

Groundwater Impact Assessment

Proposed Mixed Use Development

173 – 178 Rickard Road, Leppington, NSW

Project No. 26157
Version 1

29 May 2026

Reditus Consulting Pty Ltd
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Groundwater Impact Assessment

173 – 183 Rickard Road, Leppington NSW 2179

PREPARED FOR: LEPPINGTON (1) 88 DEVELOPMENT PTY LTD

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Executive Summary

This Groundwater Impact Assessment (GIA) has been prepared by Reditus Consulting Pty Ltd (Reditus) on behalf of Leppington (1) 88 Development Pty Ltd (**the Applicant**) to address the project-specific Secretary's Environmental Assessment Requirements (SEARs) issued for the proposed State Significant Development Application (SSDA) SSD-99319962. The development is located at 173-183 Rickard Road, Leppington (the Site) and is located within the South West Growth Area (**SWGA**) within the Camden Local Government Area (**LGA**).

The project seeks detailed development consent for the construction of a mixed-use development to deliver Leppington Civic Centre, comprising shop top housing to support residential development and commercial land uses at 173 & 183 Rickard Road, Leppington.

- Specifically, the SSDA seeks consent for:
- Demolition and earthworks to prepare the site for future development.
- Delivery of new roads and approximately 6,500 sqm of open space.
- Delivery of 8 residential buildings to accommodate a total of 1493 units, comprising of:
 - Build to Sell Apartments: 864
 - Build to Rent Apartments: 412
 - Affordable Apartments 217 (representing circa 15% of total residential yield)
- Delivery of a 156-key hotel (non-residential).
- Approximately 40,500 sqm of non-residential Gross Floor Area (GFA).
- Loading and car parking facilities on the lower ground and basement levels.

The development will include the construction of a seven-level basement carpark encompassing the entire development footprint, with a finished floor level (FFL) of the lowest basement level of RL 64.0 mAHD. The bulk excavation level (BEL) of this basement is assumed to be 0.5 m deeper than the FFL, resulting in a BEL of RL 63.5 mAHD. The BEL of the 7-level basement will require excavation depths of up to approximately 37.5 m below the existing ground levels at the site.

Excavation works for the facilitation of a "Deep Soil Area" is also noted along the northern boundary of the development and is anticipated to require excavation to the first level of the basement (Basement 01). This equates to a FFL of RL 79.0 mAHD within this area, or a BEL of RL 78.5 mAHD (assuming this is 0.5 m deeper than the FFL).

The basement parking is proposed to be constructed as 'drained' basement; however, the deep soil drainage zone only needs to be dewatered during the construction process. It is anticipated that traditional sub-slab drainage systems and vertical strip drain behind the basement walls will be used during construction.

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 15 December 2025 issued for the SSDA (SSD-99319962). Specifically, this report has been prepared to respond to the SEARS requirement issued below.

ITEM	DESCRIPTION OF REQUIREMENT	SECTION REFERENCE
12. Ground and Water Conditions	• Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site and including soil erosion. • Where required provide a Groundwater Impact Assessment in accordance with relevant Groundwater Guidelines. If the proposed development is on land identified as having high salinity or acid sulfate soil potential in an EPI provide a Salinity Management Plan or Acid Sulfate Soil Management Plan that includes appropriate management measures and strategies.	Impact Assessment sections of this report (Sections 10 to 13)

Given the proposed SSD excavation will extend into the groundwater table, dewatering will be required. As such, the proposed development is an aquifer inference activity, requiring regulatory authorisation under the Water Management Act (WMA) 2000, within a Water Sharing Plan zone, identified as the Greater Metropolitan Region Groundwater Sources 2023 – Sydney Basin Central Groundwater Source.

The primary objectives of the Groundwater Impact Assessment are to:

- Provide details on the hydrological and hydrogeological setting of the site and a summary of key environmental factors relevant to construction and ongoing management of the proposed development.
- Provide details of the proposed development layout and construction design.
- Determine the potential impacts to surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourses.
- Predict dewatering extraction volumes required for the development works during construction.
- Determine the potential impacts of the dewatering activity to groundwater dependent ecosystems (GDEs), springs, water supply works and potential for subsidence impacts on nearby structures or infrastructure (through assessment against the Minimal Impact thresholds detailed under the NSW DPI (2012) Aquifer Interference Policy, WMA 2000, and the NSW DPE (2023) Groundwater Impact Assessment Criteria.
- Provide management and mitigation strategies to minimise adverse environmental impacts as a result of construction and ongoing operation of the development.

The findings of this report include characterisation of the existing environment at the site, a review of the of potential impacts to the surface water and groundwater environment from the proposed development, review of relevant legislation and policy relating to the development and mitigating measures for the identified impacts. The report considers the impacts that have the potential to adversely affect the surface water and groundwater in the context of the construction phase and the operational phase of the development.

Surface water run-off from the site is expected to flow towards two separate unnamed creeks, located approximately 45m northwest and 800m east of the site. It is anticipated that surface water will ultimately flow along the ephemeral waterways of Kemps Creek, and South Creek, before ultimately discharging into the Hawkesbury River, located approximately 38.5 km northwest of the site. Based on groundwater quality data collected at the site to date, groundwater discharged as part of the proposed dewatering activities will likely require treatment to meet the adopted discharge water quality guidelines.

A 3D numerical groundwater flow model was developed for the site, of which the groundwater impacts associated with the basement excavation have been primarily assessed. The model simulated inflow calculations and probable drawdown expectations during the construction phase and operational phase of the development. Given the absence of Groundwater Dependant Ecosystems (GDEs) and other groundwater users within the estimated drawdown extent of the proposed drained basement, impacts to these receptors were considered low risk.

