	-84.04	23.10	-0.241
20.0	-85.55	23.50	-0.261
23.0	-83.74	25.00	-0.287
24.0	-187.96	27.00	-0.310
24.1	-187.42	31.00	-0.331
24.5	-189.89	35.00	-0.340
25.0	-190.16	40.00	-0.349

26.0	-186.73	46.00	-0.354
27.0	-185.83	63.00	-0.374
28.5	-184.95	65.00	-0.373
30.0	-184.94	68.00	-0.368
32.0	-184.33	70.00	-0.371
35.0	-184.46	71.00	-0.380
37.0	-184.31	72.00	-0.391
40.0	-182.95	73.00	-0.402
43.0	-183.18	85.90	-0.481
46.0	-183.58	88.00	-0.489
50.0	-185.66	90.00	-0.493
55.0	-185.66	92.50	-0.499
60.0	-185.66	94.00	-0.503
65.0	-184.37	118.00	-0.562
70.7	-190.83	135.00	-0.589
72.0	-800.62	146.00	-0.600
72.1	-800.69	147.00	-0.602
72.5	-801.13	157.85	-0.616
73.0	-800.72	160.60	-0.617
74.5	-807.75	162.80	-0.618
76.0	-807.75	166.00	-0.618
78.0	-807.75	168.25	-0.614
80.0	-807.75		
82.0	-807.75		
85.0	-807.75		
90.0	-800.42		
90.5	-799.84		
95.0	-797.10		
100.0	-805.99		
102.0	-805.99		
110.0	-811.14		
115.0	-802.99		
120.0	-800.72		
125.0	-799.22		
130.0	-799.22		
135.0	-806.56		
140.0	-797.51		
145.0	-797.67		
150.0	-793.66		
155.0	-793.66		
160.0	-793.13		
165.0	-787.12		
168.3	-784.81		

T13H001C 30-40			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-93.41	0.02	-0.005
0.1	-93.41	0.05	-0.009
0.1	-93.11	0.07	-0.011
0.1	-93.01	0.10	-0.016
0.2	-91.99	0.15	-0.022
0.3	-89.93	0.30	-0.042
0.4	-85.25	0.40	-0.053
0.5	-81.32	0.50	-0.066
0.8	-79.36	0.80	-0.100
1.5	-74.35	1.50	-0.173
2.0	-71.98	2.00	-0.219
3.0	-70.10	3.00	-0.272
4.0	-71.12	4.00	-0.310
6.0	-82.51	6.00	-0.367
9.0	-80.23	9.00	-0.403
11.0	-79.94	11.00	-0.414
13.0	-79.02	13.00	-0.425
15.0	-79.22	15.00	-0.426
18.0	-79.54	18.00	-0.428
20.0	-80.15	20.00	-0.429
22.0	-79.89	22.00	-0.432
24.0	-78.97	24.00	-0.434
24.1	-78.94	24.10	-0.434
24.5	-78.73	24.50	-0.434
25.0	-78.37	25.00	-0.436
26.0	-78.15	26.00	-0.437
26.1	-200.25	27.00	-0.459
28.5	-197.61	28.50	-0.476
30.0	-196.11	30.00	-0.491
32.0	-197.57	32.00	-0.504
35.0	-200.05	35.00	-0.516
37.0	-200.14	37.00	-0.528
40.0	-201.21	40.00	-0.533
43.0	-200.94	43.00	-0.537
46.0	-196.44	46.00	-0.543
50.0	-194.32	50.00	-0.547
55.0	-192.80	55.00	-0.550
60.0	-195.67	60.00	-0.551
65.0	-196.02	65.00	-0.553
70.0	-197.34	70.00	-0.553
72.0	-196.63	72.00	-0.553
72.1	-196.70	72.10	-0.553
72.5	-196.36	72.50	-0.553

73.0	-195.89	73.00	-0.554
74.5	-800.12	74.50	-0.572
76.0	-798.52	76.00	-0.579
78.0	-797.33	78.00	-0.588
80.0	-821.62	80.00	-0.596
82.0	-819.10	82.00	-0.604
85.0	-817.91	85.00	-0.615
90.0	-816.88	90.00	-0.630
90.5	-816.86	90.50	-0.631
95.0	-815.96	95.00	-0.644
100.0	-815.20	100.00	-0.656
102.0	-814.92	102.00	-0.661
104.8	-814.49	104.78	-0.667

T13H006A 30-40cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.1	-97.52	0.10	-0.053
1.0	-95.27	0.20	-0.061
2.0	-93.24	0.30	-0.065
3.0	-91.99	0.50	-0.076
4.0	-91.14	1.00	-0.096
5.0	-90.29	1.50	-0.115
6.0	-90.52	2.00	-0.129
7.0	-91.24	3.00	-0.147
8.0	-91.76	4.00	-0.159
9.0	-92.89	5.00	-0.170
10.0	-93.53	7.00	-0.180
11.0	-93.91	9.00	-0.185
12.0	-92.86	11.00	-0.190
13.0	-93.13	15.00	-0.200
14.0	-92.73	17.00	-0.201
15.0	-92.50	21.00	-0.189
16.0	-92.67	23.00	-0.192
17.0	-92.53	23.50	-0.192
18.0	-94.25	23.60	-0.192
19.0	-94.66	23.80	-0.198
20.0	-93.73	25.00	-0.207
21.0	-92.66	26.00	-0.217
22.0	-92.16	27.00	-0.226
23.6	-91.66	28.00	-0.241
23.7	-202.24	29.00	-0.248
24.0	-201.81	30.00	-0.256
25.0	-201.23	32.00	-0.270
26.0	-200.52	34.00	-0.269

27.0	-199.84	36.00	-0.282
28.0	-198.49	38.00	-0.278
29.0	-197.65	40.00	-0.278
30.0	-197.24	42.00	-0.281
31.0	-198.34	44.00	-0.284
32.0	-198.30	46.00	-0.295
33.0	-199.32	48.00	-0.293
34.0	-200.10	50.00	-0.295
35.0	-198.91	52.00	-0.298
36.0	-197.93	54.00	-0.305
37.0	-200.96	56.00	-0.306
38.0	-200.24	58.00	-0.323
39.0	-200.50	60.00	-0.321
40.0	-201.57	62.00	-0.318
41.0	-202.54	64.00	-0.314
42.0	-202.56	66.00	-0.314
43.0	-202.57	68.00	-0.317
44.0	-202.36	69.00	-0.324
45.0	-201.36	69.50	-0.322
46.0	-197.61	70.00	-0.333
47.0	-197.35	72.00	-0.336
48.0	-197.96	74.00	-0.343
49.0	-198.26	77.30	-0.381
50.0	-198.19	84.00	-0.393
51.0	-197.99	86.00	-0.402
52.0	-197.48	89.00	-0.410
53.0	-196.70	93.00	-0.421
54.0	-196.77	96.00	-0.430
55.0	-197.09	99.00	-0.436
56.0	-197.06	102.00	-0.441
57.0	-196.89	105.00	-0.443
58.0	-196.21	108.00	-0.441
59.0	-195.61	111.00	-0.454
60.0	-195.71	114.00	-0.456
61.0	-196.41	117.00	-0.467
62.0	-196.44	120.00	-0.468
63.0	-197.02	123.00	-0.473
64.0	-197.35		
65.0	-197.09		
66.0	-197.77		
67.0	-196.92		
68.0	-197.12		
69.9	-195.27		
70.0	-801.81		
71.0	-803.72		
72.0	-806.73		

73.0	-808.68		
74.0	-808.21		
75.0	-806.21		
76.0	-803.10		
77.0	-811.66		
78.0	-814.92		
79.0	-812.32		
80.0	-809.81		
81.0	-808.94		
82.0	-807.61		
83.0	-806.46		
84.0	-803.37		
85.0	-801.93		
86.0	-801.25		
87.0	-800.63		
88.0	-799.74		
89.0	-799.03		
90.0	-798.34		
91.0	-797.42		
92.0	-795.64		
93.0	-795.07		
94.0	-793.92		
95.0	-793.79		
96.0	-793.18		
97.0	-793.46		
98.0	-792.71		
99.0	-792.40		
100.0	-791.33		
101.0	-788.70		
102.0	-789.05		
103.0	-788.43		
104.0	-787.08		
105.0	-787.60		
106.0	-800.38		
107.0	-800.04		
108.0	-799.97		
109.0	-799.15		
110.0	-798.42		
111.0	-809.33		
112.0	-809.71		
113.0	-811.20		
114.0	-809.85		
115.0	-805.59		
116.0	-805.35		
117.0	-803.20		
118.0	-802.73		

119.0	-790.80		
120.0	-791.51		
121.0	-791.72		
123.0	-789.24		

T13H006B 30-40cm			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.0	-93.04	0.05	-0.005
0.1	-86.32	0.07	-0.027
0.3	-90.91	0.10	-0.027
0.3	-90.91	0.30	-0.045
0.5	-89.90	0.50	-0.078
1.0	-102.51	1.00	-0.086
1.5	-102.51	1.50	-0.094
2.0	-102.48	2.00	-0.099
3.0	-95.22	3.00	-0.102
5.0	-98.48	5.00	-0.106
7.0	-109.21	7.00	-0.118
9.0	-110.46	9.00	-0.124
11.0	-110.75	11.00	-0.129
13.0	-109.94	13.00	-0.130
15.0	-111.98	15.00	-0.132
17.0	-107.74	20.00	-0.133
18.0	-107.49	25.00	-0.131
35.0	-97.18	30.00	-0.128
40.0	-98.32	35.00	-0.129
41.0	-90.92	40.00	-0.128
42.5	-90.95	42.50	-0.134
43.0	-188.19	43.00	-0.143
44.0	-186.64	44.00	-0.161
45.0	-185.49	45.00	-0.173
46.0	-184.35	46.00	-0.186
47.0	-183.58	47.00	-0.194
49.0	-193.59	49.00	-0.201
50.0	-192.59	50.00	-0.209
52.0	-195.98	52.00	-0.214
54.0	-197.79	54.00	-0.226
56.0	-198.75	56.00	-0.238
58.0	-200.59	58.00	-0.244
60.0	-202.58	60.00	-0.248
63.0	-203.67	63.00	-0.255
66.0	-198.91	66.00	-0.261
69.0	-193.77	69.00	-0.262
72.0	-192.55	72.00	-0.267

75.0	-192.00	75.00	-0.267
80.0	-194.24	80.00	-0.268
84.0	-197.62	84.00	-0.268
88.0	-197.31	88.00	-0.272
90.0	-195.81	90.00	-0.273
91.0	-194.21	91.00	-0.272
91.2	-765.46	91.20	-0.296
92.0	-797.42	92.00	-0.302
93.0	-792.56	93.00	-0.311
94.0	-791.30	94.00	-0.314
96.0	-788.22	96.00	-0.323
98.0	-785.99	98.00	-0.331
100.0	-784.49	100.00	-0.335
103.0	-797.01	103.00	-0.344
106.0	-800.83	106.00	-0.352
109.0	-797.56	109.00	-0.361
112.0	-810.61	112.00	-0.368
115.0	-780.92	115.00	-0.373
118.0	-781.89	118.00	-0.380
121.0	-764.68	121.00	-0.384
124.0	-793.34	124.00	-0.386
127.0	-806.06	127.00	-0.389
130.0	-803.91	130.00	-0.393
135.0	-799.66	135.00	-0.399
140.0	-797.79	140.00	-0.406
145.0	-780.44	145.00	-0.411
150.0	-787.93	150.00	-0.411
155.0	-791.54	155.00	-0.417
160.0	-794.66	160.00	-0.421
165.0	-780.27	165.00	-0.425
170.0	-776.44	170.00	-0.427
175.0	-793.71	175.00	-0.431
180.0	-797.40	180.00	-0.436
185.0	-785.21	185.00	-0.442
190.0	-774.75	190.00	-0.445
195.0	-774.09	195.00	-0.446
200.0	-776.75	200.00	-0.450
205.0	-777.03	205.00	-0.452
210.0	-779.72	210.00	-0.454
213.0	-784.43	213.00	-0.457

T13H006B 5-15			
Core base pressure head		Drainage flux observations	
Time (hours)	Pressure head (cm)	Time (hours)	Cumulative Flux (cm)
0.0	-93.55	0.02	0.000

0.1	-92.03	0.05	-0.024
0.1	-88.67	0.10	-0.079
0.4	-83.39	0.40	-0.156
1.0	-80.62	0.70	-0.182
2.0	-78.89	1.00	-0.198
5.0	-77.26	2.00	-0.225
8.0	-92.06	5.00	-0.256
10.0	-91.53	8.00	-0.277
15.0	-94.84	10.00	-0.285
20.0	-95.34	13.00	-0.291
24.2	-96.05	16.00	-0.295
24.5	-195.41	19.00	-0.297
30.0	-193.84	24.20	-0.297
35.0	-193.79	24.50	-0.306
40.0	-195.61	27.00	-0.322
45.0	-198.06	30.00	-0.330
50.0	-196.54	35.00	-0.334
55.0	-194.69	40.00	-0.337
60.0	-195.05	43.00	-0.339
65.0	-197.45	46.00	-0.341
70.0	-199.60	49.00	-0.341
72.4	-195.24	52.00	-0.341
73.0	-801.22	55.00	-0.342
80.0	-793.66	60.00	-0.342
85.0	-784.76	65.00	-0.344
90.0	-790.64	70.00	-0.343
95.0	-791.02	72.40	-0.345
100.0	-787.59	73.00	-0.351
105.0	-789.94	75.00	-0.354
110.0	-785.66	80.00	-0.363
115.0	-785.64	85.00	-0.368
120.0	-784.48	90.00	-0.372
125.0	-778.99	95.00	-0.379
130.0	-781.62	98.00	-0.380
135.0	-789.33	104.00	-0.385
140.0	-790.14	110.00	-0.389
145.0	-783.81	115.00	-0.392
150.0	-780.67	120.00	-0.394
155.0	-776.31	125.00	-0.395
160.0	-771.42	129.00	-0.398
165.0	-772.13	138.00	-0.398
168.4	-782.19	140.00	-0.398
		145.00	-0.399
		150.00	-0.399
		155.00	-0.400
		160.00	-0.400

		165.00	-0.400
		168.42	-0.406

Memo

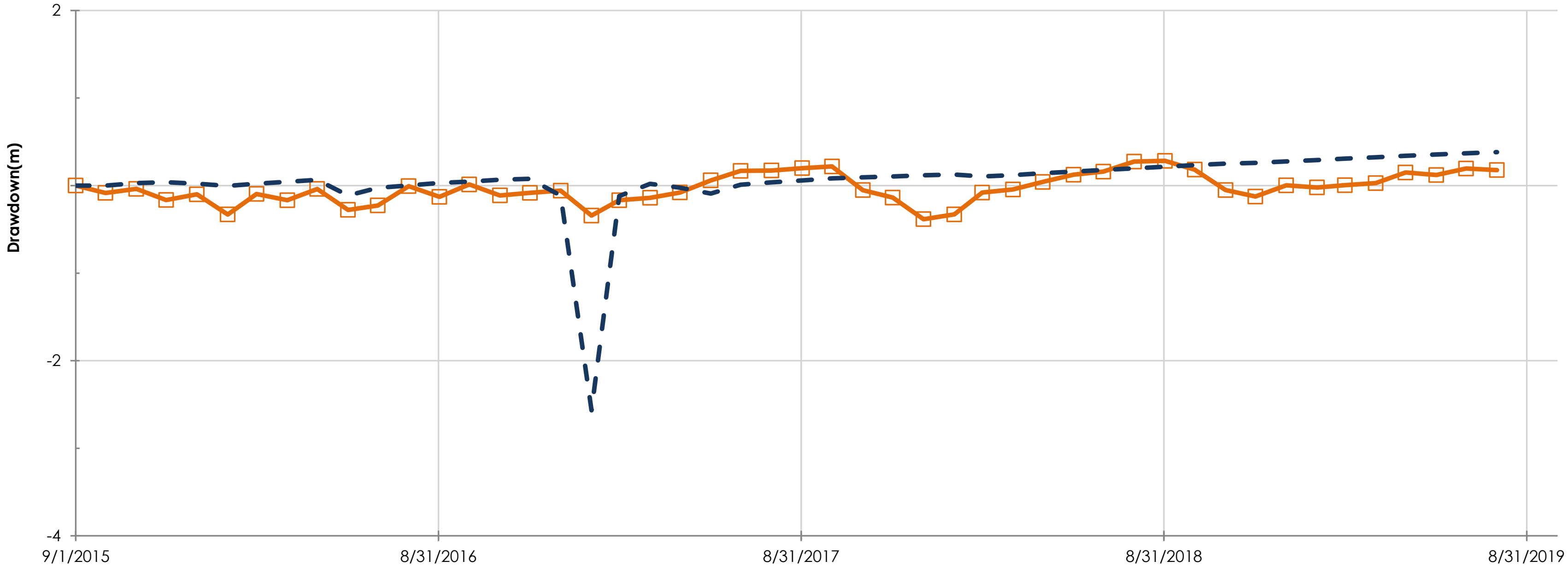
3. Initial conditions testing tabulated results

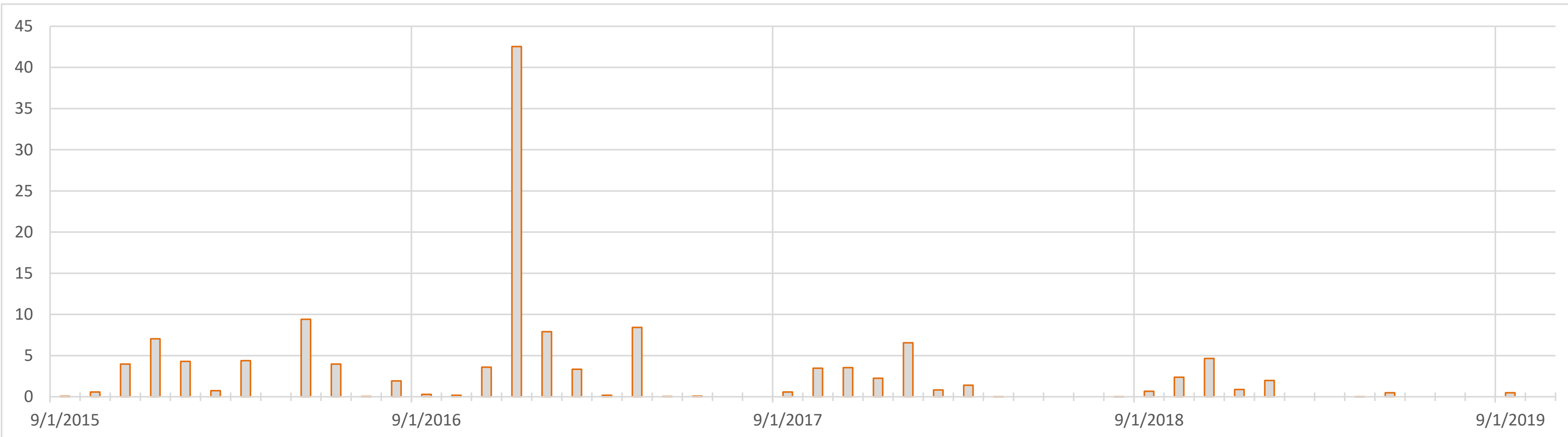
Sample ID	Profile (cm)	Soil Core Length (cm)	EC Reading (mS/cm)	Vol (cc)	OD weight (with salts) (g)	wet BD (Air Dry with salts) (g/cc)	BD (with salts) (g/cc)	Salt (g/g soil)	OD weight (no salts) (g)	BD (w/o salts) (g/cc)	Theta initial (%v/v)	TP calc (%v/v)	Theta AD (%v/v)	Theta Sat (%v/v)	Salt Vol (%v/v)	AFP (%v/v)	AFP (mm)	Total salt (g/cc)
T2AH-001	0-5	5.20	17	395.0	629.8	1.61	1.59	0.071	588.3	**1.49**	31.1%	43.8%	1.3%	**42.5%**	3.4%	8.1%	4.2	0.105
	5-10	4.95	16.21	376.0	570.0	1.53	1.52	0.065	535.5	**1.42**	33.8%	46.3%	1.3%	**44.9%**	2.9%	8.1%	4.0	0.092
	10-20	9.90	20.53	751.9	1098.7	1.48	1.46	0.084	1013.5	**1.35**	37.3%	49.1%	1.8%	**47.7%**	3.6%	6.7%	6.6	0.113
	20-30	9.70	25.1	736.8	1062.0	1.46	1.44	0.107	959.4	**1.30**	43.1%	50.9%	2.3%	**49.3%**	4.5%	1.8%	1.7	0.139
	30-40	**10.00**	**21.87**	**759.5**	**1107.9**	**1.50**	**1.46**	**0.094**	**1012.6**	**1.33**	**41.5%**	**49.7%**	**3.8%**	**48.2%**	**4.0%**	**2.7%**	**2.7**	**0.125**
	40-	2.80	18.3	212.7	275.1	1.41	1.29	0.076	255.6	**1.20**	47.5%	54.6%	11.4%	**53.0%**	2.9%	2.6%	0.7	0.092
T13H-001	0-5	4.20	15.67	319.0	279.6	0.98	0.88	0.062	263.3	**0.83**	12.1%	68.9%	10.5%	**66.8%**	1.6%	53.1%	22.3	0.051
	5-10	4.80	15.01	364.6	326.6	1.01	0.90	0.060	308.1	**0.85**	15.3%	68.1%	11.5%	**66.1%**	1.6%	49.1%	23.6	0.051
	10-20	9.50	8.52	721.6	634.1	1.00	0.88	0.031	615.3	**0.85**	19.4%	67.8%	11.8%	**65.8%**	0.8%	45.6%	43.3	0.026
	20-30	9.90	22.12	751.9	951.8	1.37	1.27	0.094	870.1	**1.16**	42.7%	56.3%	10.6%	**54.6%**	3.5%	8.5%	8.4	0.109
	30-40	**8.50**	**18.08**	**645.6**	**817.9**	**1.42**	**1.27**	**0.071**	**763.8**	**1.18**	**42.1%**	**55.4%**	**14.9%**	**53.7%**	**2.7%**	**8.9%**	**7.6**	**0.084**
	40-																	
T13H-006	0-5	4.70	25.30	357.0	314.9	0.93	0.88	0.112	283.1	**0.79**	11.1%	70.1%	5.1%	**68.0%**	2.9%	54.1%	25.4	0.089
	5-10	4.90	25.30	372.2	335.3	1.04	0.90	0.110	302.2	**0.81**	18.4%	69.4%	13.6%	**67.3%**	2.8%	46.0%	22.5	0.089
	10-20	9.80	10.40	744.3	732.6	1.09	0.98	0.039	705.2	**0.95**	24.8%	64.3%	11.0%	**62.3%**	1.2%	36.3%	35.6	0.037
	20-30	9.90	16.45	751.9	858.3	1.23	1.14	0.067	804.4	**1.07**	35.9%	59.6%	8.7%	**57.8%**	2.3%	19.7%	19.5	0.072
	30-40	**9.70**	**15.57**	**736.8**	**924.6**	**1.33**	**1.25**	**0.061**	**871.8**	**1.18**	**23.9%**	**55.3%**	**7.9%**	**53.7%**	**2.3%**	**27.5%**	**26.6**	**0.072**
	40-	2.20	19.17	167.1	199.2	1.24	1.19	0.079	184.6	**1.10**	46.9%	58.3%	4.5%	**56.6%**	2.8%	6.9%	1.5	0.087
CTH-001	0-5	4.80	36.70	364.6	509.5	1.44	1.40	0.182	431.1	**1.18**	20.2%	55.4%	4.5%	**53.7%**	6.9%	26.6%	12.8	0.215
	5-10	5.00	19.05	379.8	671.4	1.81	1.77	0.079	622.3	**1.64**	28.7%	38.2%	3.8%	**37.0%**	4.1%	4.2%	2.1	0.129
	10-20	9.90	33.36	751.9	1127.5	1.51	1.50	0.155	976.5	**1.30**	36.0%	51.0%	1.4%	**49.5%**	6.4%	7.1%	7.0	0.201
	20-30	10.00	32.76	759.5	1206.1	1.59	1.59	0.154	1044.7	**1.38**	34.6%	48.1%	0.7%	**46.7%**	6.8%	5.3%	5.3	0.212
	30-40	**9.40**	**28.86**	**714.0**	**1144.5**	**1.61**	**1.60**	**0.125**	**1017.6**	**1.43**	**35.4%**	**46.2%**	**0.9%**	**44.8%**	**5.7%**	**3.7%**	**3.5**	**0.178**
	40-	3.30	23.19	250.6	420.6	1.69	1.68	0.102	381.5	**1.52**	33.1%	42.6%	0.9%	**41.3%**	5.0%	3.2%	1.1	0.156
CTH-002	0-5	4.80	44.00	364.6	363.7	1.05	1.00	0.235	294.4	**0.81**	10.7%	69.5%	5.5%	**67.4%**	6.1%	50.7%	24.3	0.190
	5-10	4.80	44.00	364.6	373.5	1.17	1.02	0.226	304.6	**0.84**	22.3%	68.5%	14.5%	**66.4%**	6.1%	38.0%	18.3	0.189
	10-20	9.90	36.19	751.9	807.5	1.11	1.07	0.179	685.0	**0.91**	43.4%	65.6%	3.7%	**63.7%**	5.2%	15.0%	14.8	0.163
	20-30	9.50	39.22	721.6	754.3	1.11	1.05	0.196	630.6	**0.87**	50.1%	67.0%	6.1%	**65.0%**	5.5%	9.4%	9.0	0.171
	30-40	**10.80**	**36.58**	**820.3**	**1016.0**	**1.34**	**1.24**	**0.178**	**862.2**	**1.05**	**47.5%**	**60.3%**	**9.9%**	**58.5%**	**6.0%**	**5.0%**	**5.4**	**0.187**
	40-																	