A search of the NSW EPA Contaminated Land Register and the NSW EPA List of Notified sites did not identify any sites within a 1km radius of the site. The site is also not listed on the NSW EPA record of notices under Section 60 of the Contamination Land Management Act (1997), therefore it is unlikely that potentially contaminating activities would influence the status of soil / groundwater at the site.

It is noted that EI Australia is currently completing an intrusive investigation that includes the installation of groundwater monitoring wells to the BEL. Once completed, slug testing and groundwater monitoring will be conducted on these wells, and the 3D numerical model will be updated.

Based on the results from the numerical groundwater model completed for the site, the predicted long-term steady-state groundwater take was **8.9 ML/year**, whilst the predicted groundwater take during the construction phase (year 1) was **23.2 ML/year**. Reditus consider that the predicted groundwater inflows can be effectively managed under a 'drained basement' design, with the estimated inflows and drawdown meeting the relevant impact assessment criteria of 'Minimal Impact' under the AIP 2012 and WMA 2000.

It is noted that a Water Access Licence (WAL) and Water Supply Works Approval will likely be required for the ongoing operational phase dewatering activities given the expected inflow volumes exceed the 3 ML/year exemption limit.

Other potential impacts to surface water and groundwater during both the construction and operational phase of the proposed development including potential chemical spillages, increase in hardstand areas, increase in potentially



contaminating activities such as vehicle movement, incorrect soil stabilisation and other construction related impacts and are considered to be manageable with appropriate mitigation measures and management plans.

1 Introduction

This Groundwater Impact Assessment (GIA) has been prepared by Reditus Consulting Pty Ltd (Reditus) on behalf of Leppington (1) 88 Development Pty Ltd (**the Applicant**) to address the project-specific Secretary's Environmental Assessment Requirements (SEARs) issued for the proposed State Significant Development Application (SSDA) SSD-99319962. The development is located at 173-183 Rickard Road, Leppington (the Site) and is located within the South West Growth Area (**SWGA**) within the Camden Local Government Area (**LGA**).

The project seeks detailed development consent for the construction of a mixed-use development to deliver Leppington Civic Centre, comprising shop top housing to support residential development and commercial land uses at 173-183 Rickard Road, Leppington.

- Specifically, the SSDA seeks consent for:
- Demolition and earthworks to prepare the site for future development.
- Delivery of new roads and approximately 6,500 sqm of open space.
- Delivery of 8 residential buildings to accommodate a total of 1493 units, comprising of:
 - Build to Sell Apartments: 864
 - Build to Rent Apartments: 412
 - Affordable Apartments 217 (representing circa 15% of total residential yield)
- Delivery of a 156-key hotel (non-residential).
- Approximately 40,500 sqm of non-residential Gross Floor Area (GFA).
- Loading and car parking facilities on the lower ground and basement levels.

The site location and site layout is provided in **Figure 1** and **Figure 2, Appendix A** with an excerpt presented in Figure 1-1 below.

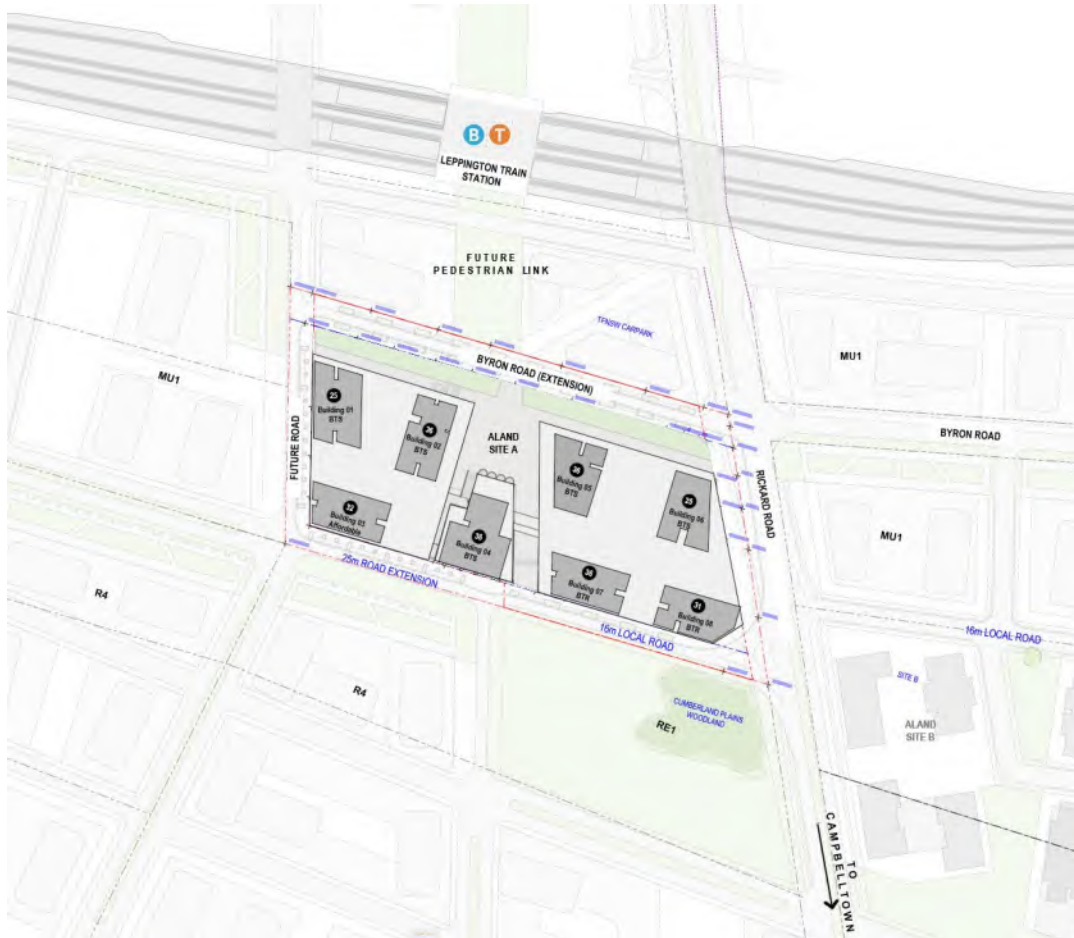


Figure 1-1 SSDA - Proposed Works

1.1 Response to SEARs

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 15 December 2025 issued for the SSDA (SSD-99319962). Specifically, this report has been prepared to respond to the SEARs requirement outlined in **Table 1-1** issued below.

1.1.1 CONSULTANTS STATEMENT

I, Sebastien McCulloch, confirm this Groundwater Impact Assessment addresses the requirements of SEARs No. 12 Ground and Groundwater Conditions and relevant state and local legislation, policies, and guidelines including those presented in **Section 4**. I further confirm that none of the information contained in the Groundwater Impact Assessment is false or misleading.

Table 1-1 SEARs Requirements

SEARS REQUIREMENT	DESCRIPTION OF REQUIREMENT	SECTION REFERENCE
12. Ground and Groundwater Conditions	- Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site and including soil erosion. - Where required provide a Groundwater Impact Assessment in accordance with relevant Groundwater Guidelines. If the proposed development is on land identified as having high salinity or acid sulfate soil potential in an EPI provide a Salinity Management Plan or Acid Sulfate Soil Management Plan that includes appropriate management measures and strategies.	Impact Assessment sections of this report (Sections 10 to 13)

1.2 Objectives

The primary objectives of the Groundwater Impact Assessment are to:

- Provide details on the hydrological and hydrogeological setting of the site and a summary of key environmental factors relevant to construction and ongoing management of the proposed development.
- Provide details of the proposed development layout and construction design.
- Determine the potential impacts to surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourses.
- Predict dewatering extraction volumes required for the development works during construction based on 3D numerical groundwater modelling.
- Determine the potential impacts of the dewatering activity to groundwater dependent ecosystems (GDEs), springs, water supply works and potential for subsidence impacts on nearby structures or infrastructure (through assessment against the Minimal Impact thresholds detailed under the NSW DPI (2012) Aquifer Interference Policy, WMA 2000, and the NSW DPE (2023) Groundwater Impact Assessment Criteria.
- Provide management and mitigation strategies to minimise adverse environmental impacts as a result of construction and ongoing operation of the development.
- Include an assessment of licencing conditions for the project.

1.3 Scope of Works

To meet the objectives of the Groundwater Impact Assessment, the following scope of works was undertaken:

- Review of proposed development drawings, excavation and construction plans.
- Review of applicable legislation, policy and guidelines.
- Establish existing environmental conditions from publicly available and site-specific data.
- Review of the proposed design features near waterways and surface water bodies.
- Completion of a qualitative assessment of the potential water quality impacts considering the following:
 - the existing water quality environment.
 - the potential pollutants and impacts to the water quality environment from construction and operation activities.
 - the effectiveness of the identified mitigation measures; and
 - any residual impacts post-mitigation and the likely performance against the water quality objectives.
- Analysis and interpretation of existing groundwater level data, hydraulic conductivity (slug test) data and water quality data previously collected from the site by both Reditus (2025) and EI (2026).
- Development of a groundwater elevation contour plan, interpretation of groundwater flow direction and assessment of the likely groundwater level fluctuations during the life of the building.
- Development of a Hydrogeological Conceptual Site Model (H-CSM) to replicate the hydrogeological stratigraphy, proposed excavation activity and proposed basement design.
- Completion of a 3D finite-difference numerical groundwater model (MODFLOW) using Groundwater Vistas software, to predict groundwater inflows and drawdown extent from the basement. This includes:
 - Development of a calibrated 3D groundwater model using MODFLOW to replicate current measured groundwater conditions (steady state “snapshot” model).
 - Expansion of the calibrated model to replicate proposed dewatering during construction and operation of the basement. This will be a transient (time varying) model, which will predict groundwater inflow rates over nominal assessment periods of construction and allow for long-term drained basement conditions, as well as provide estimates the extent of offsite groundwater drawdown (both lateral and vertical).
 - Completion of uncertainty and sensitivity analysis to identify the potential effect of inaccuracies in estimates of hydraulic properties of the aquifer.
- Discussion of the potential impacts to surface water and groundwater associated with the proposed development based on the predictions of groundwater inflows and offsite drawdown extent from the groundwater model and outline mitigation measures and management plans required for management of impacts.
- Preparation of a Groundwater Impact Assessment (Site Hydrogeological Report) in general accordance with the NSW DPI (January 2022) *Guidelines for Groundwater Documentation for SSD/SSI Projects - Technical guideline*; and the NSW DPI (October 2022) *Minimum requirements for building site groundwater investigations and reporting*; and the NSW DPI (2023) *Groundwater Impact Assessment Criteria*.