CTH-003	0-5	4.80	28.20	364.6	524.3	1.45	1.44	0.129	464.3	**1.27**	27.8%	51.9%	1.4%	**50.4%**	5.3%	17.4%	8.3	0.165
	5-10	5.15	22.90	391.2	553.6	1.43	1.42	0.096	505.2	**1.29**	34.5%	51.3%	1.7%	**49.7%**	4.0%	11.3%	5.8	0.124
	10-20	9.70	20.95	736.8	1087.7	1.49	1.48	0.092	996.4	**1.35**	35.6%	49.0%	1.5%	**47.5%**	4.0%	7.9%	7.7	0.124
	20-30	9.75	19.11	740.6	1045.4	1.43	1.41	0.081	967.5	**1.31**	38.5%	50.7%	1.6%	**49.2%**	3.4%	7.3%	7.1	0.105
	30-40	**9.70**	**28.14**	**736.8**	**923.9**	**1.28**	**1.25**	**0.126**	**820.2**	**1.11**	**43.4%**	**58.0%**	**2.6%**	**56.2%**	**4.5%**	**8.3%**	**8.1**	**0.141**
	40-	3.00	25.41	227.9	278.3	1.25	1.22	0.112	250.3	**1.10**	42.5%	58.6%	2.7%	**56.8%**	3.9%	10.3%	3.1	0.123
CTH-004	0-5	4.80	24.99	364.6	407.3	1.16	1.12	0.113	365.9	**1.00**	21.3%	62.1%	4.3%	**60.3%**	3.6%	35.3%	17.0	0.114
	5-10	5.00	26.50	379.8	498.0	1.35	1.31	0.121	444.3	**1.17**	38.3%	55.9%	4.4%	**54.2%**	4.5%	11.3%	5.7	0.141
	10-20	9.50	40.89	721.6	799.0	1.15	1.11	0.205	663.1	**0.92**	43.4%	65.3%	3.8%	**63.4%**	6.0%	13.9%	13.2	0.188
	20-30	10.00	36.32	759.5	881.8	1.24	1.16	0.179	748.2	**0.99**	45.1%	62.8%	8.4%	**60.9%**	5.6%	10.2%	10.2	0.176
	30-40	**9.20**	**23.51**	**698.8**	**1008.5**	**1.46**	**1.44**	**0.096**	**920.5**	**1.32**	**32.7%**	**50.3%**	**1.9%**	**48.8%**	**4.0%**	**12.1%**	**11.1**	**0.126**
	40-	5.30	23.79	402.6	596.8	1.53	1.48	0.101	542.2	**1.35**	31.2%	49.2%	5.2%	**47.7%**	4.3%	12.2%	6.5	0.136
CTH-005	0-5	4.90	39.35	372.2	523.1	1.53	1.41	0.202	435.2	**1.17**	37.3%	55.9%	12.6%	**54.2%**	7.6%	9.3%	4.6	0.236
	5-10	5.20	28.53	395.0	432.1	1.17	1.09	0.128	383.1	**0.97**	39.2%	63.4%	7.7%	**61.5%**	4.0%	18.3%	9.5	0.124
	10-20	9.80	35.75	744.3	827.3	1.26	1.11	0.170	706.8	**0.95**	47.6%	64.2%	14.5%	**62.2%**	5.2%	9.5%	9.3	0.162
	20-30	10.10	30.94	767.1	885.6	1.26	1.15	0.139	777.6	**1.01**	50.3%	61.8%	10.6%	**59.9%**	4.5%	5.1%	5.1	0.141
	30-40	**9.80**	**30.66**	**744.3**	**959.2**	**1.48**	**1.29**	**0.141**	**840.7**	**1.13**	**49.3%**	**57.4%**	**19.0%**	**55.7%**	**5.1%**	**1.3%**	**1.2**	**0.159**
	40-	4.10	23.65	311.4	418.4	1.45	1.34	0.102	379.5	**1.22**	46.6%	54.0%	10.3%	**52.4%**	4.0%	1.8%	0.7	0.125
CTH-006	0-5	4.70	48.68	357.0	512.0	1.48	1.43	0.251	409.3	**1.15**	33.2%	56.7%	4.9%	**55.0%**	9.2%	12.6%	5.9	0.288
	5-10	4.90	38.72	372.2	442.4	1.22	1.19	0.196	369.8	**0.99**	35.6%	62.5%	3.2%	**60.6%**	6.2%	18.7%	9.2	0.195
	10-20	10.20	34.06	774.7	997.9	1.33	1.29	0.162	859.2	**1.11**	36.1%	58.2%	3.9%	**56.4%**	5.7%	14.6%	14.9	0.179
	20-30	9.70	39.29	736.8	955.9	1.41	1.30	0.195	800.1	**1.09**	44.2%	59.0%	11.1%	**57.2%**	6.8%	6.3%	6.1	0.211
	30-40	**9.90**	**45.84**	**751.9**	**834.8**	**1.37**	**1.11**	**0.245**	**670.7**	**0.89**	**51.4%**	**66.3%**	**26.1%**	**64.3%**	**7.0%**	**6.0%**	**5.9**	**0.218**
	40-	5.20	41.79	395.0	437.7	1.45	1.11	0.207	362.8	**0.92**	51.4%	65.3%	34.5%	**63.4%**	6.1%	5.9%	3.1	0.190
CTH-008	0-5	3.70	59.85	281.0	321.6	1.21	1.14	0.360	236.5	**0.84**	14.7%	68.2%	7.0%	**66.2%**	9.7%	41.8%	15.5	0.303
	5-10	4.70	26.49	357.0	369.4	1.17	1.03	0.115	331.4	**0.93**	22.3%	65.0%	14.0%	**63.0%**	3.4%	37.3%	17.5	0.107
	10-20	10.10	16.22	767.1	760.0	1.09	0.99	0.065	713.9	**0.93**	26.3%	64.9%	10.3%	**62.9%**	1.9%	34.7%	35.1	0.060
	20-30	9.60	25.40	729.2	775.8	1.09	1.06	0.112	697.6	**0.96**	40.8%	63.9%	3.0%	**62.0%**	3.4%	17.8%	17.1	0.107
	30-40	**7.70**	**38.43**	**584.8**	**610.9**	**1.09**	**1.04**	**0.188**	**514.3**	**0.88**	**44.6%**	**66.8%**	**4.2%**	**64.8%**	**5.3%**	**15.0%**	**11.5**	**0.165**
	40-																	
CTH-009	0-5	4.90	29.53	372.2	442.3	1.23	1.19	0.132	390.7	**1.05**	30.7%	60.4%	4.3%	**58.6%**	4.4%	23.4%	11.5	0.139
	5-10	5.00	39.30	379.8	485.4	1.32	1.28	0.183	410.4	**1.08**	42.5%	59.2%	4.2%	**57.4%**	6.3%	8.6%	4.3	0.197
	10-20	9.70	38.62	736.8	827.3	1.33	1.12	0.191	694.4	**0.94**	51.1%	64.4%	20.3%	**62.5%**	5.8%	5.6%	5.5	0.180
	20-30	9.70	47.84	736.8	910.3	1.40	1.24	0.240	734.4	**1.00**	48.5%	62.4%	16.4%	**60.5%**	7.6%	4.3%	4.2	0.239
	30-40	**9.80**	**32.90**	**744.3**	**901.0**	**1.42**	**1.21**	**0.150**	**783.7**	**1.05**	**48.5%**	**60.3%**	**21.4%**	**58.5%**	**5.0%**	**5.0%**	**4.9**	**0.158**
	40-	3.25	36.85	246.9	282.5	1.32	1.14	0.176	240.3	**0.97**	55.9%	63.3%	17.7%	**61.4%**	5.5%	0.0%	0.0	0.171

CTH-011	0-5	4.80	39.64	364.6	435.1	1.21	1.19	0.203	361.5	**0.99**	28.4%	62.6%	1.4%	**60.7%**	6.5%	25.9%	12.4	0.202
	5-10	4.90	34.48	372.2	467.8	1.27	1.26	0.159	403.5	**1.08**	32.0%	59.1%	1.7%	**57.3%**	5.5%	19.8%	9.7	0.173
	10-20	9.75	31.59	740.6	1026.2	1.39	1.39	0.152	890.9	**1.20**	36.3%	54.6%	0.8%	**53.0%**	5.8%	10.8%	10.6	0.183
	20-30	9.60	32.44	729.2	1016.9	1.43	1.39	0.145	888.0	**1.22**	40.7%	54.0%	3.6%	**52.4%**	5.7%	6.0%	5.8	0.177
	30-40	**9.60**	**45.96**	**729.2**	**990.0**	**1.47**	**1.36**	**0.243**	**796.5**	**1.09**	**47.5%**	**58.8%**	**11.6%**	**57.0%**	**8.5%**	**1.0%**	**1.0**	**0.265**
	40-																	
CTH-013	0-5	4.70	40.68	357.0	388.9	1.19	1.09	0.205	322.8	**0.90**	37.4%	65.9%	10.5%	**63.9%**	5.9%	20.5%	9.7	0.185
	5-10	5.00	54.59	379.8	295.6	0.97	0.78	0.315	224.8	**0.59**	50.0%	77.7%	19.3%	**75.3%**	6.0%	19.4%	9.7	0.186
	10-20	9.70	39.21	736.8	716.1	1.08	0.97	0.196	598.8	**0.81**	41.0%	69.3%	10.5%	**67.3%**	5.1%	21.1%	20.5	0.159
	20-30	10.00	30.66	759.5	852.9	1.29	1.12	0.143	746.2	**0.98**	46.0%	62.9%	16.8%	**61.0%**	4.5%	10.5%	10.5	0.140
	30-40	**10.20**	**37.23**	**774.7**	**1075.1**	**1.52**	**1.39**	**0.183**	**908.8**	**1.17**	**40.0%**	**55.7%**	**13.3%**	**54.1%**	**6.9%**	**7.2%**	**7.3**	**0.215**
	40-	2.30	28.51	174.7	241.9	1.40	1.38	0.129	214.2	**1.23**	38.4%	53.7%	1.8%	**52.1%**	5.1%	8.7%	2.0	0.159
CTH-014	0-5	4.90	31.16	372.2	490.1	1.37	1.32	0.143	428.7	**1.15**	35.7%	56.5%	5.4%	**54.8%**	5.3%	13.9%	6.8	0.165
	5-10	4.90	35.34	372.2	440.5	1.24	1.18	0.168	377.2	**1.01**	38.1%	61.8%	5.9%	**59.9%**	5.4%	16.4%	8.0	0.170
	10-20	10.25	30.39	778.5	897.3	1.36	1.15	0.137	789.4	**1.01**	42.1%	61.7%	21.1%	**59.9%**	4.4%	13.3%	13.7	0.139
	20-30	10.25	34.88	778.5	913.2	1.49	1.17	0.160	787.2	**1.01**	48.5%	61.8%	31.8%	**60.0%**	5.2%	6.3%	6.4	0.162
	30-40	**10.00**	**38.08**	**759.5**	**911.6**	**1.40**	**1.20**	**0.184**	**769.7**	**1.01**	**50.2%**	**61.8%**	**20.4%**	**59.9%**	**6.0%**	**3.7%**	**3.7**	**0.187**
	40-	2.70	38.94	205.1	226.0	1.26	1.10	0.190	189.9	**0.93**	49.8%	65.1%	16.2%	**63.1%**	5.6%	7.7%	2.1	0.176
CTH-017	0-5	4.00	45.99	303.8	386.2	1.39	1.27	0.230	314.0	**1.03**	39.2%	61.0%	11.8%	**59.2%**	7.6%	12.3%	4.9	0.238
	5-10	5.50	45.79	417.7	380.8	1.04	0.91	0.237	308.0	**0.74**	38.9%	72.2%	13.3%	**70.0%**	5.6%	25.6%	14.1	0.174
	10-20	10.10	36.02	767.1	832.3	1.33	1.08	0.170	711.5	**0.93**	41.1%	65.0%	24.4%	**63.0%**	5.0%	16.9%	17.1	0.157
	20-30	10.20	25.35	774.7	1068.2	1.61	1.38	0.110	962.2	**1.24**	37.6%	53.1%	22.7%	**51.5%**	4.4%	9.5%	9.7	0.137
	30-40	**10.30**	**26.36**	**782.3**	**1210.6**	**1.79**	**1.55**	**0.116**	**1085.2**	**1.39**	**39.7%**	**47.7%**	**24.6%**	**46.2%**	**5.1%**	**1.4%**	**1.5**	**0.160**
	40-	4.10	35.55	311.4	421.6	1.49	1.35	0.172	359.8	**1.16**	47.5%	56.4%	13.4%	**54.7%**	6.3%	0.9%	0.4	0.198
CTH-018	0-5	4.90	27.70	372.2	475.8	1.29	1.28	0.125	423.1	**1.14**	28.8%	57.1%	1.3%	**55.4%**	4.5%	22.1%	10.8	0.142
	5-10	4.60	29.26	349.4	400.6	1.16	1.15	0.128	355.1	**1.02**	35.5%	61.6%	1.4%	**59.8%**	4.2%	20.1%	9.3	0.130
	10-20	9.80	23.56	744.3	937.4	1.35	1.26	0.100	852.1	**1.14**	41.7%	56.8%	9.4%	**55.1%**	3.7%	9.7%	9.5	0.115
	20-30	10.00	35.30	759.5	858.5	1.28	1.13	0.172	732.7	**0.96**	51.1%	63.6%	14.7%	**61.7%**	5.3%	5.3%	5.3	0.166
	30-40	**9.90**	**33.63**	**751.9**	**915.5**	**1.43**	**1.22**	**0.160**	**789.1**	**1.05**	**50.4%**	**60.4%**	**21.4%**	**58.6%**	**5.4%**	**2.8%**	**2.8**	**0.168**
	40-	3.05	23.21	231.7	302.5	1.39	1.31	0.100	275.0	**1.19**	47.4%	55.2%	8.8%	**53.5%**	3.8%	2.4%	0.7	0.118

Appendix G TRANSIENT CALIBRATION HYDROGRAPHS





Stantec

Client/Project

Mackay Potash Project, Western Australia

Well No. **MA_2**

Layer No. **1**

Title

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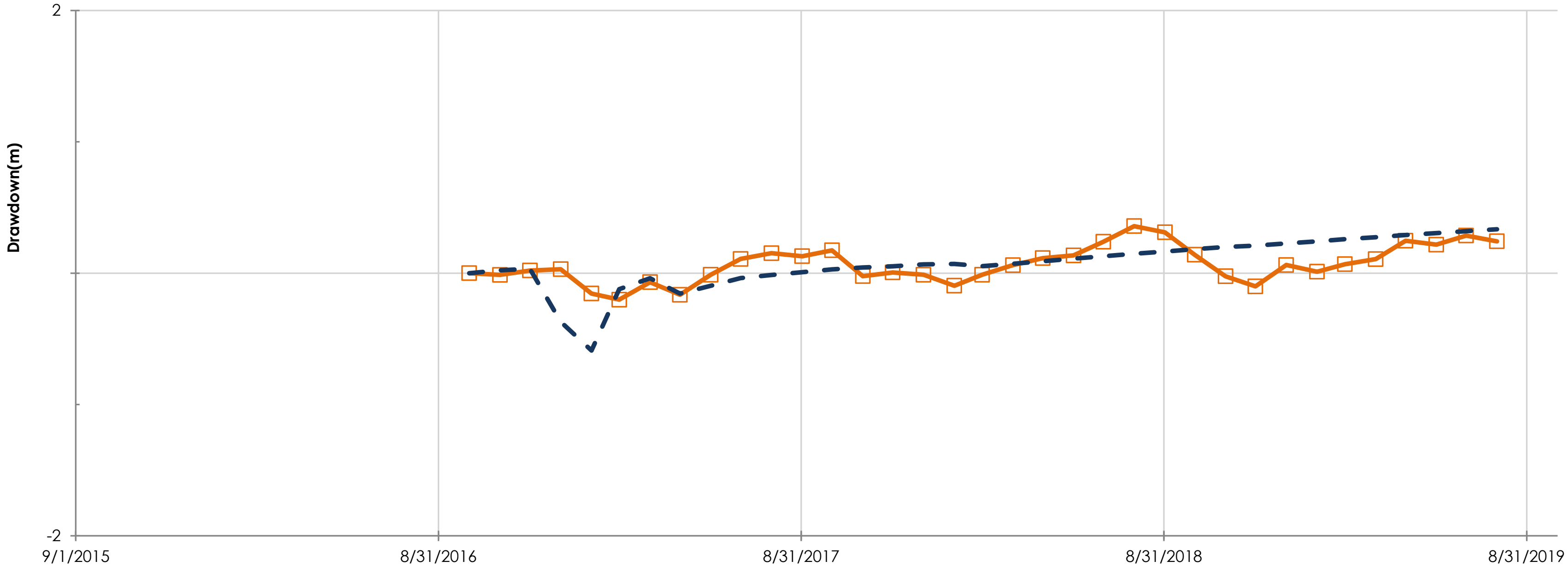

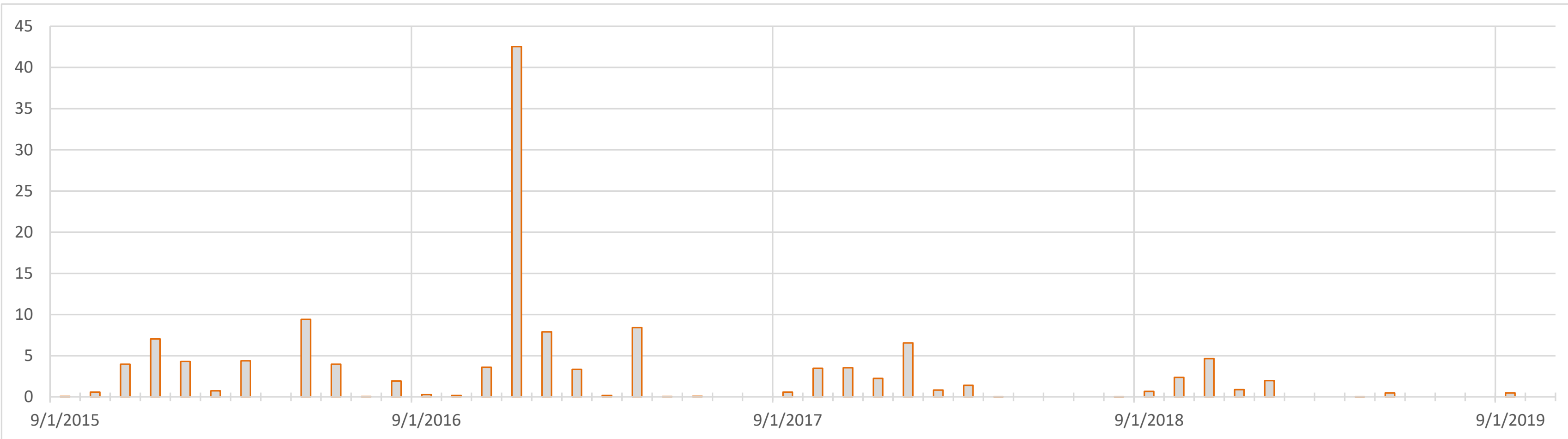

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Client/Project

Mackay Potash Project, Western Australia

Well No. **MA_5**

Layer No. **1**

Title

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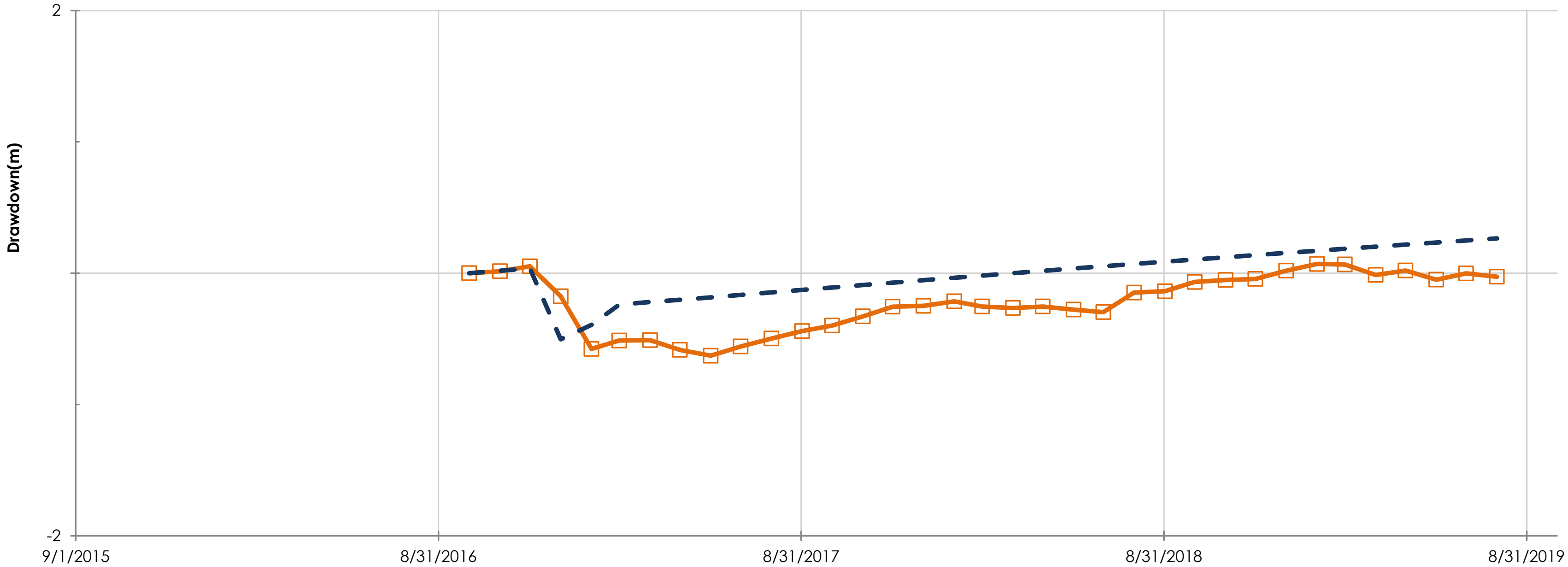
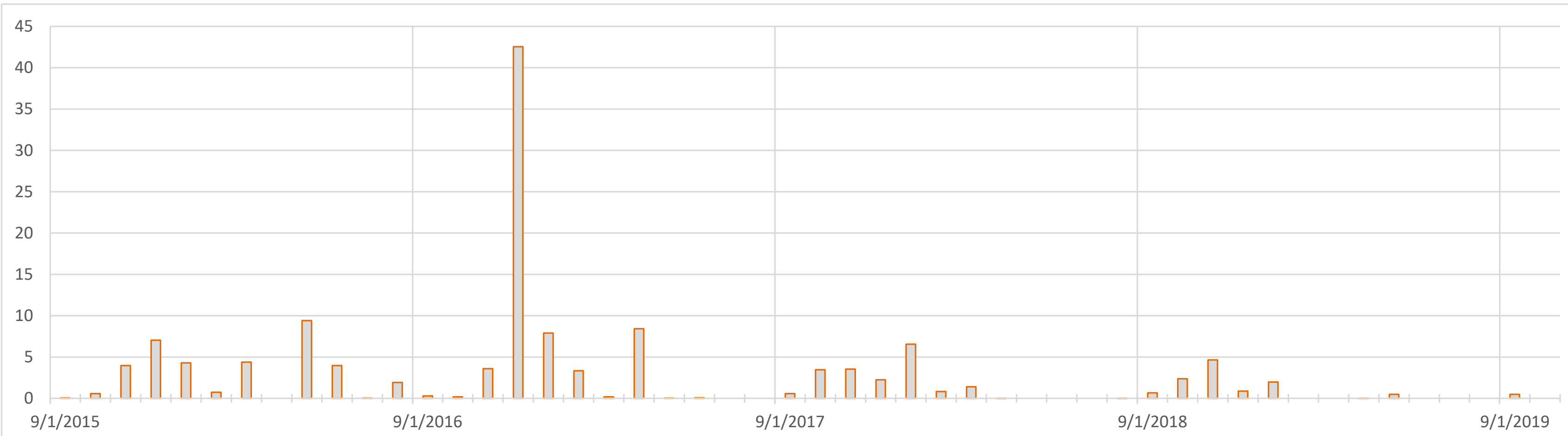




Client/Project

Mackay Potash Project, Western Australia

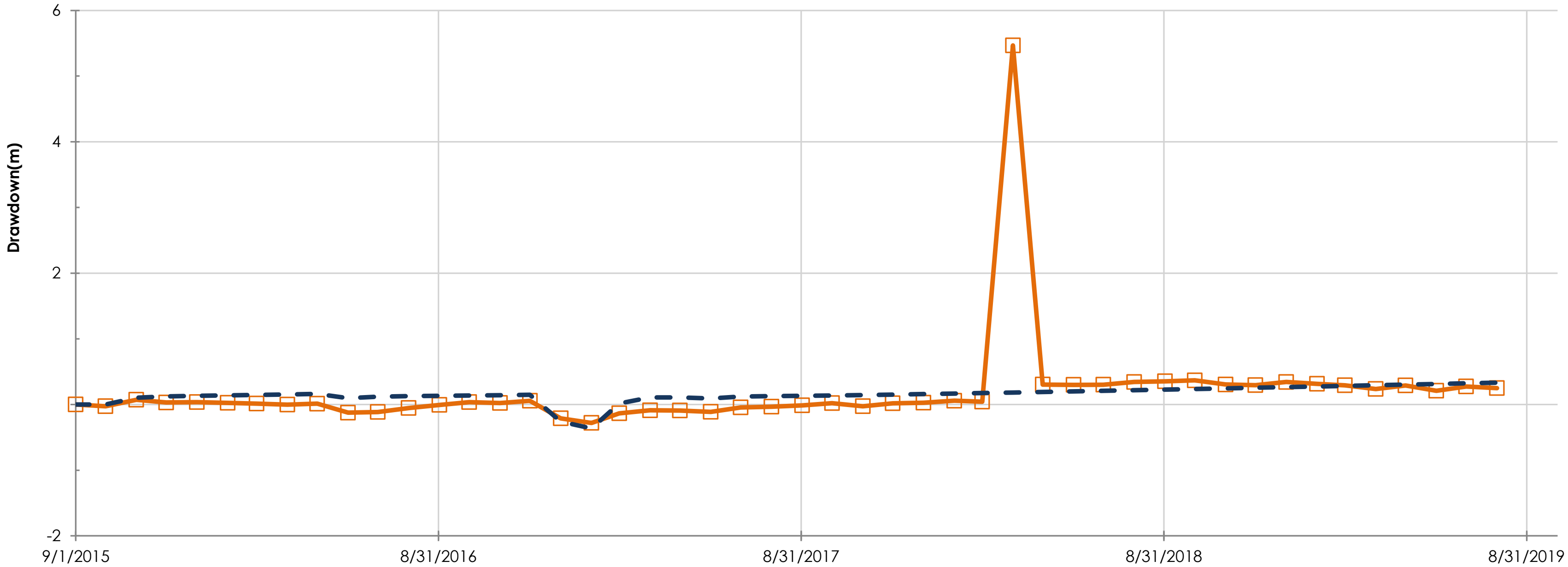
Well No. **MA09**

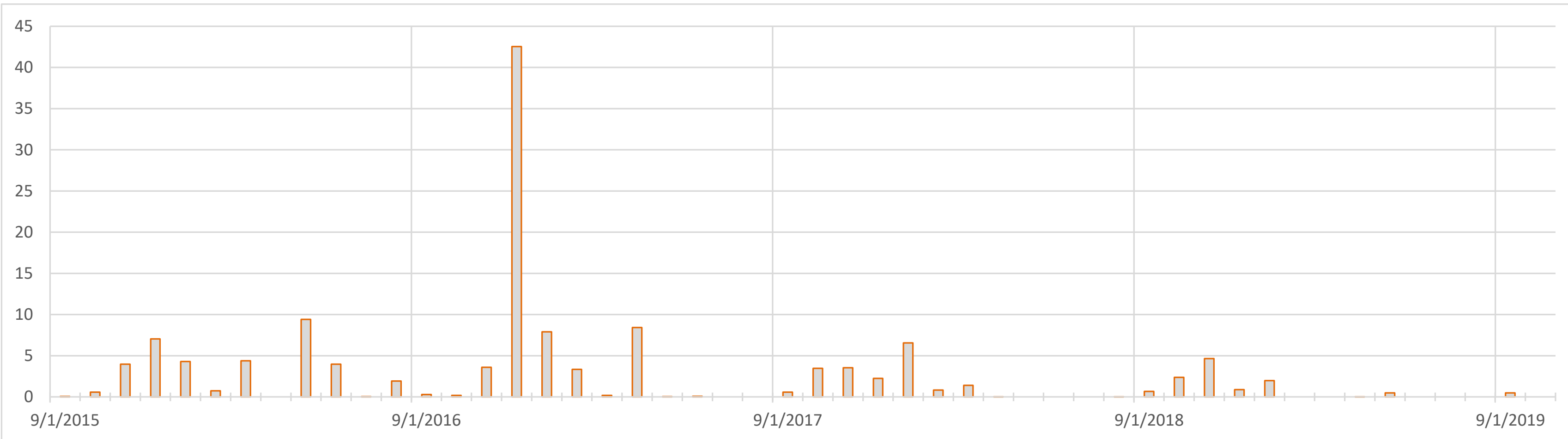
Layer No. **1**

Title

Groundwater Model Calibration Hydrograph

Stantec





Client/Project

Mackay Potash Project, Western Australia

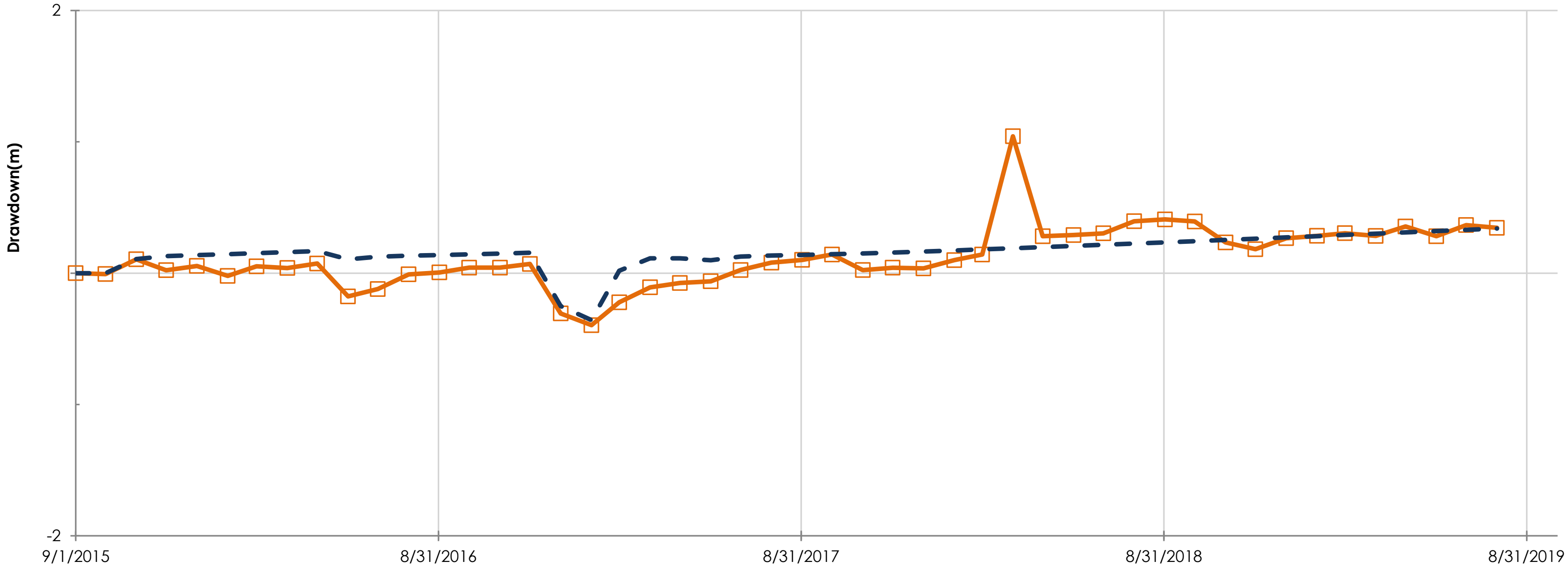
Well No. **MA13a**

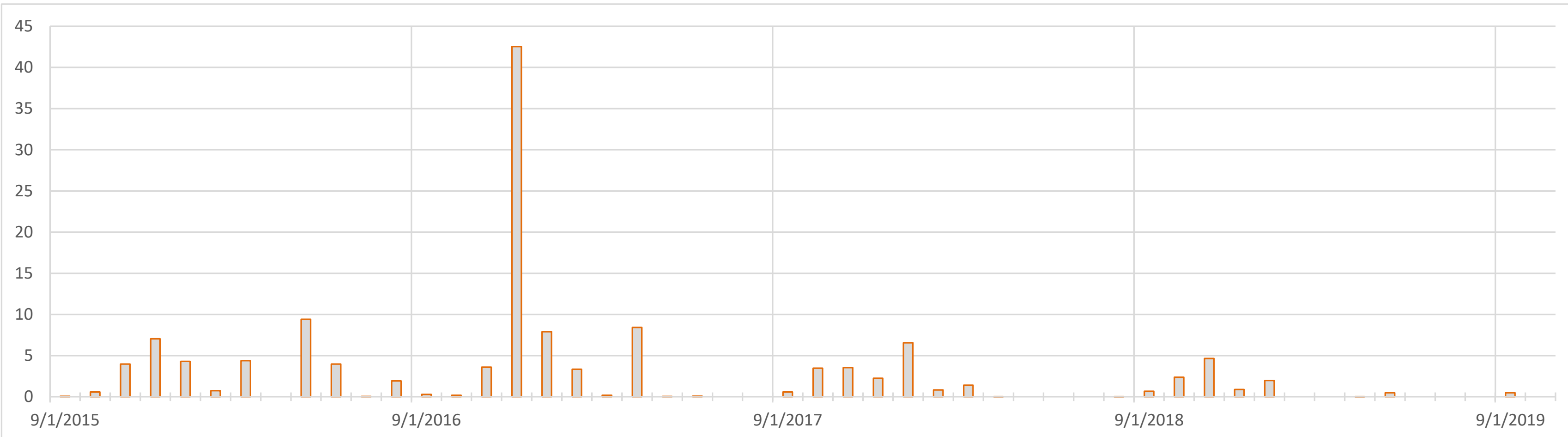
Layer No. **1**

Title

Groundwater Model Calibration Hydrograph

Stantec





Stantec

Client/Project

Mackay Potash Project, Western Australia

Well No.	**MA13b**
Layer No.	**2**

Title

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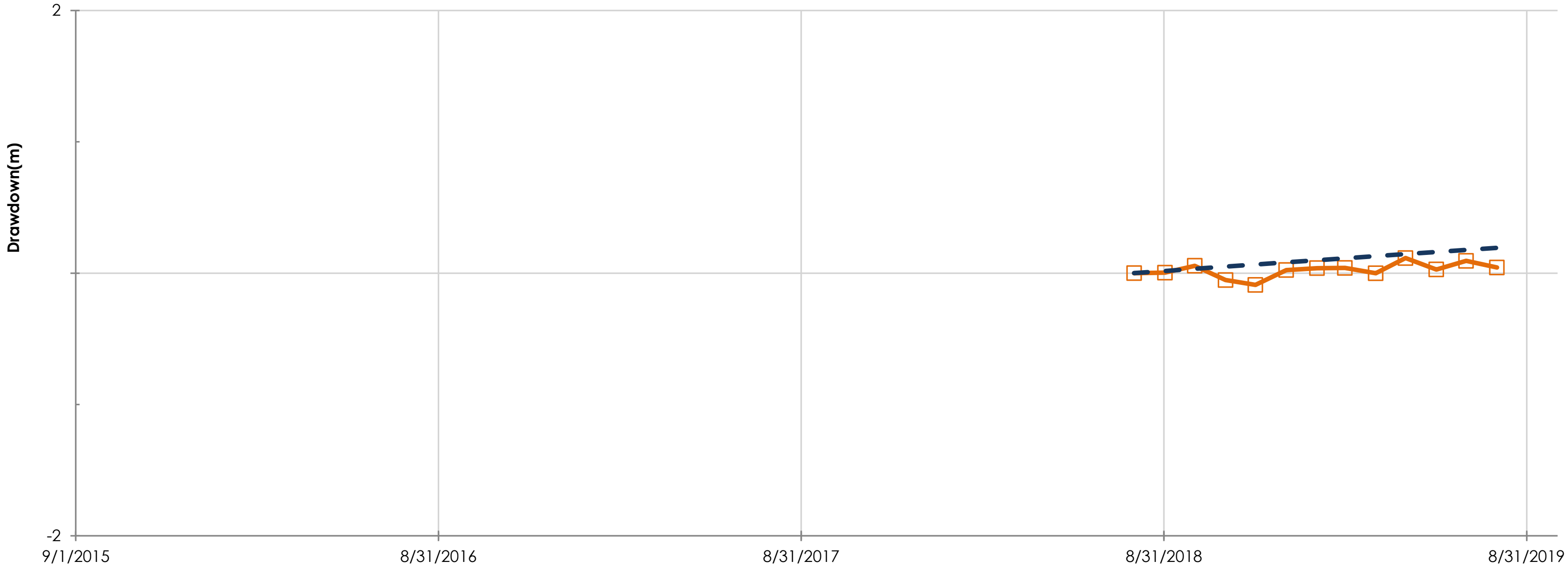
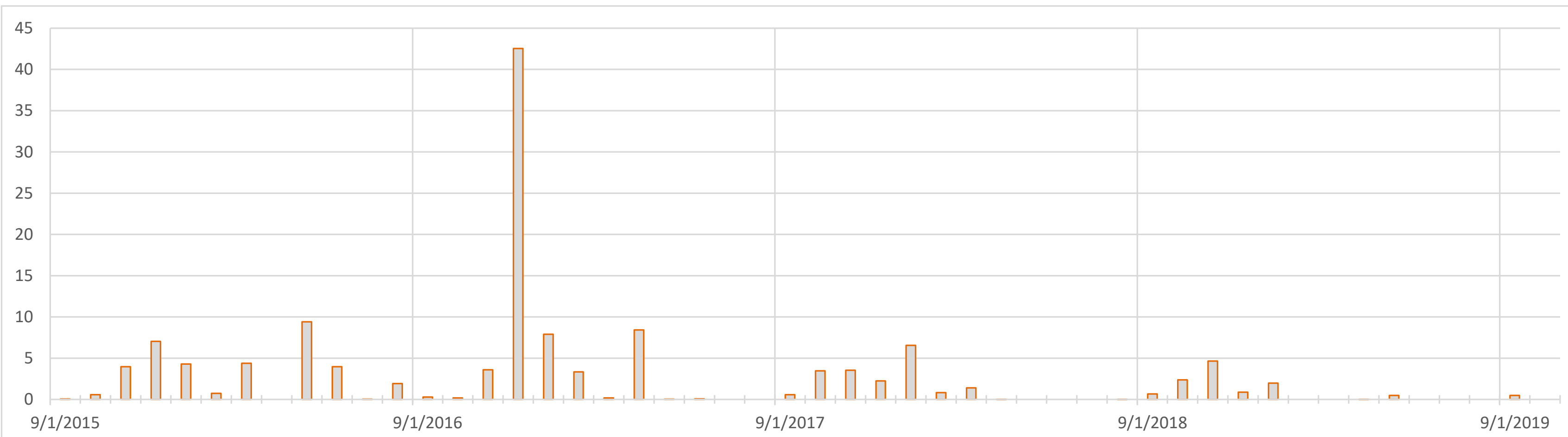