2 Methodology

2.1 General

The assessment of potential groundwater related impacts arising from the proposed development have been implemented as follows:

- Review of legislation, policies and guidelines relevant to groundwater impacts for the proposal as outlined in **Section 3**.
- Characterisation of the existing environment including:
 - Climate, topography, hydrology, geology, hydrogeology, water quality and sensitive receiving environments in order to review the potential impacts to surface and groundwater arising from the proposed development
- Completion of a 3D numerical groundwater model to assess inflows and drawdown extents.
- Assessment of potential groundwater related impacts to satisfy the minimal impact considerations of the NSW Aquifer Interference Policy (AIP) and NSW DPI (2023) *Groundwater Impact Assessment Criteria*
- Water quality assessment of surface and groundwater
- Recommendations for monitoring and management of identified impacts and risks, including mitigation measures as appropriate.
- The specific methodologies used for these components are described in the following sections.

2.2 Desktop Assessment

The desktop assessment undertaken in this report involved review of the existing environment within the proposed development boundary in order to assess potential impacts to flow (quantity) and quality of surface water and groundwater during the construction and ongoing operation as a result of the development.

The desktop assessment included review of background information, previous reports and proposed development information including:

- Sensitive environmental receptors near the proposed development including drainage lines, downstream receptors and watercourses, and groundwater dependant ecosystems (GDEs).
- Publicly available water quality information.
- Review of relevant legislation and guidelines.
- Review of the proposed basement footprint and the development at large.
- Publicly available and site-specific groundwater data.

2.2.1 PUBLICLY AVAILABLE DATA SOURCES

A list of publicly available data sources used for the desktop review as part of this assessment is provided in **Table 2-1** below.

Table 2-1. Summary of publicly available data sources

DATA DESCRIPTION	SOURCE
Groundwater users including Water Access License (WAL) holders and basic landholder rights bores	WaterNSW Water Register website (https://waterregister.watarnsw.com.au/water-register-frame)
Registered bore data	- WaterNSW real time data website (https://realtimedata.watarnsw.com.au/water.stm) - Bureau of Meteorology Australian Groundwater Explorer (http://www.bom.gov.au/water/groundwater/explorer/)
Groundwater dependent ecosystem's location and data	Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (http://www.bom.gov.au/water/groundwater/gde/)
Surrounding contaminated site locations	- The NSW Environmental Protection Authority (EPA) list of contaminated sites (https://www.epa.nsw.gov.au/your-environment/contaminated-land/notified-and-regulated-contaminated-land/list-of-notified-sites) - The NSW Environmental Protection Authority (EPA) contaminated land record website (https://app.epa.nsw.gov.au/prclmapp/searchregister.aspx) - The NSW Environmental Protection Authority (EPA) Protection of the Environment Operations Act (POEO) public register website (https://app.epa.nsw.gov.au/prpoeoapp/)
Regional geology data and mapping	Penrith 1:100,000 Geological Map Sheet 9030

2.2.2 REVIEW OF PREVIOUS INVESTIGATIONS

A review of relevant information relating to surface water and groundwater from previous investigations is summarised in **Table 2-2** below. The documents specific to the site utilised for this report include:

- El Australia (EI), (2026), Borelogs: BH1M – BH2M, 173 – 183 Rickard Road, Leppington, 12 May 2026.
- Environmental Consulting Services Group (ECS), (2025), Borelogs: BH1 – BH3, 173 – 183 Rickard Road, Leppington, 29 April 2025.
- DKO Architecture (DKO) (2026), State Significant Development Application – Updated Coordination Pack, 173-183 Rickard Road, Leppington NSW 2179, [Architectural plans], 22 May 2026.
- Reditus Consulting Pty Ltd (29 October 2024) Preliminary Hydrogeological Assessment, 173 and 183 Rickard Road, Leppington, (reference: 24302RP01, version 1)
- Reditus Consulting Pty Ltd (29 August 2025) Hydrogeological Assessment – Dewatering Management Plan, 173 and 183 Rickard Road, Leppington, (reference: 25122RP01, version 2)

Table 2-2. Summary of previous investigations

ITEM	DETAIL
PRELIMINARY HYDROGEOLOGICAL ASSESSMENT (REDITUS, 2024)	
Document Information	Preliminary Hydrogeological Assessment – 173 and 183 Rickard Road, Leppington 29 October 2024
Prepared by	Reditus Consulting Pty Ltd
Prepared for	Leppington (1) 88 Development Pty Ltd
Purpose	To support the Development Application (DA) for the proposed mixed use residential / commercial town centre development
Relevant Information	- During this investigation, steady-state analytical equations were utilised to provide an estimate of groundwater take and drawdown as a result of the development. Reditus predicted a total groundwater take of 2.466ML during construction in the first 12 months, with ongoing groundwater inflows of 0.786 ML/year after construction / excavation works were completed. - The preliminary predictions of drawdown in the surrounding aquifer for the “most likely” scenario of the western basement was <1 m beyond 5 m of the basement wall, and for the Eastern basement was <1 m beyond 8 m of the basement wall.
Findings and Recommendations	- It was noted that predictions of groundwater take and drawdown are preliminary in nature only and based on inferred aquifer parameters from publicly available data. As a result, this investigation provided the following recommendations: - A Dewatering Management Plan (DMP) was required prior to the commencement of any basement excavations and associated groundwater discharge during construction dewatering. The DMP will need to be completed in general accordance with the NSW DPE (2022) Minimum requirements for building site groundwater investigations and reporting guidelines. This is to include at a minimum: - Installation of groundwater monitoring wells to below the Bulk Excavation Level (BEL) - Completion of site-specific hydrogeological testing to provide estimates of site-specific hydraulic conductivity - Groundwater quality sampling event using low-flow sampling techniques and NATA accredited laboratory analysis. - Following the completion of the DMP, prepare and submit an application for a Water Supply Works and Water Use Approval to WaterNSW for the proposed basement developments. - In the instance that a drained basement is proposed and approved, a separate Long-term Groundwater Management Plan (LTGMP) will be required for the ongoing operation and management of the drained basement post the completion of construction works at the site. The LTGMP must be incorporated into the building management system, specifying the specific monitoring and reporting requirements required to be completed for the life of the building
DEWATERING MANAGEMENT PLAN (REDITUS, 2025)	
Document Information	Hydrogeological Assessment Dewatering Management Plan – 173 and 183 Rickard Road, Leppington 29 August 2025
Prepared by	Reditus Consulting Pty Ltd
Prepared for	Leppington (1) 88 Development Pty Ltd