Client/Project

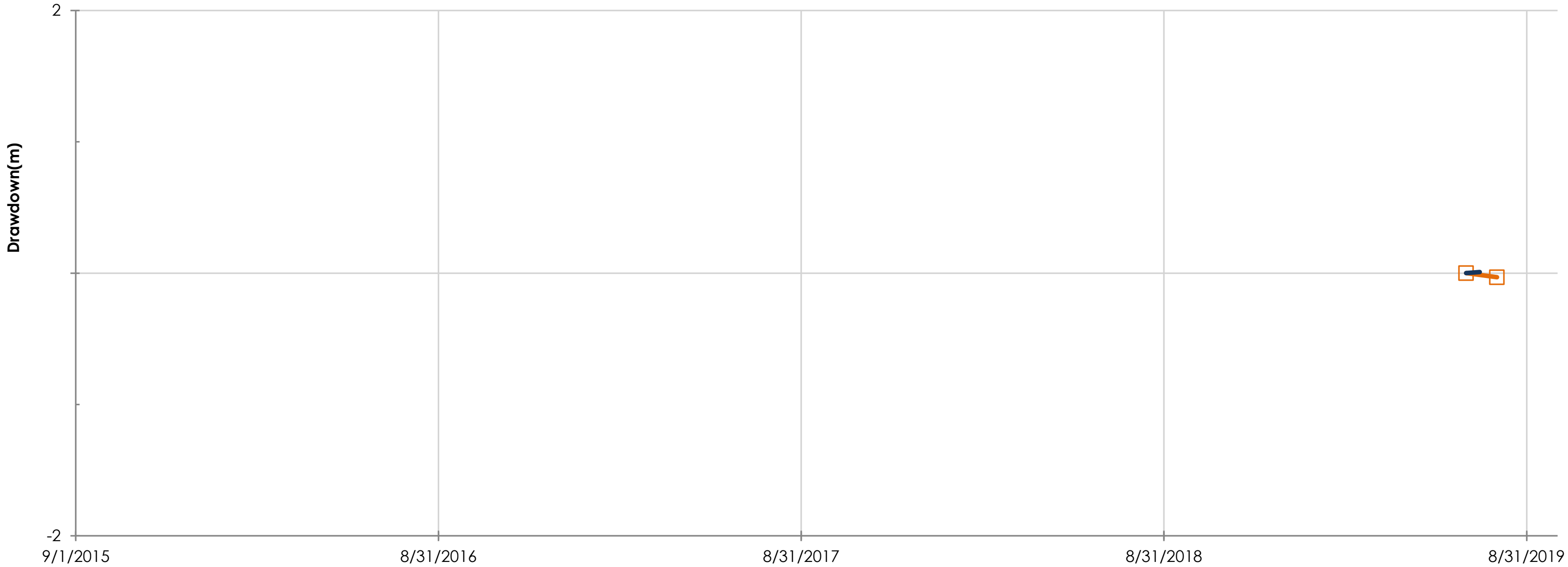
Mackay Potash Project, Western Australia

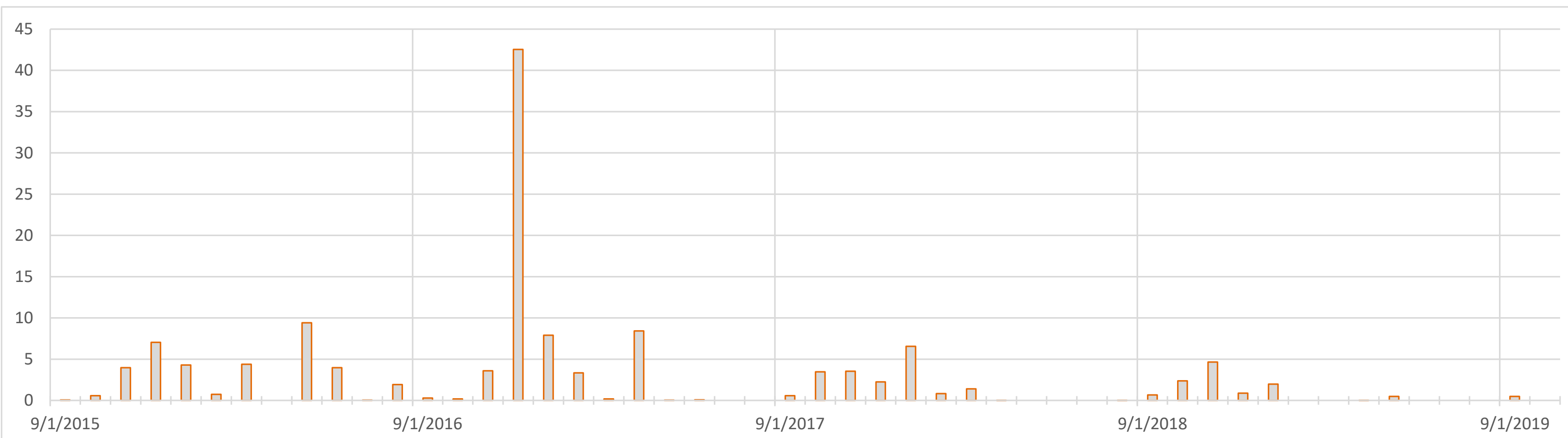
Well No.	**MC05**
Layer No.	**1**

Title

Groundwater Model Calibration Hydrograph

Stantec





Stantec

Client/Project

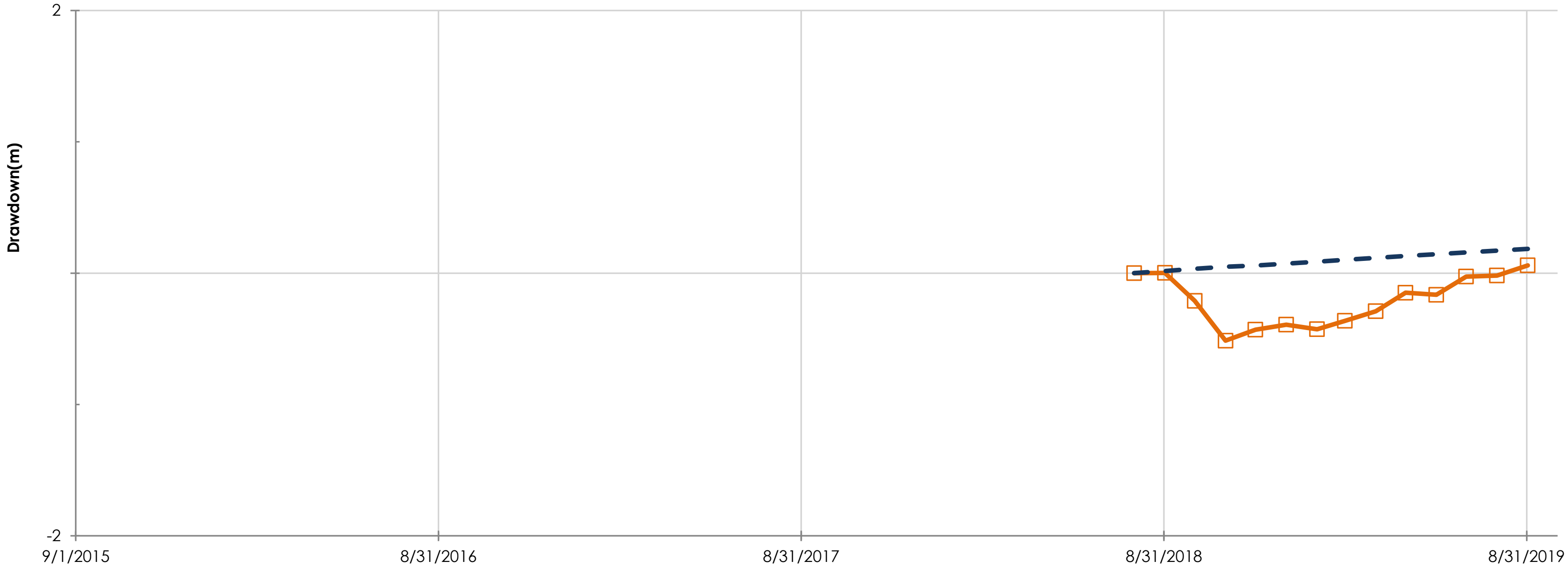
Mackay Potash Project, Western Australia

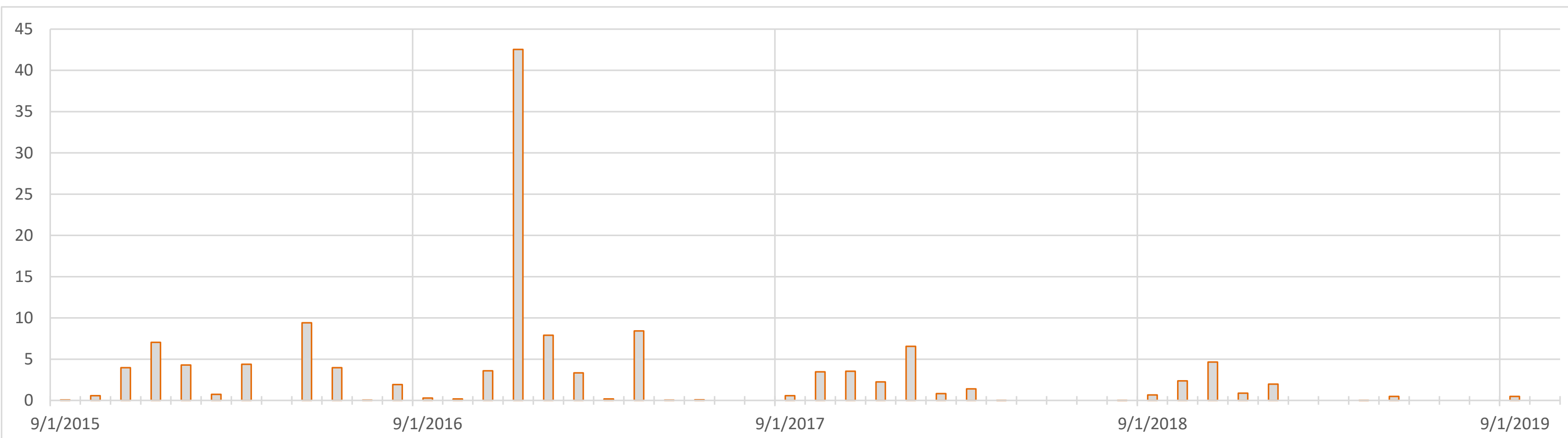
Well No. **MC13**

Layer No. **1**

Title

Groundwater Model Calibration Hydrograph





Stantec

Client/Project

Mackay Potash Project, Western Australia

Well No.	**MC37deep**
Layer No.	**2**

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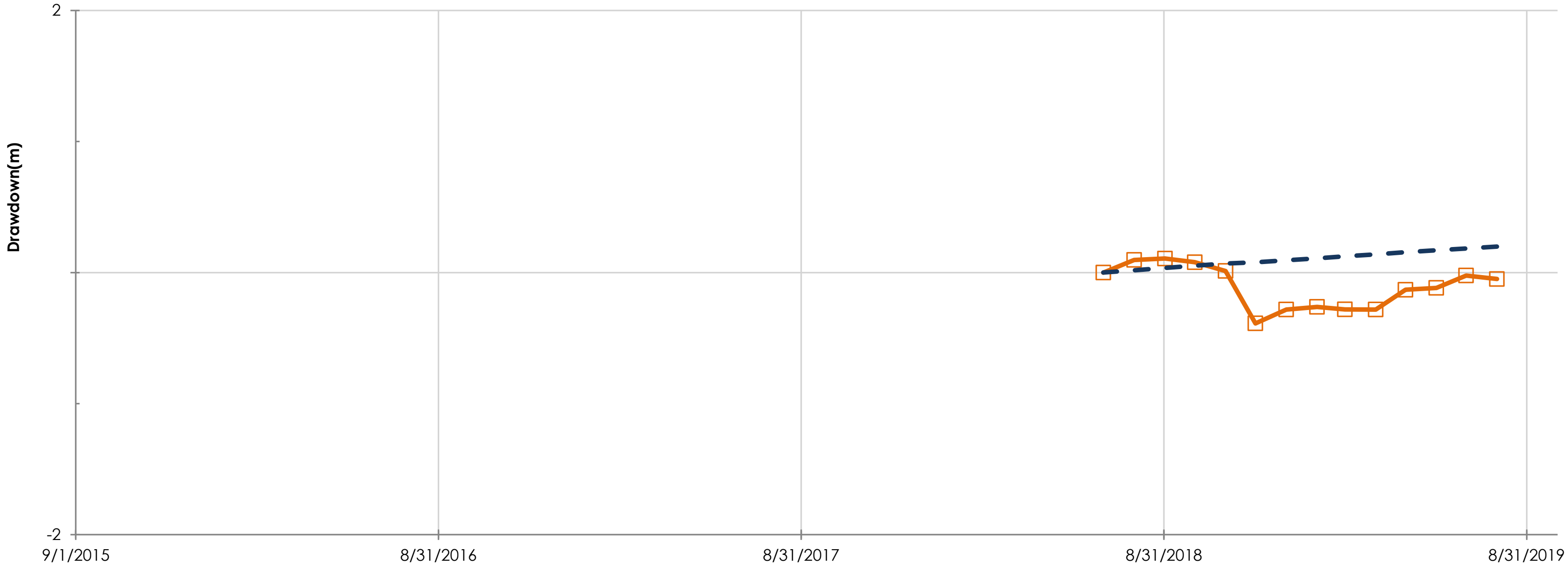

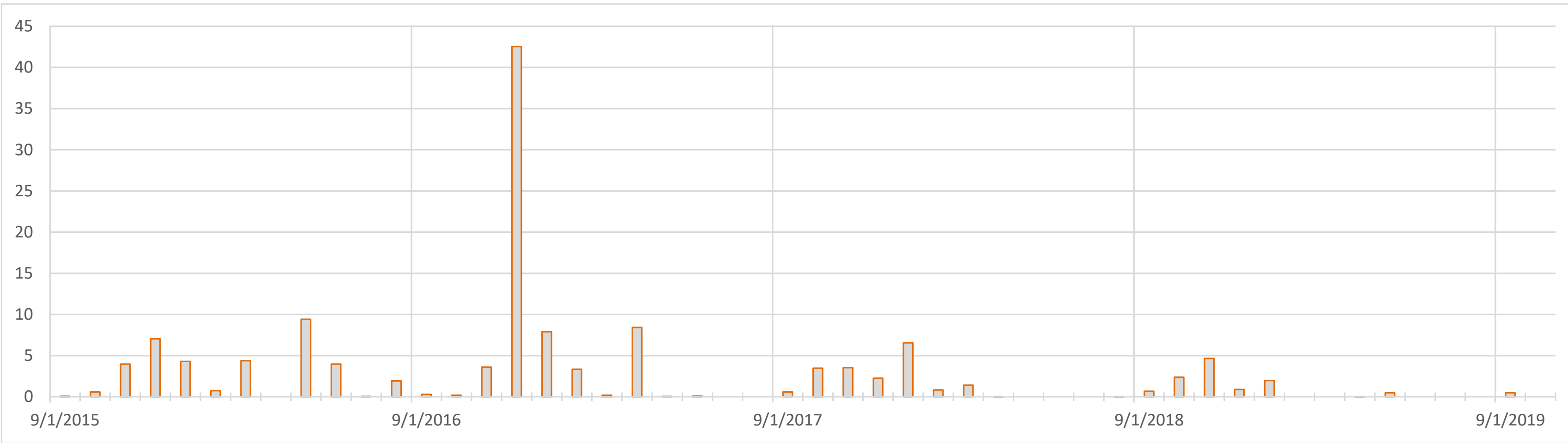

Client/Project

Mackay Potash Project, Western Australia

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Layer No.	**1**

Title

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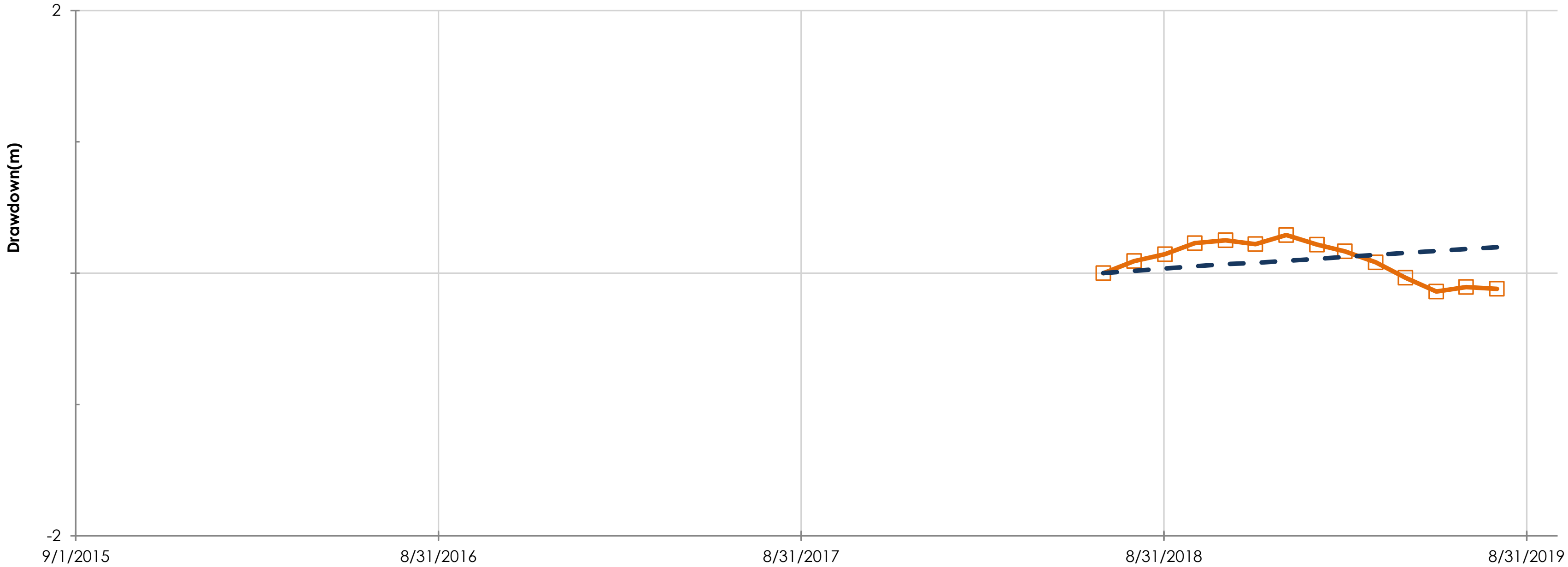
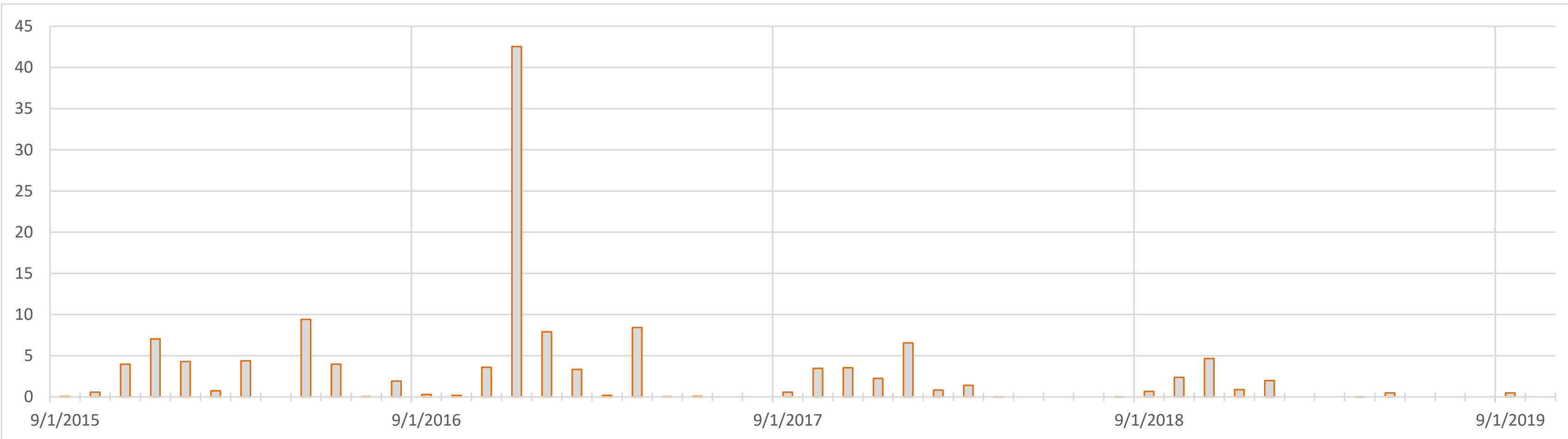




Stantec

Client/Project

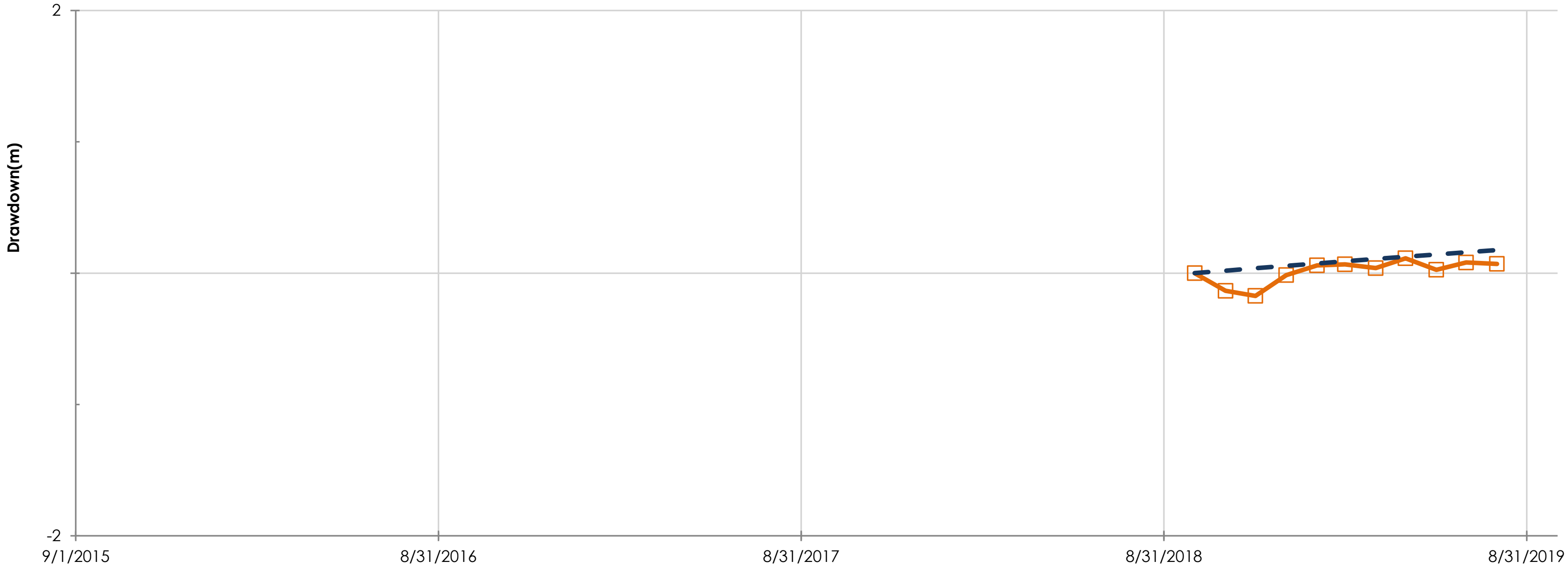
Mackay Potash Project, Western Australia

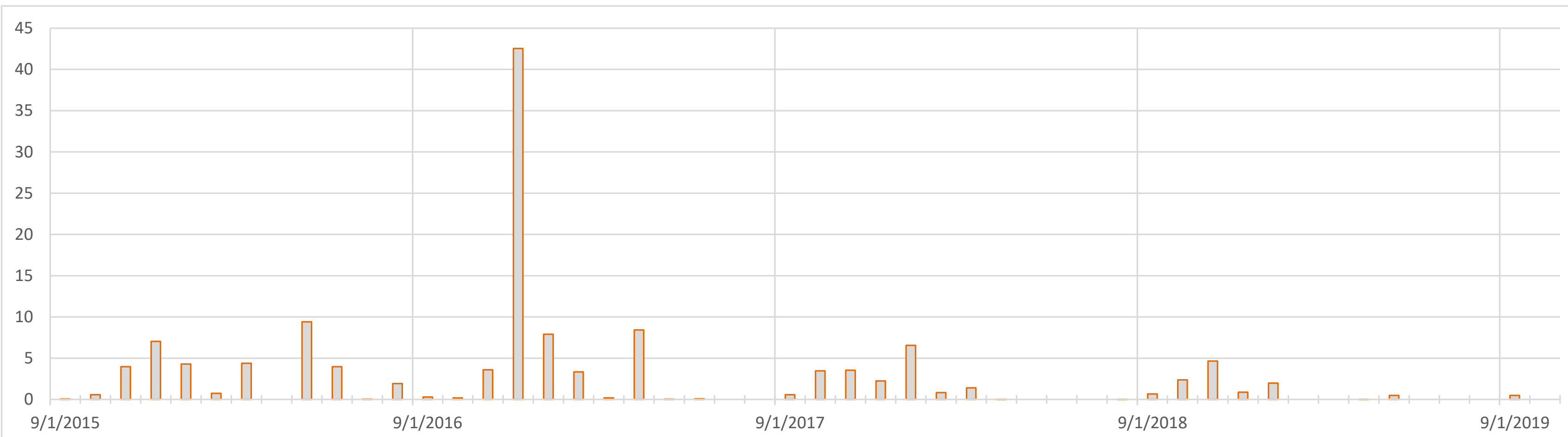
Well No. **MC46deep**

Layer No. **2**

Title

Groundwater Model Calibration Hydrograph





Client/Project

Mackay Potash Project, Western Australia

Well No. **MT23P**

Layer No. **1**

Title

Groundwater Model Calibration Hydrograph

Stantec

Appendix C Trench Pump Testing Memorandum (Agrimin 2021)

MEMO

To:	Stantec
From:	Agrimin Technical Team
Subject:	Long Term Pump Test Evaluation
Date:	13 November 2021

1. Overview

Brine extraction from infiltration trenches is the proposed mining method for the Mackay Potash Project. Agrimin excavated 23 trenches across the on-lake portion of the project area, these trenches were typically 100m in length and 6m deep. Monitoring bores (piezometers) were installed at each trench site and at varying distances from the trench. Short term pump tests were conducted at 19 trenches to provide pumping and drawdown data that were used to calibrate hydraulic conductivity parameters in the lake groundwater model. Two locations were selected to undergo long term pumping tests to record groundwater drawdown responses (if any) on the lake islands and analyse the influence of “wet season” rainfall on the water table and groundwater chemistry. The pumping tests were run for 6 months over the 2018-2019 wet season. The tests also aimed to increase the understanding of the hydraulic properties of the near surface sediments and quantify long-term trench performance.