ITEM	DETAIL
Purpose	To support the integrated development approval requirements under the Water Management Act 2000, NSW Aquifer Interference Policy 2012 and relevant Water Sharing Plans for the proposed drained basement of the Development Application.
Relevant Information	- The DMP provides relevant information on the hydrogeological setting, construction design, predictions of groundwater extraction volumes (based on 3D numerical groundwater modelling) and assessment of potential dewatering impacts. - The DMP also provides relevant management strategies to minimise the adverse environmental impacts including proposed water treatment system, environmental control procedures, monitoring programs, performance criteria and compliance reporting requirements.
Findings and Recommendations	- Reditus predicts a groundwater take of 3.42 ML during construction of the basement (i.e. excavation and establishment of the basement drainage system). After construction of the drained basement (i.e. operational period), the groundwater take will be 1.66 ML/year and decrease towards steady-state conditions at 1.27 ML/year over time. - Groundwater inflow rates will stabilise to near steady-state conditions within approximately 30 years of operation. - Based on the groundwater take and impact assessment, the dewatering activities are considered to be of Minimal Impact under the NSW DPI (2012) Aquifer Interference Policy, WMA 2000 and the NSW DPE (2032) <i>Groundwater Impact Assessment Criteria – Impact Assessment Criteria that apply to groundwater dealings and approval applications</i>. Reditus considers that the predicted groundwater inflows could be effectively managed under the proposed drained basement design. - Based on the results of the hydrogeological assessment and management protocols detailed within this DMP, prepared in general accordance with the NSW DPE (2022) <i>Minimum Requirements for Building Site Groundwater Investigations and Reporting</i> guidelines, Reditus consider that the proposed drained basement may be granted General Terms Approval (GTAs). Reditus also consider that this DMP meets the requirements to grant a 'Water Supply Work Approval' under the Water Management Act (2000).

2.3 3D Numerical Groundwater Modelling

- Development of a groundwater elevation contour plan, interpretation of groundwater flow direction and assessment of the likely groundwater level fluctuations during the life of the building.
- Review of existing lithology and groundwater level data, hydraulic conductivity (slug test) data and water quality data previously collected from the site by both Reditus (2025) and EI (2026).
- Development of a Hydrogeological Conceptual Site Model (H-CSM) to replicate the hydrogeological stratigraphy, proposed excavation activity and proposed basement design.
- A 3D finite-difference numerical groundwater model (MODFLOW) was then developed, to predict groundwater inflows and drawdown extent from the basement. This will include:
 - Development of a calibrated 3D groundwater model using MODFLOW to replicate current measured groundwater conditions (steady state "snapshot" model).
 - Expansion of the calibrated model to replicate proposed dewatering during construction and operation of the basement. This will be a transient (time varying) model, which will predict groundwater inflow rates over nominal assessment periods of construction and allow for long-term drained basement conditions, as well as provide estimates the extent of offsite groundwater drawdown (both lateral and vertical).
 - Completion of uncertainty and sensitivity analysis to identify the potential effect of inaccuracies in estimates of hydraulic properties of the aquifer.
- Assessment of model results against the NSW DPI (2012) Aquifer Interference Policy Minimal Impact assessment criteria and the NSW DPE (2023) Groundwater impacts assessment criteria.

3 Proposed Development

3.1 Development Details

The proposal seeks consent for:

- **Approval of a Concurrent Rezoning Amendment:** To facilitate the built form proposed under SSD- 99319962, concurrent amendments are sought to the WPC SEPP pursuant to the concurrent rezoning process facilitated by the HDA planning pathway. This concurrent rezoning seeks to vary existing controls under the WPC, whilst also seeking broad alignment with the LTC SARP which is expected to be finalised by DPHI mid-2026. Specifically, the project seeks to amend the WPC SEPP as follows:
 - Amend the Land Zoning Map to rezone the site from B3 Commercial Centre to MU1 Mixed Use.
 - Amend Clause 4.3 to increase the height of buildings control from 24m to 138.5m.
 - Introduce a floor space ratio control of 5.8:1 for the entire site, equates to approximately 188,000sqm of GFA.
 - Incorporating a site-specific provision, requiring the provision of a minimum of 6,500sqm of public open space
- **State Significant Development consent for the proposed development:** The SSDA seeks detailed consent for the following works:
 - Demolition of existing structures, clearing of vegetation and site preparation works across the site.
 - *Subdivision of the site to create separate lots and road reserves.*
 - *Bulk earthworks and civil infrastructure works across the site.*
 - *Construction of an internal street (road) network.*
 - *Construction of 8 residential buildings to accommodate a total of 1493 units, comprising of:*
 - Build to Sell Apartments: 864
 - Build to Rent Apartments: 412
 - Affordable Apartments 217 (representing circa 15% of total residential yield)
 - *Delivery of approximately 40,500m² of non-residential floor space, including:*
 - Hotel (with ancillary function spaces)
 - Centre-based child care facility, accommodating approx. 70 children.
 - Pub (licensed)
 - Shop – neighbourhood supermarket, discount department store (DDS), other retail
 - Retail liquor store
 - Food and beverage premises
 - Vehicle repair station – Tyre and auto, carwash
 - Recreation facility (indoor) – Indoor swim school, Gym
 - *Delivery of retail and residential parking spaces across seven (7) basement levels*
 - *Delivery of an active and connected public domain, including:*
 - *Approximately 6,500sqm of public open space in the form of north-south and east-west linear parks that connect with the broader town centre.*
 - *communal open space for all residential occupants and visitors.*
 - *Street landscaping, tree planting and public domain works throughout the site.*

- Installation of building signage to support wayfinding and building identification across the precinct.