Trench 02A (T02A) and Trench 13 (T13) locations (See Figure 1), were selected based on their proximity to lake islands, as well as contrasting hydrogeological properties of the surficial lakebed sediments in those areas. Groundwater chemistry and abstraction rates were monitored for the duration of the tests.

Weather events during the wet season are typically either regional and wide-spread rainfall to the lake and surrounding areas, or scattered, bringing heavy rainfall to isolated areas. As T13 is located approximately 60km north east of the Pilot Pond weather station, it was necessary to monitor rainfall at the pumping test locations so that representative rainfall data could be used to analyse the results. Tipping bucket rain gauges equipped with data loggers were set up at both trench locations to record localised rainfall data for the duration of the pumping tests. Pilot Pond, T02A and T13 rain gauge data is presented in Figure 2.

2. Objectives

The long-term pump testing aimed to address the following:

- Record groundwater drawdown in the trench and in close proximity to the trench within the monitoring piezometers (up to 100m away);
- Record groundwater drawdown on islands adjacent to the infiltration trench, up to 1000m away;
- Monitor water chemistry at regular intervals over the duration of the pump test, and
- Record how significant rainfall events affected recharge and impacted on groundwater drawdown.

MEMO

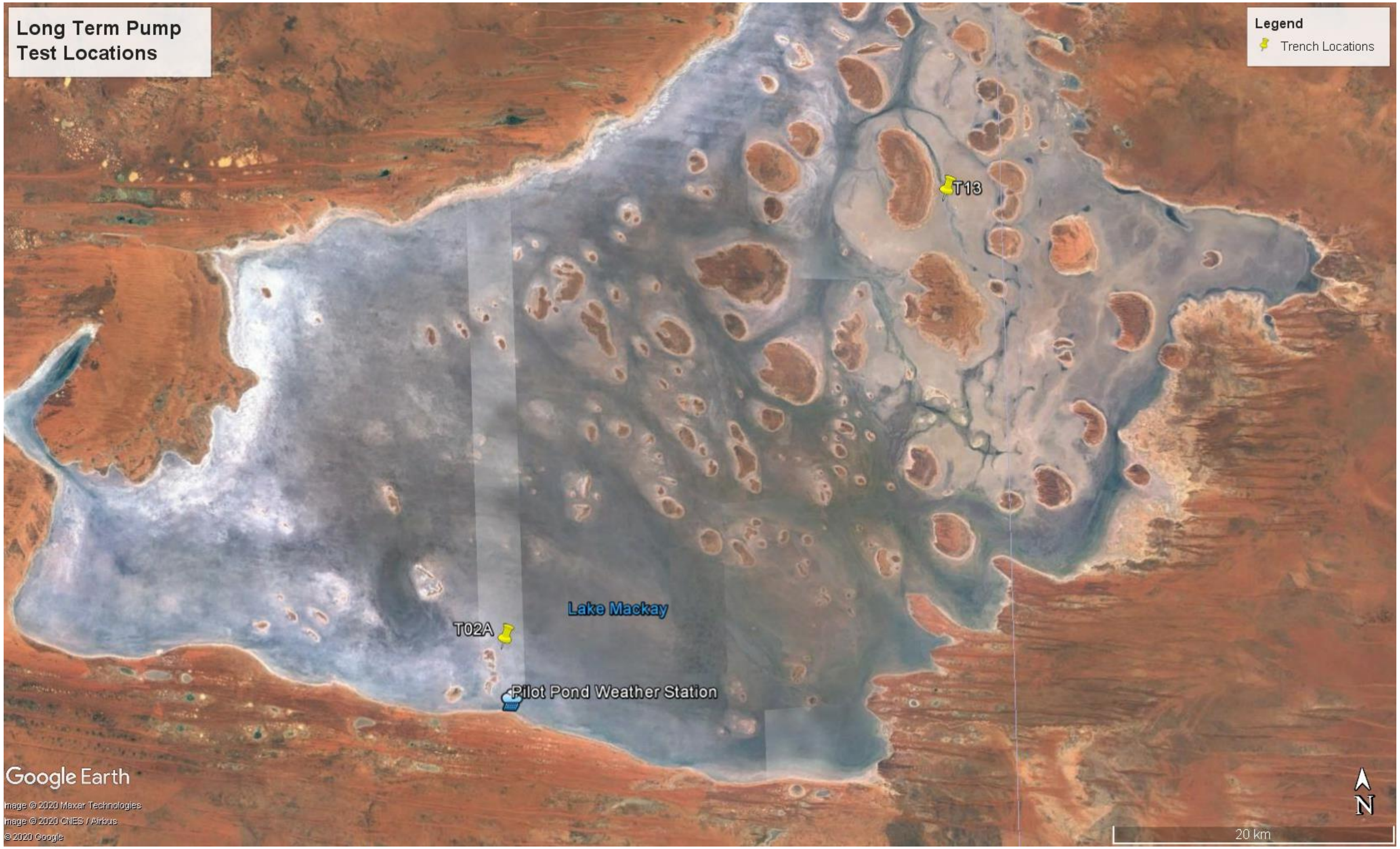


Figure 1 – Long-term pumping test trench locations.

MEMO

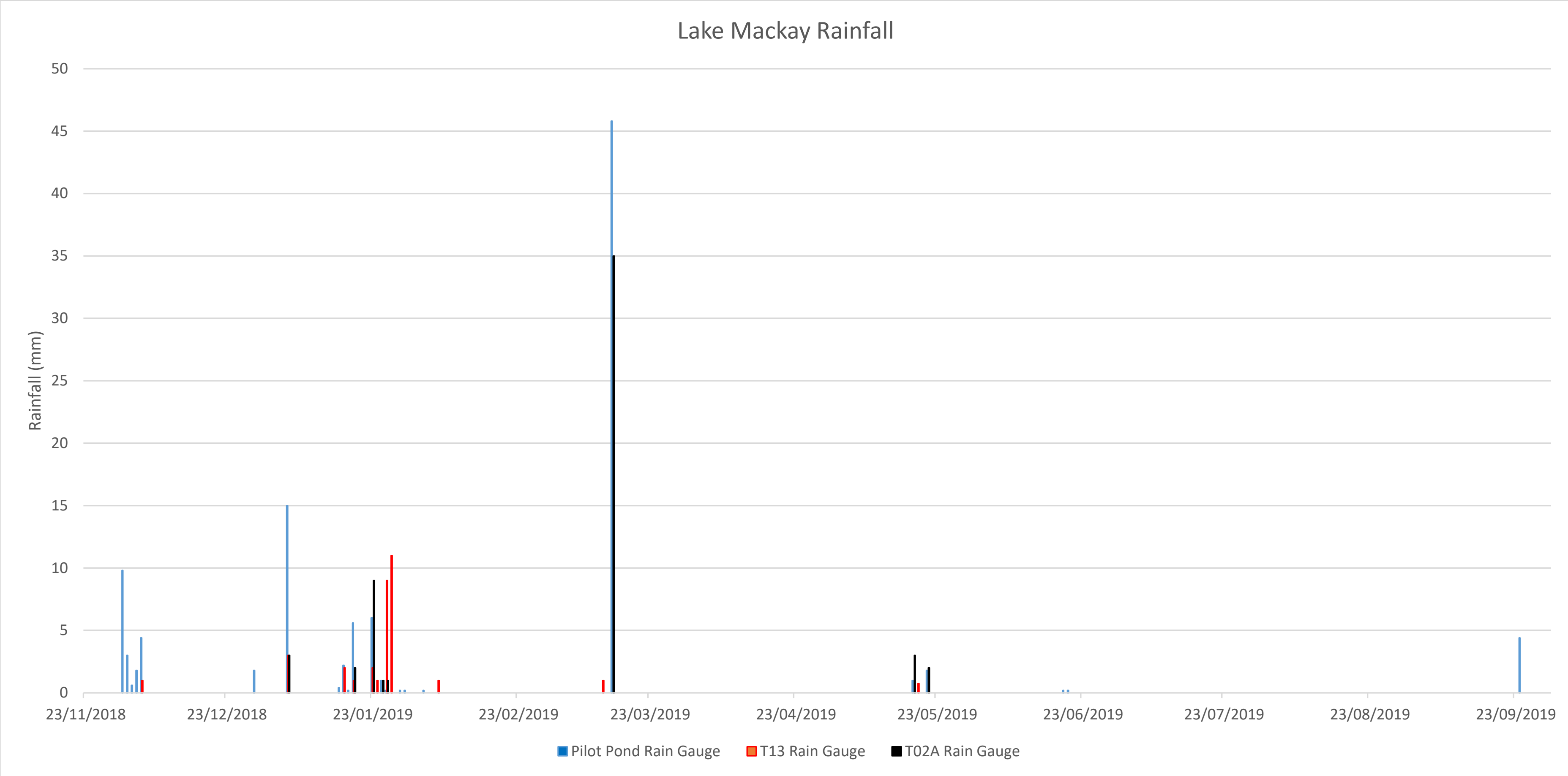


Figure 2 – Rainfall data for pumping test period

3. Trench Pump Tests

3.1 T02A

3.1.1 Location

T02A is located 4 km from the southern shoreline of Lake Mackay, in the central-western region of the lake (See Figure 1).

3.1.2 Pump Test Setup

- Generator and submersible pump
- Flex drive pump
- Flow meter and valve assembly
- 500m discharge lay flat hose

3.1.3 Pumping Test Methodology

The pumping test commenced on the 2nd of December 2018. The first stage of the pumping test involved lowering the trench water level below the baseline ground water level and removing the trench storage. The baseline trench water level was 0.50 mbgl and was lowered to 3.30 mbgl in the first 25 days of the pumping test. Once the target pumping water level had been achieved the flow rate was reduced to match the groundwater inflow rate. The initial steady state trench flow rate was 0.72 L/sec and was further reduced to 0.45 L/sec as the test progressed. The flow rate for the final 4 weeks of the pumping test was 0.25 L/sec. Flow rates over the duration of the pumping test are presented in Figure 3.

The flow rate was adjusted if an increase or decrease in the trench water level was detected. The trench flow rate, water level and piezometer water levels were measured and recorded at regular intervals throughout the duration of the pump test. Pumping equipment failures and extreme weather events resulted in periods of time when the abstraction rate from the trench was zero, this resulted in fluctuations in the trench water level. Following a period of no pumping, the pump flow rate was increased to lower the trench water level and restabilise the test. These events have been annotated on the trench flow rate plot, Figure 3 – Trench 02A pumping test flow rates and Table 1 - T02A Trench water level annotation comments (see Figure 3 – Trench 02A pumping test flow rates). Water level drawdown trends for the trench and associated monitoring piezometers are presented in Figure 4 and in Figure 5 (MD stands for 'manual dip' measurement).

The test ended on the 27th June 2019 following 207 days of pumping. Monitoring of the trench and piezometer recovery water levels continued after pumping was stopped.

Table 1 - T02A Trench water level annotation comments (see Figure 3 – Trench 02A pumping test flow rates)

Annotation	Comment
1	Drawdown trench water level at beginning of test
2	Stabilize trench water level by reducing pump flow rate
3	Pump off due to generator failure
4	Increased flow rate to drawdown trench water level
5	Flow rate reduced to stabilize trench water level
6	Trench water level at surface due to inundation event, pump off
7	Flow rate increased to drawdown trench water level
8	Reduce flow rate to stabilize trench water level