The development will include the construction of a seven level basement carpark encompassing the entire development footprint, with a finished floor level (FFL) of the lowest basement level of RL 64.0 mAHD. The bulk excavation level (BEL) of this basement is assumed to be 0.5 m deeper than the FFL, resulting in a BEL of RL 63.5 mAHD. The BEL of the 7-level basement will require excavation depths of up to approximately 37.5 m below the existing ground levels at the site.

Additionally, a “Deep Soil Area” is included along the northern boundary of the development, which is approximately 2,320 m² in area, and is anticipated to require excavation to the first level of the basement (Basement 01). This equates to a FFL of RL 79.0 mAHD within this area, or a BEL of RL 78.5 mAHD (assuming this is 0.5 m deeper than the FFL).

The basement parking will be proposed to be constructed as ‘drained’ basement; however, the deep soil drainage zone only needs to be dewatered during the construction process. It is anticipated that traditional sub-slab drainage systems and vertical strip drain behind the basement walls will be used during construction. The basement walls are proposed to be constructed via bore pile shoring (soldier pile walls), with external anchors.

A summary of the proposed basement excavation parameters is provided in **Table 3-1** below. The basement layout is illustrated in **Figure 2, Appendix A** with a snapshot provided in **Figure 3-1** below.

Table 3-1 Summary of Proposed Excavation Parameters

ITEM	DESCRIPTIONS
Basement Excavation Footprint Area (m²)	<u>Basement Parking Area:</u> approximately 23,305 m ² <u>Deep Soil Area:</u> approximately 2,320 m ²
Ground Surface Elevations	Topography across the site ranges in elevation from approximately 85 – 95 m Australian Height Datum (AHD). The site generally follows a minor grade of approximately 3% towards the northwest. Topographic elevation contours are presented in Figure 3, Appendix A .
Finished Floor Levels (FFL)	<u>Basement Parking Area:</u> RL 64.0 mAHD <u>Deep Soil Area:</u> RL 79.0 mAHD
Bulk Excavation Level (BEL)¹	<u>Basement Parking Area:</u> RL 63.5 mAHD <u>Deep Soil Area:</u> RL 78.5 mAHD

¹ Assumed to be 0.5m below the FFLs



Figure 3-1 Basement layout and BEL

3.2 Basement Construction Methodology

The proposed construction methodology is of a “drained basement” design, which is typically constructed consisting of a sub-slab drainage system. The basement floor is understood to consist of slab-on-grade, strip, or pad footings on the underlying shale bedrock.

Given the presence of underlying shale bedrock at the site (discussed in **Section 5.3**), the proposed shoring is likely to consist of conventional shoring with soldier piles and shotcrete infill panels. As part of the drained basement design, the soldier pile wall will include drainage to be connected to the proposed sub-slab drainage system. Alternatively, if there are geotechnical constraints, a secant pile wall retention system may be used for the basement excavation.

3.3 Dewatering Extraction Rate and Duration

Dewatering is proposed to commence following the competition of shoring walls and during excavation. Groundwater is proposed to be extracted using internal drainage sump and pump dewatering system during construction (refer to **Figure 3-2** below).

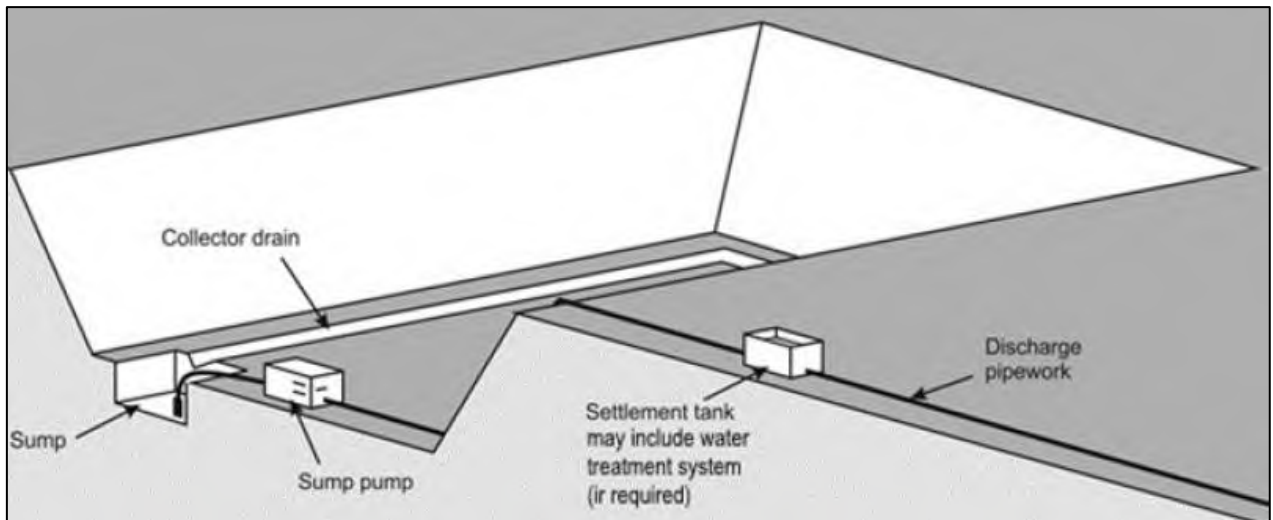


Figure 3-2 Conceptual layout of a sump and pump dewatering system

From an environmental perspective, construction methods to minimise the ingress of groundwater are recommended (such as grout injection into water bearing fractures), as it is effective in:

- Mitigating the risk of environmental impacts associated with drawdown of the water table, and the potential settlement of unconsolidated soils.
- Reducing the volume of extracted groundwater to be discharged (typically) off-site, which often requires treatment and has the potential to adversely impact the receiving environment.

Irrespective of the method, the dewatering depth shall be minimised to the extent practicable to reduce the volume of water to be extracted and to limit groundwater drawdown.

The duration to complete the necessary excavation works and basement construction is assumed to be approximately 12 months. Dewatering is likely to be required to operate 24 hours a day / seven days a week to maintain the water table at operational levels during construction and operation of the drained basement.

To minimise interruptions to the project and unnecessary expenditure, it is recommended that extraction pumps that can cater for low to high flow rates rather than mobilising multiple pumps that may not be required if lower flows are encountered.

4 Legislative Context

4.1 NSW Legislation

4.1.1 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

Conditions of consent in relation to dewatering are likely to be prescribed by the Council in the Development Consent and NSW DPE General Terms of Approval for the works issued under the Environmental Planning and Assessment Act (1979). A copy of the approval must be kept on location at all times.

4.1.2 PROTECTION OF THE ENVIRONMENT OPERATIONS (POEO) ACT 1997

The POEO Act 1997 and its associated schedules and regulations are directly relevant to SSDs. In particular, the Act includes requirements prohibiting the pollution of waters, preventing or minimising air and noise pollution, regarding maintenance and operation plant in a proper and efficient condition/manner, and for minimising and managing wastes.

The Act also requires notification to the NSW Environmental Protection Authority (EPA) and Council, when a pollution incident occurs that causes or threatens material harm to the environment (including discharges above the set limits to the stormwater and where any unacceptable impact to the receiving waters is identified).

4.1.3 NSW WATER QUALITY OBJECTIVES (2006)

The NSW Water Quality Objectives (WQOs) are the community's agreed values and uses (environmental values) and long-term goals for all waterways and catchments in NSW. The WQOs set out the following:

- The community's values and uses for rivers, creeks, estuaries, and lakes (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water); and
- A range of water quality indicators to help assess whether the current condition of our waterways supports those values and uses.

The WQOs are consistent with the agreed national framework for assessing water quality set out in the Australian & New Zealand Guidelines for Fresh & Marine Water Quality (ANZG 2018). These guidelines provide an agreed framework to assess water quality in terms of whether the water is suitable for a range of environmental values (including human uses). The WQOs provide environmental values for NSW waters and the ANZG 2018 Guidelines provide the technical guidance to assess the water quality needed to protect those values.

The groundwater flow contours indicate that groundwater at the site is expected to move east to west towards an unnamed creek (located approximately 250m west of the site), before following Kemps Creek and South Creek, and ultimately discharging into the Hawkesbury River, approximately 38.5 km northwest of the site.

At the time the interim environmental objectives were approved by the Government (September 1999) the Healthy Rivers Commission (HRC) had completed or substantially completed public inquiries for the Hawkesbury-Nepean River catchment. Interim environmental objectives are not provided for the Hawkesbury-Nepean River catchment.

4.1.4 NSW DEPARTMENT OF PLANNING, HOUSING AND INFRASTRUCTURE – DEWATERING DISCHARGE APPROVAL/PERMIT

As this is an SSD, the Water Supply Works approval will be applied for through the NSW Department of Planning, Housing and Infrastructure – Planning Secretary's Environmental Assessment Requirements. Once granted, and the SSD has been determined, Council approval may be required for discharge to the stormwater system.

Council generally requires groundwater to be discharged must be compliant with the General Terms of Approval/Controlled Activity permit issued by WaterNSW (if applicable), Landcom's 'Managing Urban Stormwater: Soils and Construction' (2004, Blue Book), Council's Compliance and Enforcement Policy, and legislation including Protection of the Environment Operations Act 1997 and Contaminated Lands Act 1997.

All approvals, water discharges and monitoring results are to be documented and kept on site. Copies of all records shall be provided to the appropriate regulatory authority, including Council, upon request.

4.1.5 WATER ACT 1912 AND WATER MANAGEMENT ACT 2000

Dewatering for construction purposes is classified as an aquifer interference activity under the NSW Aquifer Interference Policy 2012.

WaterNSW are responsible for waters work approvals under the provisions of the Water Management Act 2000 (WMA) which includes regulation of all aquifer interference activities within Water Sharing Plan management areas. WaterNSW also are responsible for water works approvals for all groundwater extraction in areas outside Water Sharing Plan management areas, as well as State Significant Development.

While minor aquifer interference activities works are generally exempt from the full extent of the WMA 2000, an application for “Approval for Water Supply Works and/or Water Use” (previously known as a Dewatering Licence) is required, regardless if the total volume of groundwater extracted is expected to exceed <3 ML per year a Water Access License (WAL), or written approval from WaterNSW/NRAR if no licence is required, must be obtained prior to commencement. As the anticipated groundwater take is >3 ML/year (see **Section 8.1** Error! Reference source not found.), Reditus note that a WAL will likely be required, based on the predicted groundwater take during construction and operation of the basement (discussed in **Section 8**).