9	Pump failure
10	Reduce flow rate to stabilize water level

MEMO

3.1.4 Pumping test data

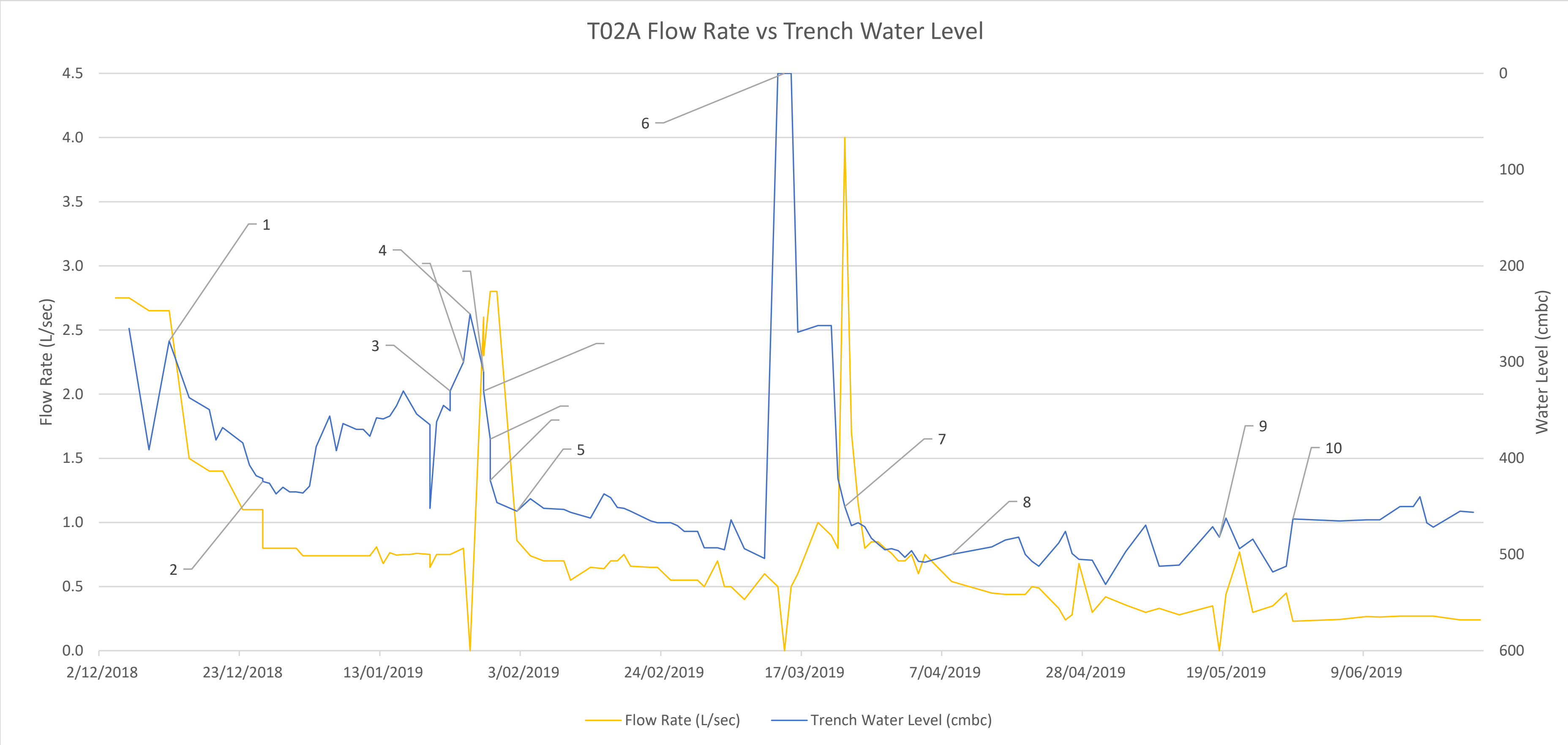


Figure 3 – Trench 02A pumping test flow rates & water level data

MEMO

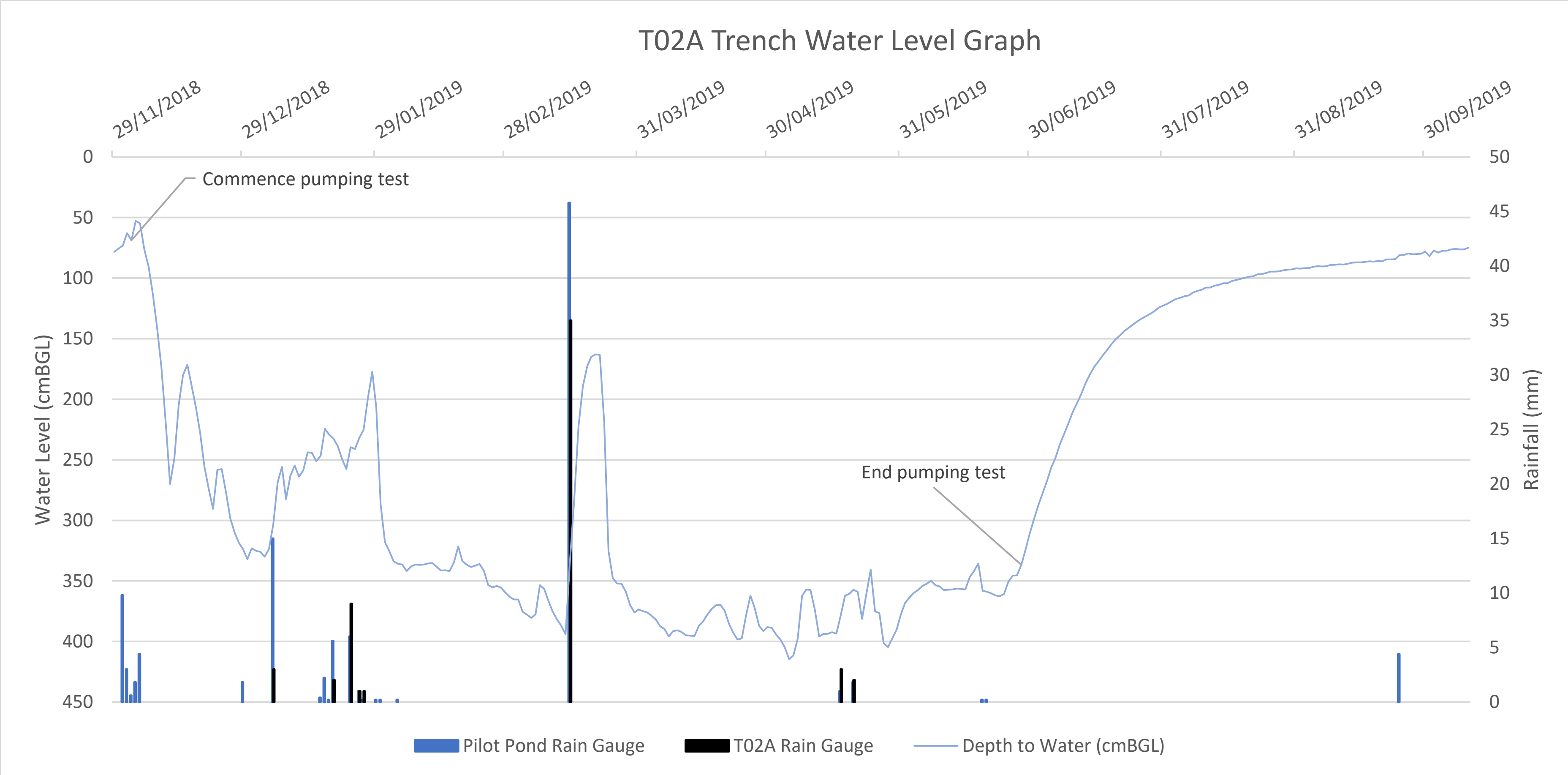


Figure 4 – Trench 02A water level

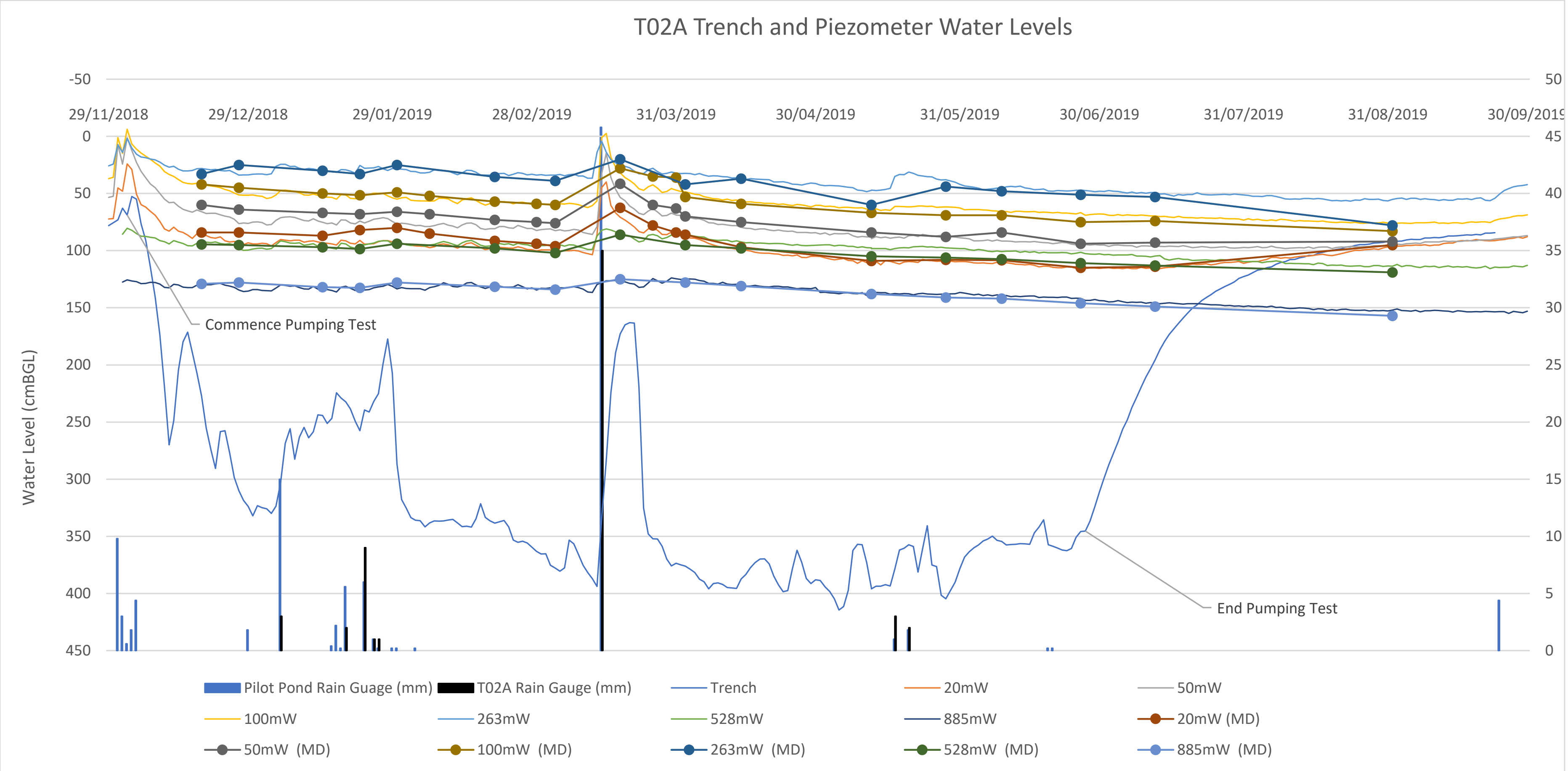


Figure 5 – Trench 02A piezometers-water levels

3.1.5 Groundwater Chemistry

A total of 122 groundwater samples were taken from Trench 02A and the surrounding piezometers. Samples were taken at regular intervals throughout the duration of the pumping test. Samples were assayed for total dissolved solids and a suite of target ions. A plot of trench and monitoring piezometers assay results are presented in Appendix C and Appendix D. Comments for the annotations are presented in Table 2.

3.1.6 Results and discussion

3.1.6.1 Drawdown and yield trends

- Data loggers were installed at T02A approximately one week before the pump test commenced. This was so that baseline water levels could be recorded. The initial increasing and decreasing water level trend observed in the trench and monitoring piezometers during this period was due to rainfall inundation of the surface of the lake surrounding T02A. This rainfall even was recorded by both the Pilot Pond weather station and trench rain gauge.
- Throughout the course of the pumping test, several pump stoppages occurred and resulted in fluctuations of the trench water level. Flow rates were temporarily increased following a pump failure to lower the trench water level and re-stabilize the test. Overheating of the pumping equipment was the primary source of equipment failure as the daytime atmospheric temperatures during the first 4 months of the test frequently exceeded 45°C. Some of the pump stoppages coincided with rainfall events which indicates that rainfall may have also affected the pumping equipment. Several mechanical failures were also experienced during the test.
- An isolated 45 mm rainfall event on the 15th March 2019 resulted in the pump failing and the trench flooding. The water level of the trench rose to ground level as a result of the rainfall (annotation 6 on Figure 3). Following this event, the trench pumping rate was increased to draw down the water level to re-establish the pre-storm trench water level. The piezometers recorded groundwater levels at or above the lake surface. In the month following the inundation event, the groundwater level gradually stabilized back to pre-inundation levels.
- Drawdown trends in the monitoring piezometers showed very gradual responses to trench level fluctuations. This is due to the low hydraulic conductivity and permeability of the near surface lake bed sediments in this region of the lake.
- At the conclusion of the pumping test, the pump was switched off and the trench water level allowed to recover back to pre-pumping levels. All data loggers within the monitoring piezometers remained in place for the duration of the recovery period. The trench water level rapidly recovered over a period of approximately 18 days. A delayed and slow recovery response in the 20 m and 50 m piezometers was observed once the trench water level had recovered over approximately 2 weeks.
- The remaining monitoring piezometers continued to show a steady decreasing trend in water levels until the next rainfall event in early September 2019.

3.1.6.2 Chemistry

- Groundwater chemistry results for the trench and surrounding piezometers showed no significant overall change as a result groundwater abstraction during the pumping test.

- Trench groundwater sample concentrations were initially elevated at ~280,000 mg/L and experienced some fluctuations due to rainwater dilution because of two rainfall events (8.4 mm and 45 mm, respectively) that occurred during the test. The concentration stabilized at ~260,000 mg/L following four months of pumping.
- No defined salinity gradient was identified between T02A and the adjacent island. Salinity between the trench and 263mW monitoring bore are between 200,000 mg/L and 260,000 mg/L. There is a decrease in the island bores, 528mW and 885mW, to between 114,000 mg/L and 162,000 mg/L (Appendix H).(*Note, the T02A island classification (small) is not the same as the T13 island (landform) classification).*

Table 2 -T02A TDS chart annotations (see Appendix C)

Annotation	Comment
1	Trench concentration recovering following a 19.6 mm rainfall event over 5 days
2	Concentration decrease following 8.4 mm rainfall over 4 days resulting in localised inundation at the trench.
3	Concentration decrease following severe 45.8 mm rainfall event resulting in localised inundation at the trench.

3.1.6.3 Island impacts

- No variation in island groundwater chemistry was observed throughout the pumping test.
- 885mW piezometer showed no response to the pumping test. All fluctuations detected are part of lake wide seasonal trends in response to evaporation and rainfall recharge.

MEMO

Plate 1: (A) T02A prior to commencing pumping test, (B) Water level during pumping test, (C) Pumping equipment, (D) T02A rain gauge, inundated lake surface in background, (E) Trench after inundation event, (F) Monitoring piezometer data download.

3.2 T13

3.2.1 Location

T13 is located in the north eastern region of the lake, adjacent to one of three landform islands. See

Appendix B – T13 location and piezometer layout.

3.2.2 Pump test setup

- Generator and submersible pump
- Flex drive pump
- Flow meter
- 500m discharge lay flat hose

3.2.3 Pumping test methodology

The pumping test commenced on the 3rd of December 2018. The first stage of the pumping test involved lowering the trench water level to below the baseline groundwater level. The static trench water level was 0.86 m bgl and was lowered to 2.45 m bgl in the first 30 days of the pump test. Once the target water level had been achieved, the flow rate was reduced to match the groundwater inflow rate. The initial steady state trench flow rate was approximately 1.20 L/sec and was further reduced to 1.10 L/sec as the test progressed. Flow rates over the duration of the test are presented in Figure 6.

The flow rate was adjusted if an increase or decrease in the trench water level was detected. The trench flow rate and water level and piezometer water levels were measured and recorded at regular intervals throughout the duration of the pumping test. Pumping equipment failures resulted in periods of time when the abstraction rate was zero, resulting in fluctuations in the trench water level. Following a period of no pumping, the flow rate of the pump was increased to lower the trench water level and restabilize the test.

The test was ended on the 2nd June 2019 following 184 days of pumping. Monitoring of the trench and piezometer recovery water levels continued after the pumping had ended. Hydrographs for the T13 pumping test are presented in Figure 7 and Figure 8. (MD stands for 'manual dip' measurement).

Table 3 – T13 water level annotation comments (see Figure 6)

Annotation	Comment
1	High flow rate at beginning of test to draw down trench water level
2	Flow rate decreased due split in suction hose
3	Pump off due to mechanical issue
4	Pump off due to mechanical issue, pump replaced
5	Pump off due to mechanical issue
6	Flow rate increased to draw down trench water level
7	Flow rate reduced to stabilize trench water level
8	Pump off due to mechanical issue, pump replaced
9	Pump off due to mechanical issue, pump replaced
10	Flow rate increased to draw down trench water level
11	Reduce flow rate to stabilize trench water level
12	Pump off due to mechanical issue
13	Increase flow rate to draw down trench water level
14	Reduce flow rate to stabilize trench water level

MEMO

3.2.4 Pumping test data

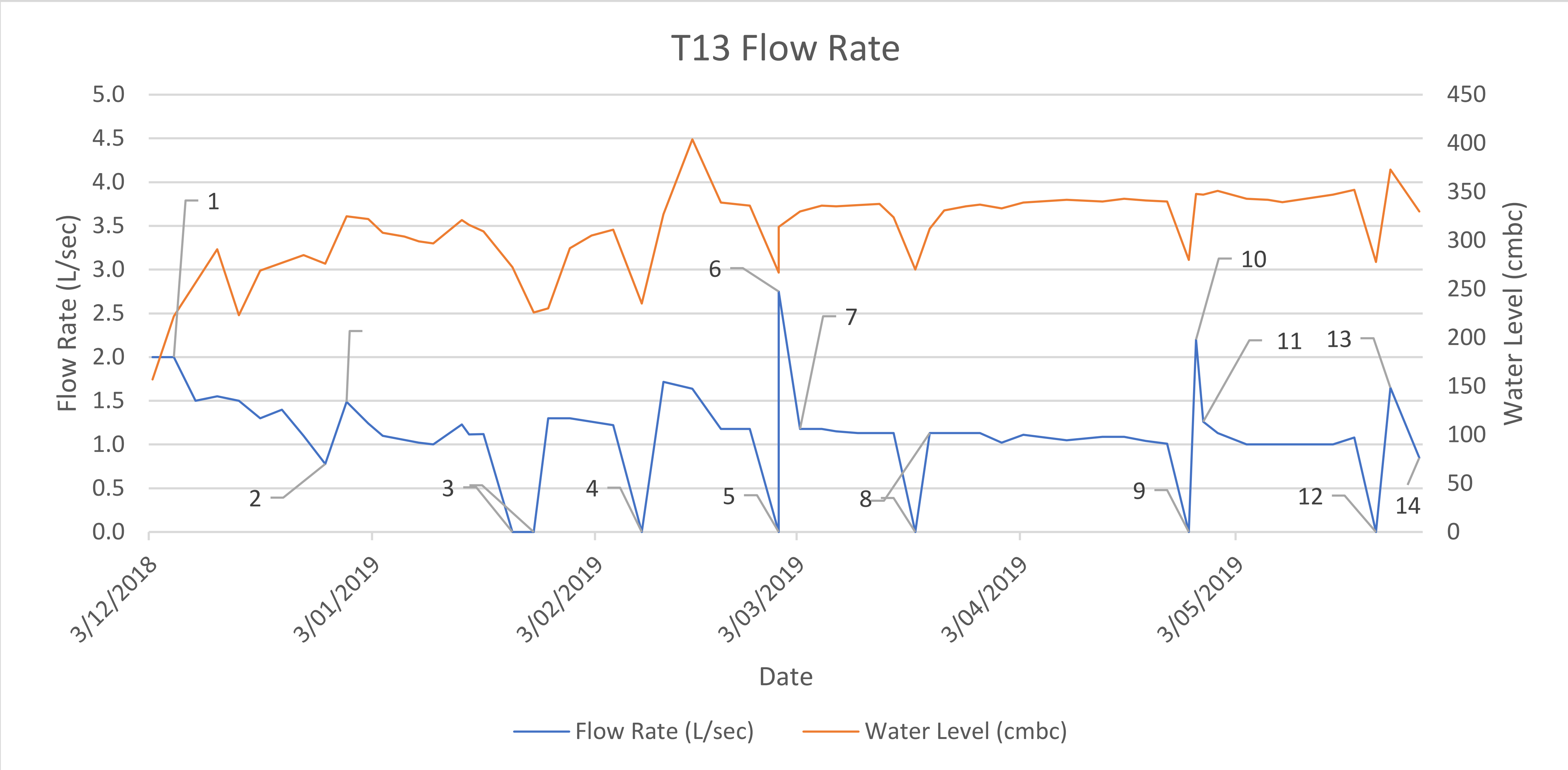


Figure 6 – Trench 13 pumping test flow rate graph

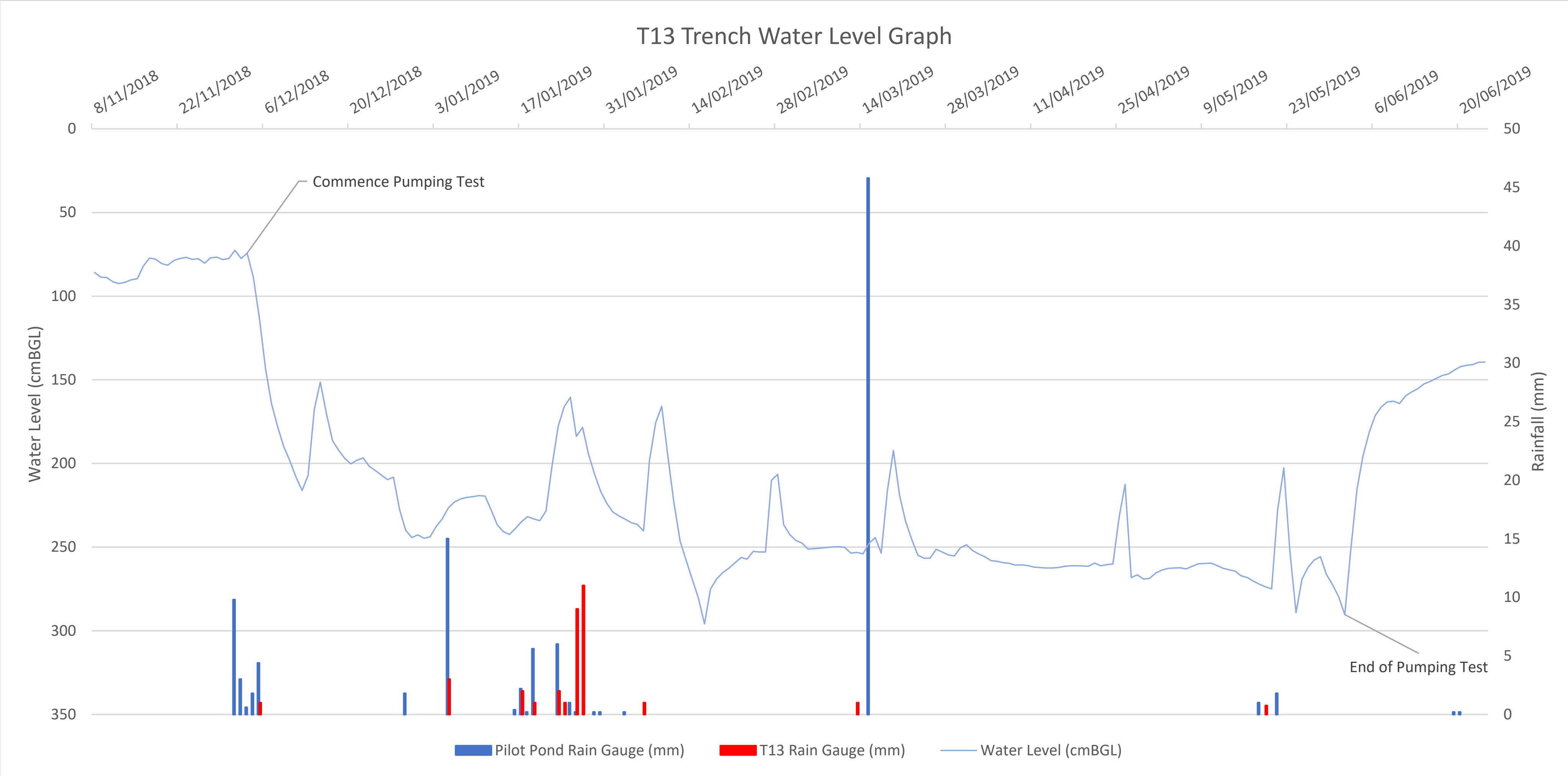


Figure 7 – Trench 13 data logger plot

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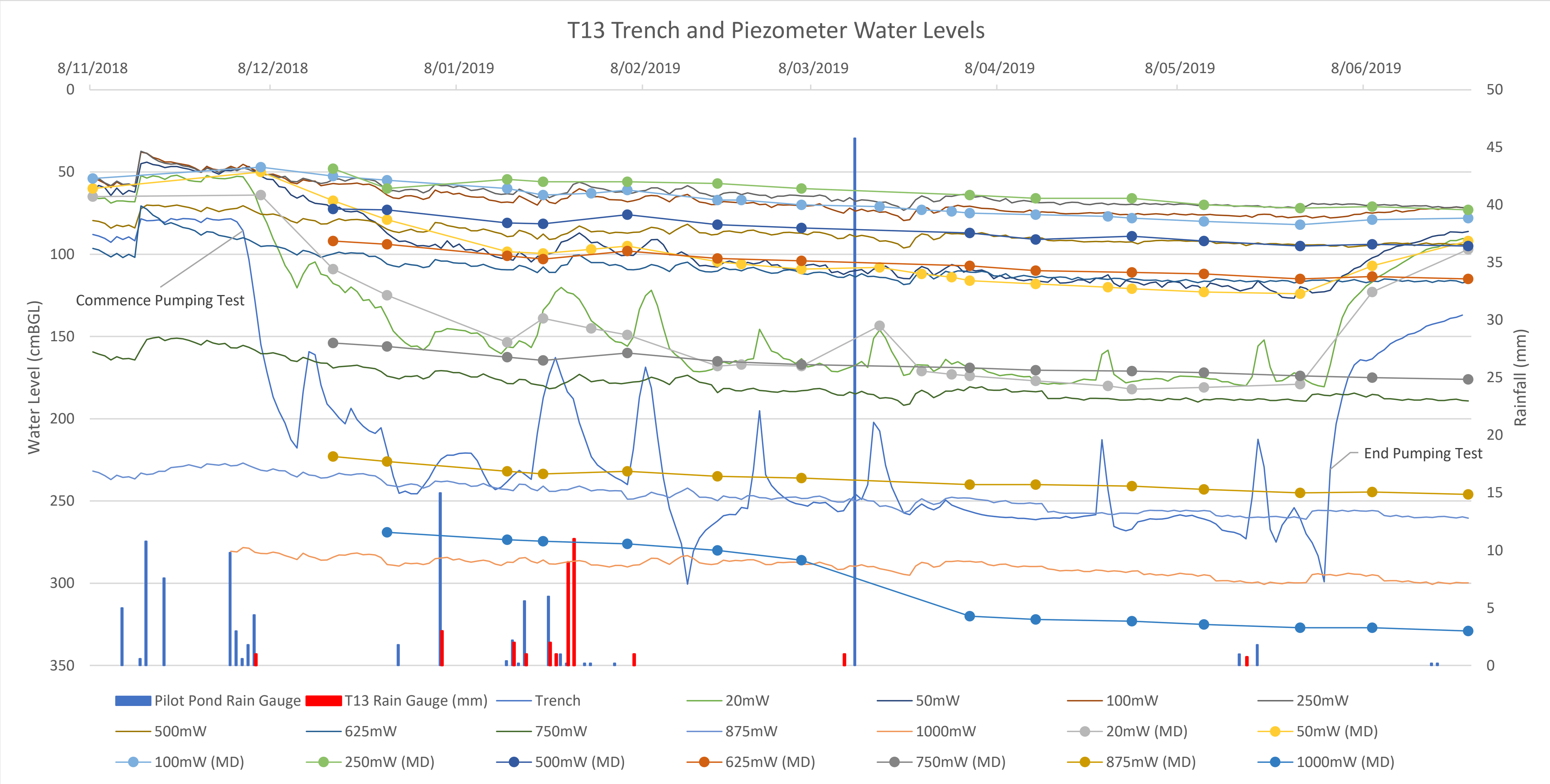

Figure 8 – Trench 13 piezometer graph

3.2.5 Groundwater chemistry

A total of 135 groundwater samples were taken from T13 and the surrounding piezometers. Samples were taken at regular intervals throughout the duration of the pumping test. Samples were assayed for total dissolved solids and a suite of target ions. A plot of trench and monitoring piezometers assay results are presented in Appendix E and Appendix F. Comments for the annotations are presented in Table 4.

3.2.6 Results and discussion

3.2.6.1 Drawdown and yield trends

- The near surface lakebed sediments in the eastern region of the lake where T13 is located have higher permeability due to the higher coarse sand content in the upper 3m. The steady state pumping test flow rate was approximately 1.0 L/s.
- Drawdown due to pumping was observed to extend out to the 500mW piezometer. This lateral drawdown extent is due to the higher hydraulic conductivity of the sediments in the eastern section of the lake.
- The monitoring piezometers located in the riparian zone leading onto the island adjacent to T13 (625mW, 750mW, 875mW and 1000mW) showed no response to trench pumping drawdown. The gradual declining water level trend observed in the hydrographs for these monitoring points is part of a lake wide declining groundwater level trend associated with below average seasonal rainfall.
- When the pumping test was terminated, the trench recorded a rapid initial water level recovery over a period of ~6 days, followed by a more gradual increase for the remainder of the recovery period. This sharp recovery trend was due to the high hydraulic conductivity of the lake sediments. The recovery trend in the 20mW piezometer closely reflected the trench trend due to its close proximity and the high hydraulic conductivity. The 50mW, 100mW, 250mW and 500mW monitoring piezometers all showed more gradual recovery rates, with the steepness of the trends decreasing with distance from the trench.

3.2.6.2 Chemistry

The initial brine sample taken at the beginning of pumping (1) returned an elevated concentration due to the water in the trench being evapoconcentrated in the period leading up to the pumping test. The concentration decreased to levels reflective of true groundwater chemistry once the evapoconcentrated water had been displaced from the trench (2). The chemistry of the trench remained consistent for the duration of the test with no major fluctuations observed.

Table 4 – T13 chemistry plot comments (see Appendix E)

Annotation	Comment
1	Initial high concentration due to evaporation of standing water in trench
2	Trench brine concentration decrease following displacement of evapoconcentrated brine.

Groundwater salinity in the monitoring piezometers between T13 and the island piezometer 1000mW (MC13) indicated the presence of a decreasing salinity gradient (Figure 9, Appendix F and Appendix G). The lake groundwater salinity was ~225,000 mg/L in the 20mW, 50mW and 100mW monitoring piezometers. Between the 250mW and 750mW monitoring piezometers the salinity decreased from 200,000 mg/L to 65,000 mg/L. These points are located in the riparian zone and correspond to a gradual increase in elevation. The salinity decreases to between 32,000 mg/L and 42,000 mg/L in the 875mW and 1000mW monitoring piezometers.

The 1000mW (MC13) monitoring piezometer is drilled through island sediments into lakebed sediments. It is thought that the water column in the bore is stratified, with less saline water sitting atop more saline water at depth. The brine sampling technique used to obtain all samples with a salinity average of ~40,000 mg/L was completed by lowering a PVC bailer into the water in the upper most zone of the casing. This resulted in a discrete water sample taken from the water column.

It is likely that the three anomalous samples (between 61,000 mg/L and 89,000 mg/L TDS) are as a result of lowering the bailer to the bottom of the hole resulting in a composite sample made up of a mix of more saline lake water and lower salinity island sediment water.

3.2.6.3 Island impacts

No direct impact from the long-term pump test was detected in the monitoring bores on the island adjacent to T13. A gradual decreasing water level trend was observed in the island monitoring bores which is associated with a seasonal water level fluctuation observed in all the on-lake monitoring piezometers.

4. Conclusions

Results from the two long term pumping tests were successful in providing drawdown data for the development of the lake groundwater model.

No directly obvious groundwater drawdown was observed within the piezometers installed on the lake islands during the pumping tests. All groundwater fluctuations on the islands are a result of seasonal fluctuations in response to rainfall infiltration and evapotranspiration process.

Trench and piezometer chemistry monitored through the wet season and during recharge events, indicates that the effects of dilution are limited, and the TDS concentration of the groundwater returns to baseline levels shortly after the inundation event. Sampling of the piezometers between T13 and the adjacent island was successful in identifying a decreasing salinity gradient toward the island.

On going monitoring of lake and island groundwater levels and regional and local precipitation will continue for the foreseeable future. Hydrographs will be updated on a quarterly basis.

Further island and riparian zone hydrogeological investigations, including drilling and pump testing are planned for 2021. Specific island groundwater models will also be developed.

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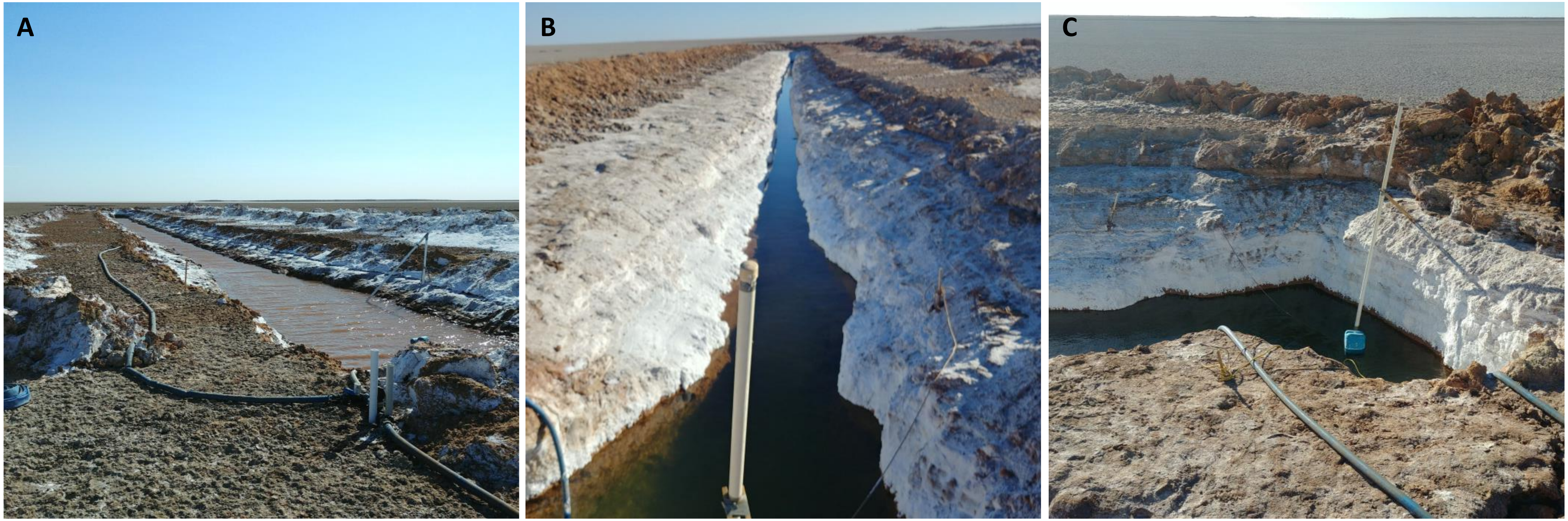

Plate 2: (A) T13 prior to commencing pumping test, (B) Water level during pumping test, (C) Trench monitoring piezometer.

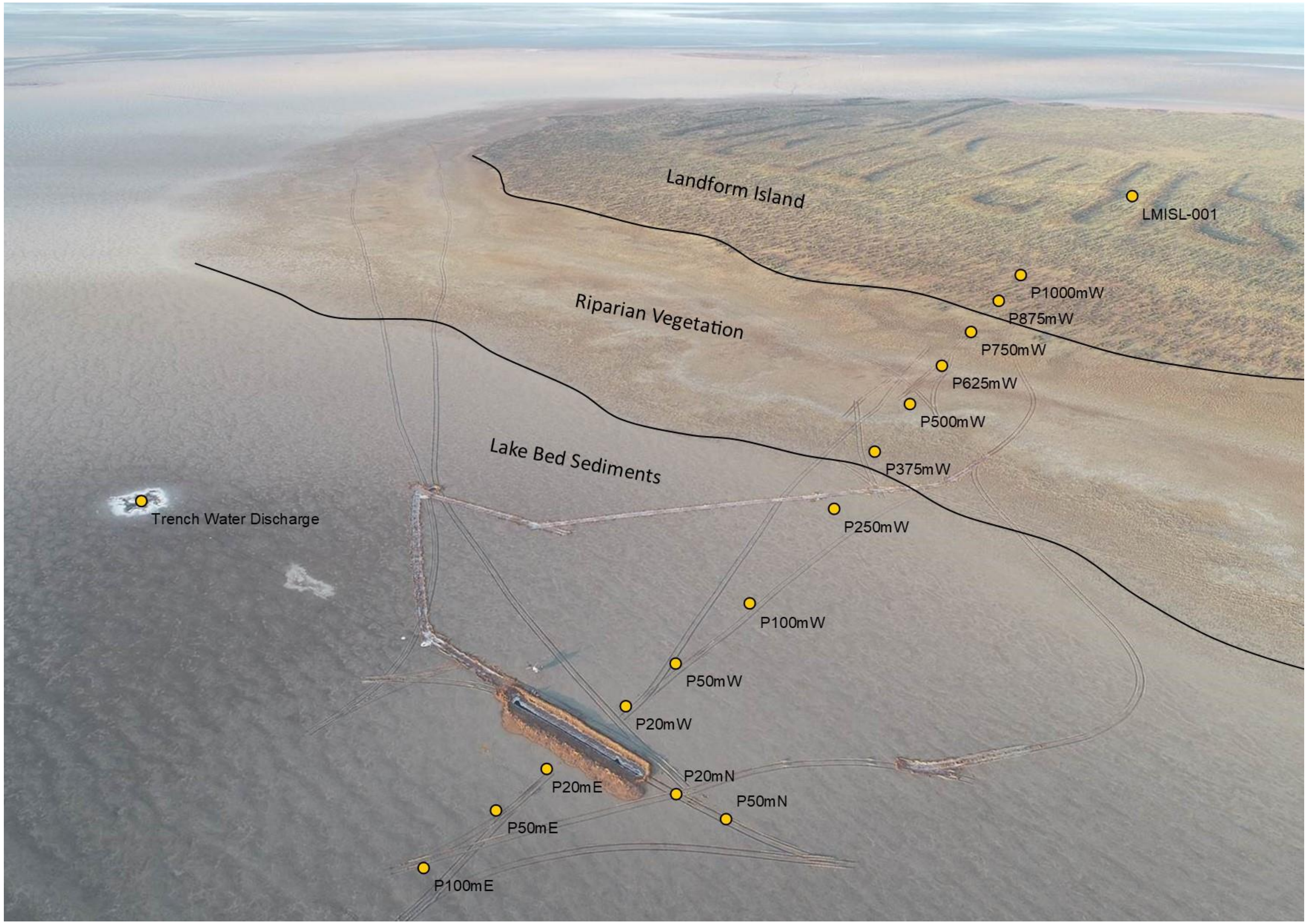

Figure 9 - T13 trench and piezometer layout

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5. Appendices

Appendix A- T02A location and piezometer layout.

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Appendix B – T13 location and piezometer layout

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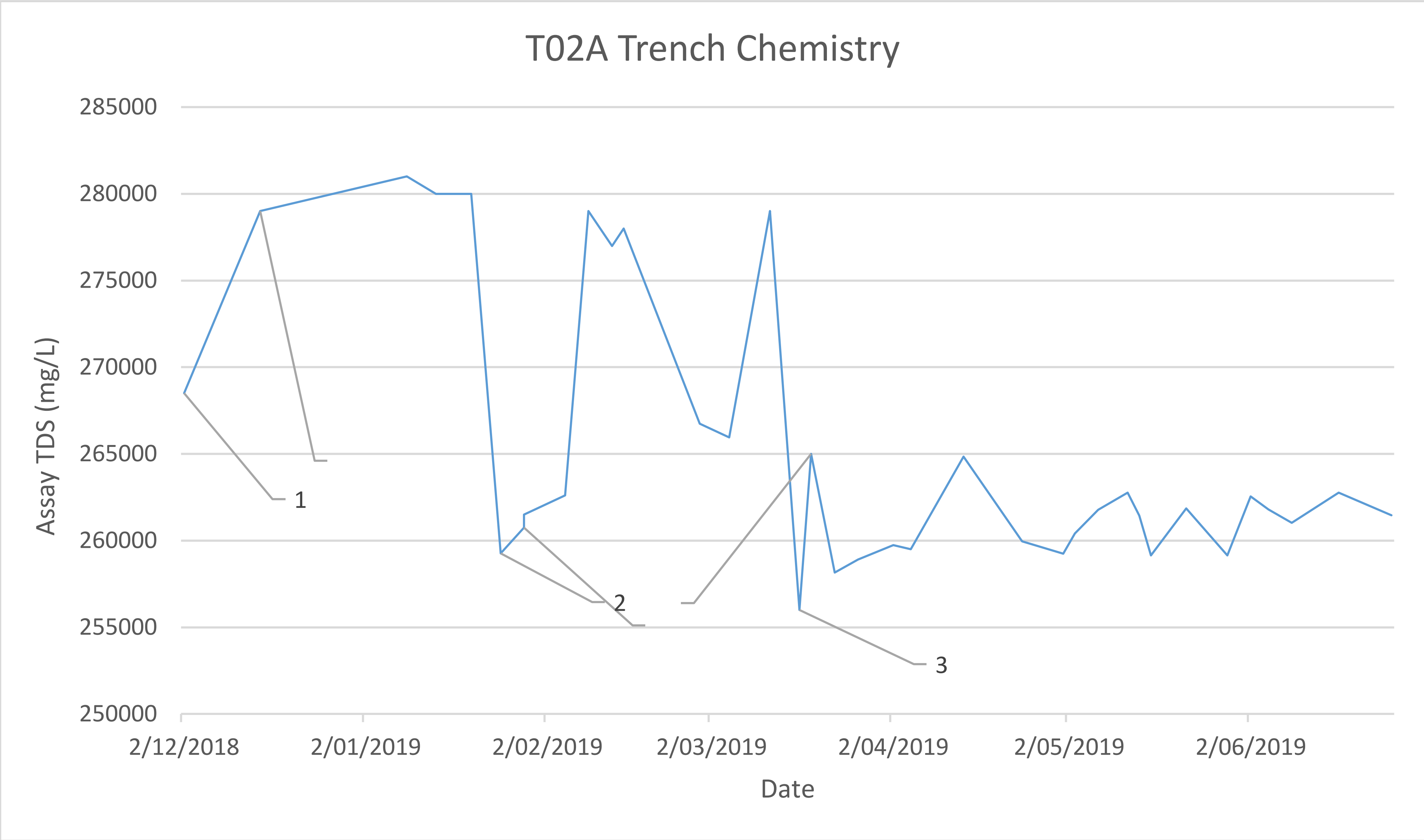
Appendix C – T02A pumping test trench chemistry



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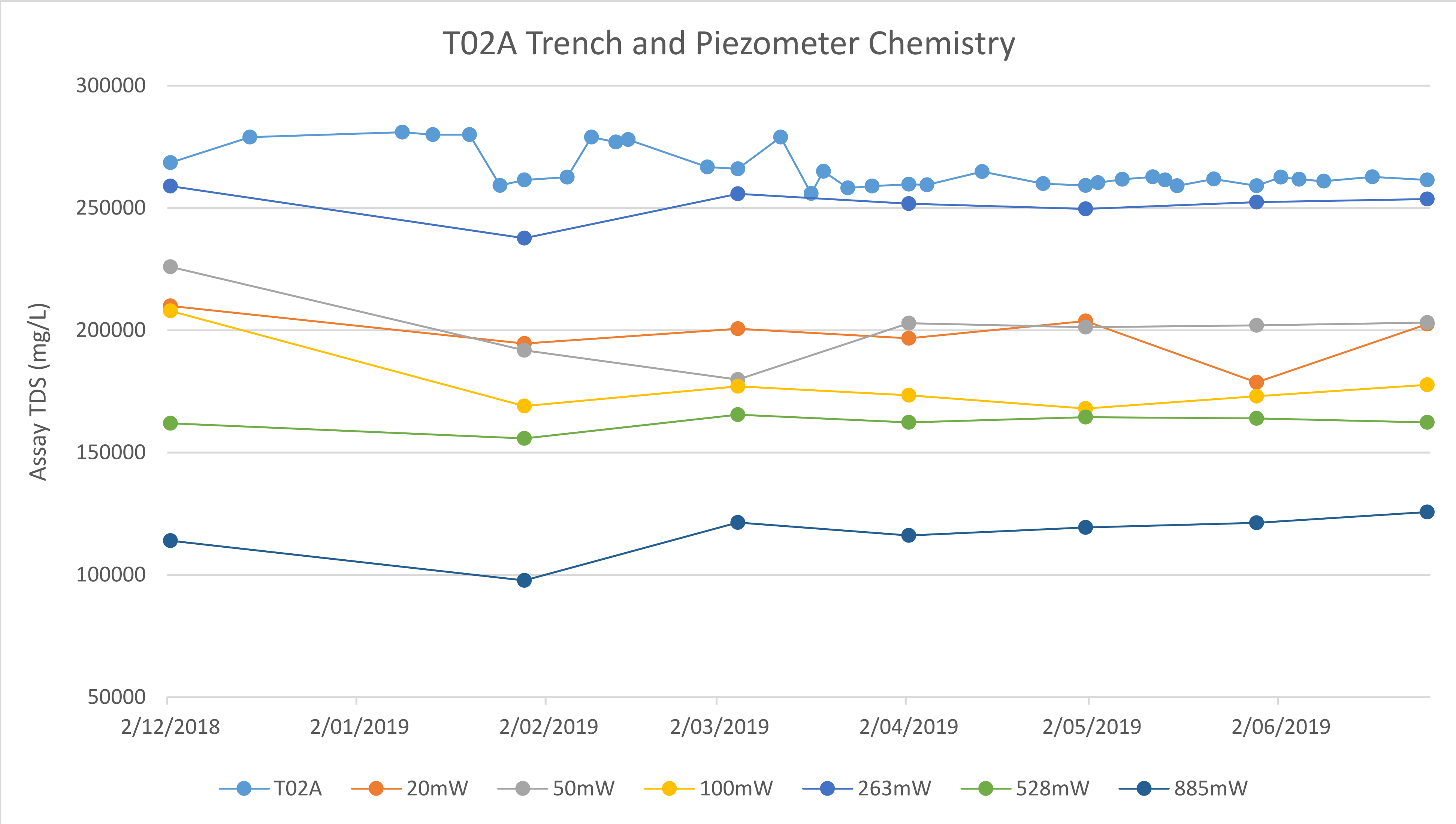
Appendix D – T02A piezometer chemistry



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Appendix E – Trench 13 chemistry

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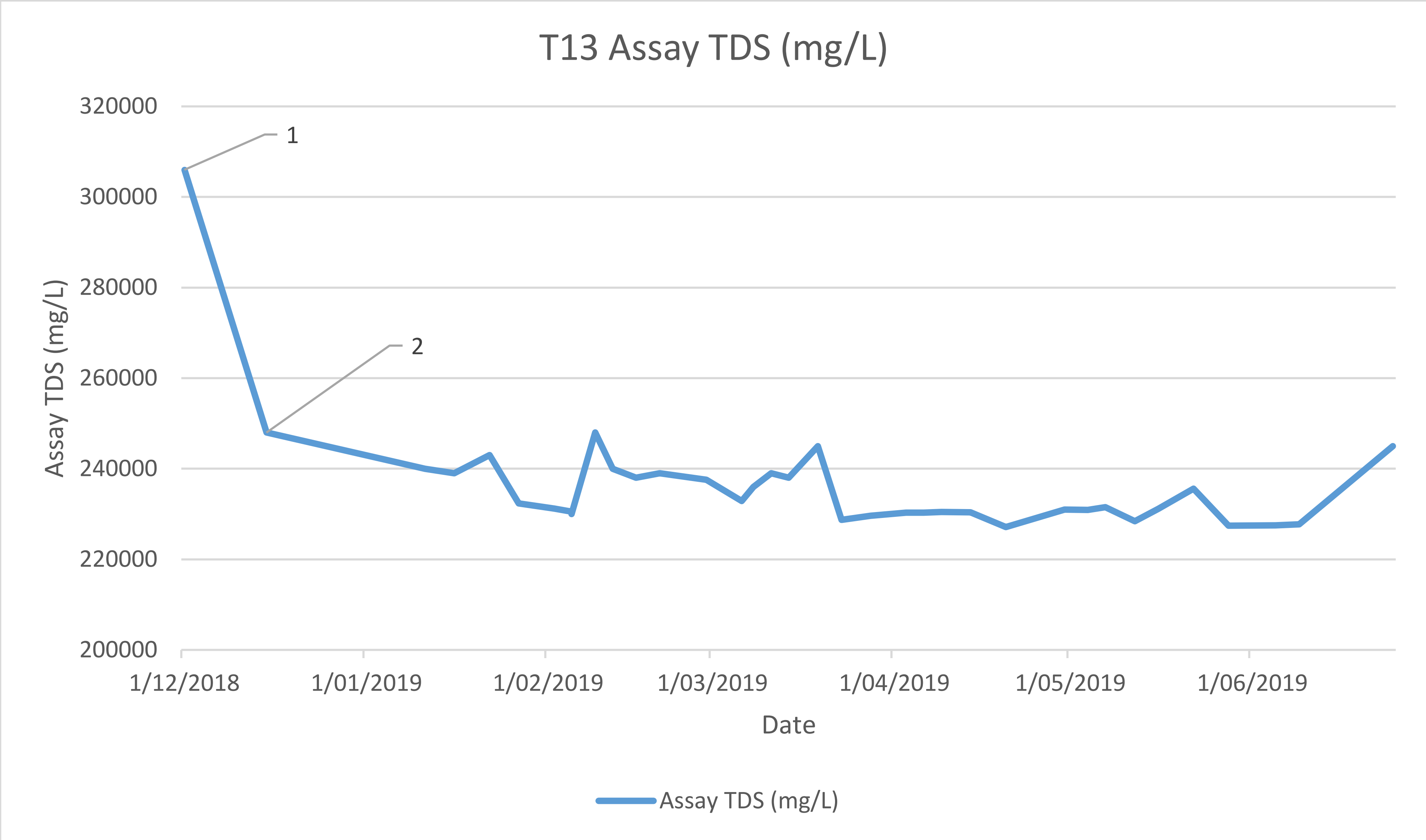
Appendix E



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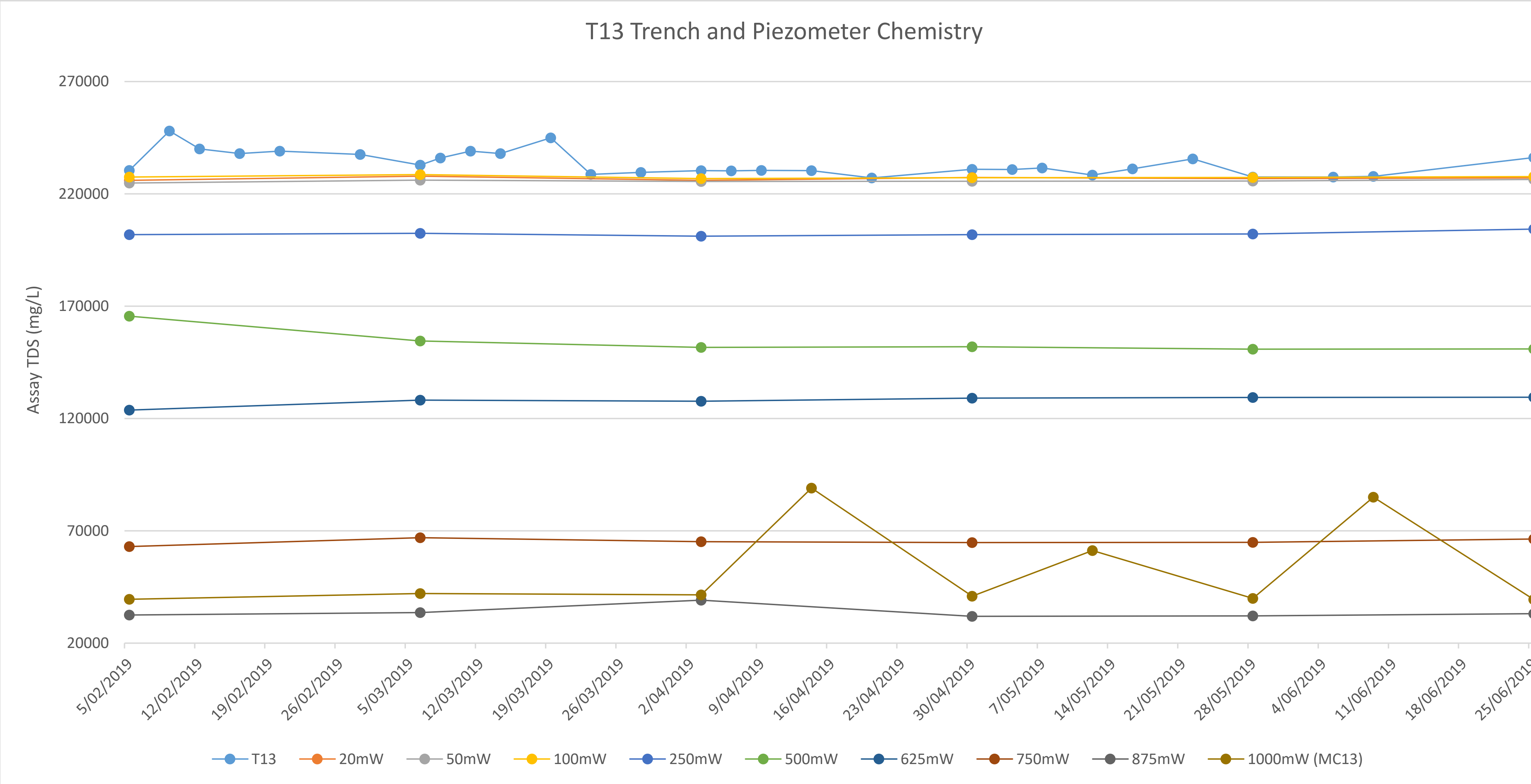
Appendix F – T13 trench and piezometer chemistry



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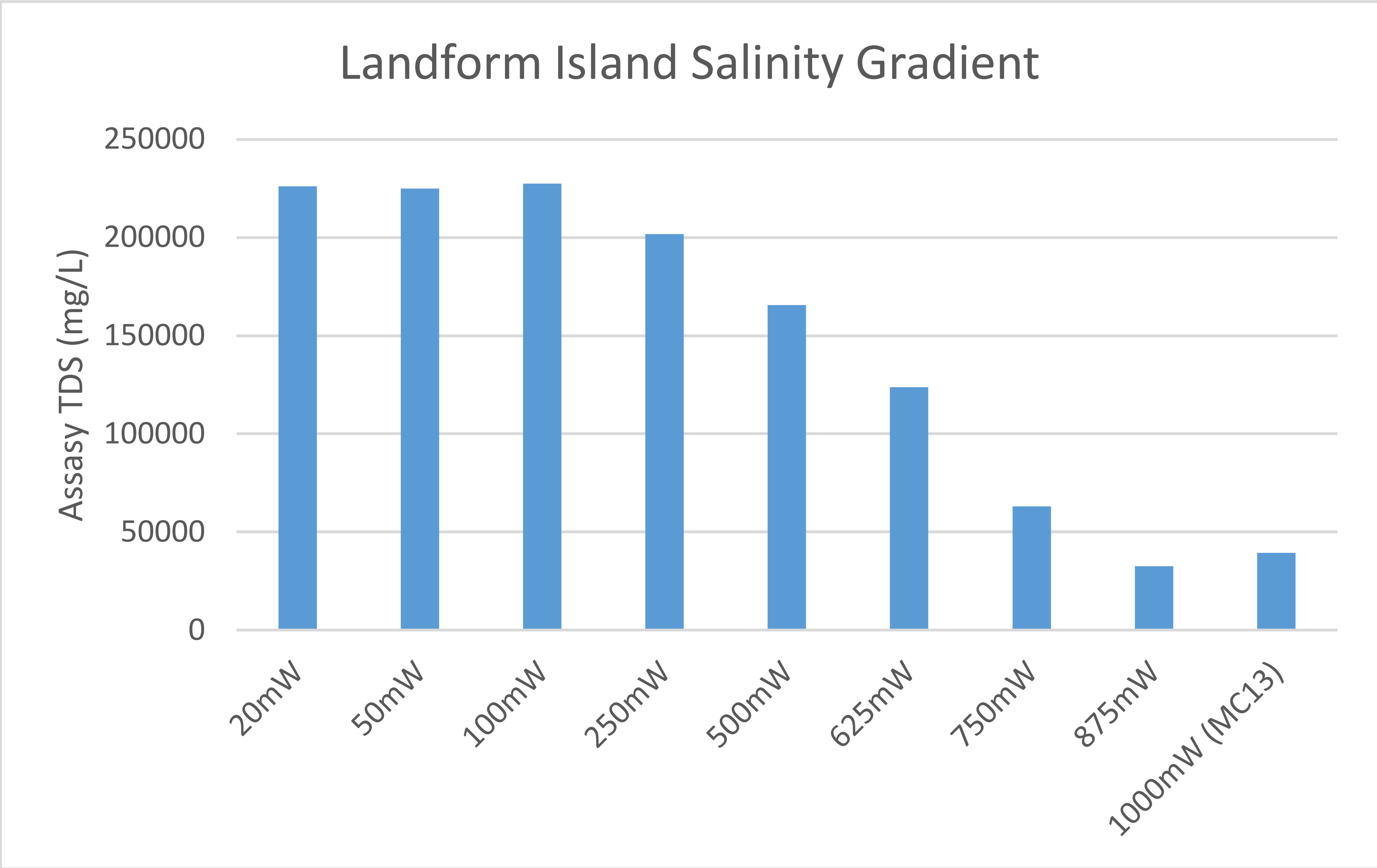
Appendix G – T13 piezometer salinity gradient



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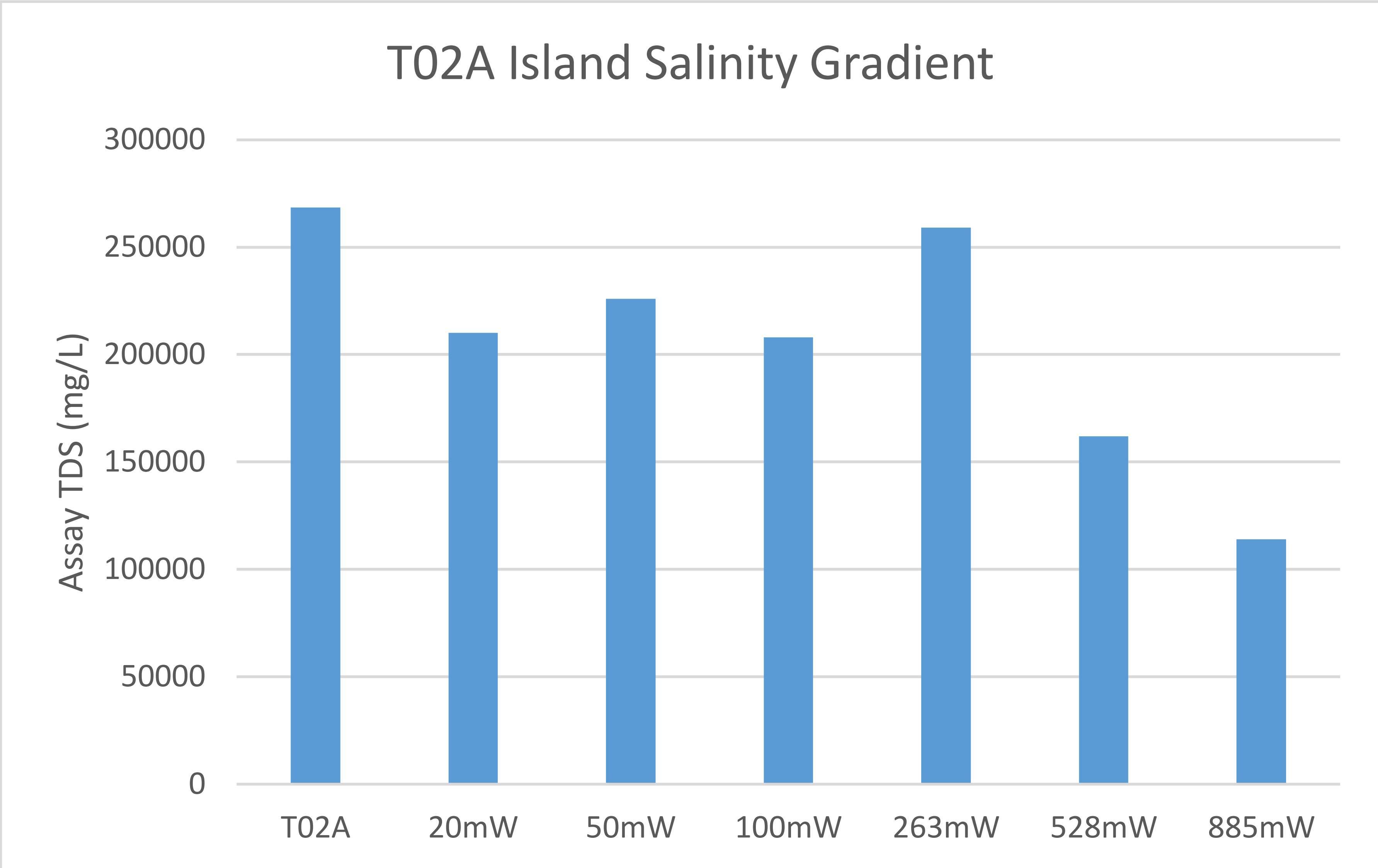
Appendix H – T02A piezometer salinity gradient



Appendix D Monitoring Bores Trigger and Threshold Criteria

Lake Island Groundwater Monitoring Program

Island Classification	Potentially Sensitive Receptor	New Monitoring Bores	Additional Groundwater / Stygofauna Monitoring Bores	Location	5-Year			10-Year			15-Year			20-Year		
					Predicted Drawdown (m)	Early Warning Trigger (Drawdown m)	Action Threshold (Drawdown m)	Predicted Drawdown (m)	Early Warning Trigger (Drawdown m)	Action Threshold (Drawdown m)	Predicted Drawdown (m)	Early Warning Trigger (Drawdown m)	Action Threshold (Drawdown m)	Predicted Drawdown (m)	Early Warning Trigger (Drawdown m)	Action Threshold (Drawdown m)
Landform Island	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW01	LMISL01^, MC13^, T13-H-011	Eastern side of landform island, approx. 250m west of test trench MT13 (and 1.7km east of island monitoring bore LMISL01), **on-lake bore**.	0.16	2.0	3.0	0.16	2.0	3.0	0.83	2.0	3.0	0.67	2.0	3.0
	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW02		Eastern side of landform island, approx. 750m west of trench network MT13 (and 1.2km east of island monitoring bore LMISL01), **riparian zone bore**.	0.36	2.0	3.0	0.36	2.0	3.0	0.75	2.0	3.0	0.65	2.0	3.0
Landform Island	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW03	LMISL02^	Western side of landform island, approx. 1.1km west of existing island monitoring bore LMISL02, **on-lake bore**.	-0.02	2.0	3.0	-0.02	2.0	3.0	-0.01	2.0	3.0	-0.01	2.0	3.0
	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW04		Western side of landform island, approx. 800m west of existing island monitoring bore LMISL02, **riparian zone bore**.	-0.01	2.0	3.0	-0.01	2.0	3.0	0.00	2.0	3.0	0.00	2.0	3.0
Large Island	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW05	LMISL03^	Eastern side of large island, 500m northwest of test trench MT09 (and 1.4km southeast of island monitoring bore LMISL03), **on-lake bore**.	2.00	2.0	3.0	1.82	2.0	3.0	1.39	2.0	3.0	1.07	2.0	3.0
	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW06		Eastern side of large island, 500m northwest of test trench MT09 (and 1km southeast of island monitoring bore LMISL03), **riparian zone bore**.	1.63	2.0	3.0	1.54	2.0	3.0	1.24	2.0	3.0	0.98	2.0	3.0
Large Island	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW07	LMISL05+, MC05*	Southern side of landform island, 1.3km south of proposed island monitoring bore LMISL05, **on-lake bore**.	0.32	2.0	3.0	0.44	2.0	3.0	0.29	2.0	3.0	0.23	2.0	3.0
	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW08		Southern side of landform island, 900m south of proposed island monitoring bore LMISL05, **riparian zone bore**.	0.24	2.0	3.0	0.26	2.0	3.0	0.22	2.0	3.0	0.21	2.0	3.0
Landform Island	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW09	LMISL06+	South-eastern side of landform island, 1.2km southeast of proposed island monitoring bore LMISL06, **on-lake bore**.	0.05	2.0	3.0	0.07	2.0	3.0	0.02	2.0	3.0	-0.01	2.0	3.0
	Stygofauna (copepods) and Groundwater Dependent Vegetation (*Allocasuarina decaisneana*)	MBISLGW10		South-eastern side of landform island, 1km southeast of proposed island monitoring bore LMISL06, **on-lake bore**.	0.04	2.0	3.0	0.05	2.0	3.0	0.04	2.0	3.0	0.03	2.0	3.0
TOTAL: 18 BORES (10 new groundwater bores for triggers and thresholds, plus 6 existing bores and two new stygofauna bores to be drilled and monitored, providing additional data									**0**							

Note: Triggers and thresholds only apply to the 10 new monitoring bores. Refer to the IWEMP groundwater monitoring program (Appendix A) for detailed information; ^indicates existing monitoring bore;* indicates bore located on large island south of LMISL02; + indicates stygofauna monitoring bore to be drilled.

On-Lake Groundwater Monitoring Program

Mine Stage	Bore Name	BMU	Stage	Lake Location	2-Year			5-Year			10-Year			15-Year			20-Year		
					Pred. DD m	Trigger	Threshold	Pred. DD m	Trigger	Threshold	Pred. DD m	Trigger	Threshold	Pred. DD m	Trigger	Threshold	Pred. DD m	Trigger	Threshold
Stages 1 -2 (Year 2, 5 &10)	MC46	17	Stage 2	South western	0.31	2.00	3.00	0.30	2.00	3.00	0.30	0.00	3.00	0.29	2.00	3.00	0.28	2.00	3.00
	MC49	17	Stage 2	South western	0.21	2.00	3.00	0.21	2.00	3.00	0.21	2.00	3.00	0.21	2.00	3.00	0.21	2.00	3.00
	T02AH-010	15	Stage 1	South western	0.88	2.00	3.00	0.81	2.00	3.00	0.71	2.00	3.00	0.48	2.00	3.00	0.31	2.00	3.00
	LV15	15	Stage 1	South western	0.75	2.00	3.00	0.69	2.00	3.00	0.60	2.00	3.00	0.38	2.00	3.00	0.27	2.00	3.00
	LV01	12	Stage 2	South central	0.16	2.00	3.00	0.16	2.00	3.00	0.16	2.00	3.00	0.16	2.00	3.00	0.16	2.00	3.00
	T02AH-013	12	Stage 2	South central	0.70	2.00	3.00	0.65	2.00	3.00	0.56	2.00	3.00	0.37	2.00	3.00	0.21	2.00	3.00
	LV09	9	Stage 1	South central	1.61	2.00	3.00	1.51	2.00	3.00	1.36	2.00	3.00	1.04	2.00	3.00	0.79	2.00	3.00
	LMD001	9	Stage 1	South central	0.88	2.00	3.00	0.81	2.00	3.00	0.70	2.00	3.00	0.44	2.00	3.00	0.28	2.00	3.00
	LV06	7	Stage 1	South eastern	1.45	2.00	3.00	1.36	2.00	3.00	1.21	2.00	3.00	0.90	2.00	3.00	0.66	2.00	3.00
	LV08	7	Stage 1	South eastern	1.67	2.00	3.00	1.57	2.00	3.00	1.43	2.00	3.00	1.11	2.00	3.00	0.86	2.00	3.00
	LV05	6	Stage 1	South central	0.87	2.00	3.00	0.82	2.00	3.00	0.71	2.00	3.00	0.48	2.00	3.00	0.29	2.00	3.00
	MC30	6	Stage 1	South central	0.69	2.00	3.00	0.64	2.00	3.00	0.57	2.00	3.00	0.42	2.00	3.00	0.31	2.00	3.00
	MC06	3	Stage 2	South eastern	0.60	2.00	3.00	0.88	2.00	3.00	0.92	2.00	3.00	0.83	2.00	3.00	0.71	2.00	3.00
	MT08	3	Stage 2	South eastern	0.87	2.00	3.00	1.00	2.00	3.00	0.88	2.00	3.00	0.62	2.00	3.00	0.41	2.00	3.00
	MT11	2	Stage2	East central	0.04	2.00	3.00	1.51	2.00	3.00	1.44	2.00	3.00	1.14	2.00	3.00	0.89	2.00	3.00
	MA08	2	Stage2	East central	0.26	2.00	3.00	0.99	2.00	3.00	1.19	2.00	3.00	0.94	2.00	3.00	0.70	2.00	3.00
Stages 3-4 (Year 10, 15, 20)	MT02	14	Stage 3	West central	0.18	2.00	3.00	0.18	2.00	3.00	0.17	2.00	3.00	0.16	2.00	3.00	0.16	2.00	3.00
	LV21	14	Stage 3	West central	0.66	2.00	3.00	0.64	2.00	3.00	0.56	2.00	3.00	0.40	2.00	3.00	0.29	2.00	3.00
	MA06	11	Stage 4	Central	0.29	2.00	3.00	0.29	2.00	3.00	0.37	2.00	3.00	0.33	2.00	3.00	0.30	2.00	3.00
	MA23	11	Stage 4	Central	0.17	2.00	3.00	0.17	2.00	3.00	0.44	2.00	3.00	0.29	2.00	3.00	0.22	2.00	3.00
	MC31	8	Stage 4	Central	0.26	2.00	3.00	0.26	2.00	3.00	0.58	2.00	3.00	0.45	2.00	3.00	0.30	2.00	3.00
	MA21	8	Stage 4	Central	0.30	2.00	3.00	0.30	2.00	3.00	0.32	2.00	3.00	0.31	2.00	3.00	0.31	2.00	3.00
	MA18	5	Stage 3	Central	-0.03	2.00	3.00	0.90	2.00	3.00	0.86	2.00	3.00	1.10	2.00	3.00	0.79	2.00	3.00
	MC26	5	Stage 3	East central	0.14	2.00	3.00	1.13	2.00	3.00	1.37	2.00	3.00	1.06	2.00	3.00	0.80	2.00	3.00
	MC29	5	Stage 3	East central	0.21	2.00	3.00	0.86	2.00	3.00	1.04	2.00	3.00	0.81	2.00	3.00	0.61	2.00	3.00
	MC22	1	Stage 4	East central	0.15	2.00	3.00	0.18	2.00	3.00	0.19	2.00	3.00	1.27	2.00	3.00	1.00	2.00	3.00
	MC17	1	Stage 4	East central	0.20	2.00	3.00	0.24	2.00	3.00	0.25	2.00	3.00	1.22	2.00	3.00	0.98	2.00	3.00
Stage 5 (Year 10, 15, 20)	MA16	4	Stage 5	North eastern	0.18	2.00	3.00	0.18	2.00	3.00	0.18	2.00	3.00	0.31	2.00	3.00	0.26	2.00	3.00
	MC23	4	Stage 5	North eastern	0.26	2.00	3.00	0.26	2.00	3.00	0.26	2.00	3.00	0.26	2.00	3.00	0.26	2.00	3.00
	MC10	4	Stage 5	North eastern	-0.10	2.00	3.00	-0.09	2.00	3.00	-0.10	2.00	3.00	1.23	2.00	3.00	0.93	2.00	3.00
	MC34	10	Stage 5	North central	0.18	2.00	3.00	0.18	2.00	3.00	0.18	2.00	3.00	0.23	2.00	3.00	0.21	2.00	3.00
	MT19	10	Stage 5	North central	0.20	2.00	3.00	0.20	2.00	3.00	0.20	2.00	3.00	0.54	2.00	3.00	0.41	2.00	3.00
	MA24	13	Stage 5	North central	0.07	2.00	3.00	0.07	2.00	3.00	0.07	2.00	3.00	0.07	2.00	3.00	0.40	2.00	3.00
	MT18	13	Stage 5	North central	0.13	2.00	3.00	0.13	2.00	3.00	0.13	2.00	3.00	0.13	2.00	3.00	0.34	2.00	3.00
	MC38	16	Stage 5	North west	0.03	2.00	3.00	0.03	2.00	3.00	0.03	2.00	3.00	0.03	2.00	3.00	0.06	2.00	3.00
	MC41	16	Stage 5	North west	0.10	2.00	3.00	0.10	2.00	3.00	0.10	2.00	3.00	0.10	2.00	3.00	0.30	2.00	3.00
TOTAL: 36 BORES																			

Note: Refer to the IWEMP groundwater monitoring program (Appendix A) for detailed information.

DESIGN WITH COMMUNITY IN MIND

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of place and of belonging. That's why at Stantec, we always design with community in mind.

We care about the communities we serve—because they're our communities too. This allows us to assess what's needed and connect our expertise, to appreciate nuances and envision what's never been considered, to bring together diverse perspectives so we can collaborate toward a shared success.

We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

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