The following information must be provided in support of the “Approval for Water Supply Works and/or Water Use” application:

- A copy of a valid planning consent for the project.
- A copy of the written authorisation for the disposal of the extracted groundwater (to be prepared by Camden Council following review of the DMP).
- A Dewatering Management Plan (DMP), which clearly and concisely set out:
 - Current groundwater levels, preferably based on at least three repeat measurements from at least three monitoring bores and should be used to develop a water table map for the site and its near environs, be accompanied by an interpretation of the groundwater flow direction from these data, and an assessment of the likely level to which groundwater might naturally rise during the life of the building.
 - Predictions of total volume of groundwater to be extracted during the life of the approval (or during the construction period) – the method of calculation and the basis for parameter estimates and any assumptions used to derive the volume are to be clearly documented. Details of how dewatering volumes are to be measured, and of the maximum depth of the proposed dewatering system.
 - Predicted duration of dewatering at the property, noting that temporary water supply works approvals are generally issued for no more than 24 months.
 - Details of how dewatering volumes are to be measured, e.g., by calibrated flow meter or other suitable method, and of the maximum depth of the proposed dewatering system.
 - Details of any predicted impacts or particular issues, e.g., proximity of groundwater dependent ecosystems springs; or water supply losses by neighbouring groundwater users; or potential subsidence impacts on nearby structures or infrastructure.
 - Details of monitoring proposed during the dewatering program. These should be designed to inform and facilitate the protection of any identified potential impacts.
 - Details of ambient groundwater quality conditions beneath the property and of any proposed treatment to be applied to pumped water prior to disposal – at a minimum, treatment must be undertaken to remove contaminants, manage pH levels, reduce suspended solids and turbidity to acceptable levels and ensure that dissolved oxygen levels are compatible with ambient quality requirements in receiving waters. Groundwater cannot be re- injected into an aquifer without the specific approval of, and licensing by, WaterNSW.
 - Details of how reporting will occur during and following the dewatering program, to confirm that predicted quantities and quality objectives were met.
 - Description of the method of dewatering and related construction including any proposal to use temporary piling or support walls and the relative depths thereof.

Further information on the aquifer interference policy and licencing requirements are available from the WaterNSW website.

Reditus note that if/once approval has been provided, an application for a “new water access licence with a zero share component” may be required to be completed and a suitable groundwater entitlement may also need to be obtained

from the market to account for the groundwater take within the same groundwater source (in this case, Sydney Basin – Central Groundwater Source, under the Water Sharing Plan for the Greater Metropolitan Region Groundwater 2023. This will need to be obtained within three months of granting of the Zero Access Licence.

Works or activities that intersect or interfere with groundwater systems and where take is incidental to the primary purpose of the activity, or where there is no take, are managed as aquifer interference activities. Aquifer interference activities taking 3 ML or less of groundwater per year are exempt from requiring a WAL.

4.1.6 WATER SHARING PLANS (WSPS)

WSPs are being progressively developed for rivers and groundwater systems across NSW following the introduction of the Water Management Act (WMA) 2000. WSPs made under the WMA are being prepared as Minister's plans under Section 50 of the Act. These plans protect the health of our rivers and groundwater while also providing water users with perpetual access licences, equitable conditions, and increased opportunities to trade water through separation of land and water.

WSPs provide a legislative basis for sharing water between the environment and consumptive purposes. Under the WMA, a plan for the sharing of water must protect each water source and its dependent ecosystems and must protect basic landholder rights.

The site is located within the following WSP:

- Water Sharing Plan for the Greater Metropolitan Region Groundwater Source 2023 – Sydney Basin Central Groundwater Source.

Water sharing plan for the Greater Metropolitan Region Groundwater Source 2023 – Sydney Basin Central Groundwater Source

The Sydney Basin Central Groundwater Source extends from the Hawkesbury River in the north, the Nepean River in the west to the Cataract Dam in the south. The long-term average annual extraction limit (LTAAEL) of the Sydney Basin Central Coast Groundwater Source is 31,859 ML/yr (2023)

4.2 Policies and Guidelines

4.2.1 NSW AQUIFER INTERFERENCE POLICY 2012

The purpose of the NSW Aquifer Interference Policy 2012 is to explain the role and requirements of the Minister administering the WMA in the water licensing and assessment processes for aquifer interference activities under the WMA and other relevant legislative frameworks. The NSW Aquifer Interference Policy 2012:

1. Clarifies the requirements for obtaining water licences for aquifer interference activities under NSW water legislation; and
2. Establishes and objectively defines considerations in assessing and providing advice on whether more than minimal impacts might occur to a key water-dependent asset.

The proposed development will result in aquifer interference under the NSW Aquifer Interference Policy (2012) as groundwater will be intercepted and removed from at least one aquifer. Accordingly, groundwater licensing may be required.

Licensing of Water Taken Through Aquifer Interference

A water licence is required under the WMA (unless an exemption applies, or water is being taken under a basic landholder right) where any act by a person carrying out an aquifer interference activity causes:

- The removal of water from a water source; or
- The movement of water from one part of an aquifer to another part of an aquifer; or
- The movement of water from one water source to another water source, such as:
 - from an aquifer to an adjacent aquifer; or
 - from an aquifer to a river/lake; or
 - from a river/lake to an aquifer.

A licence for the removal of water from a water source may be required for the development.

4.2.2 NSW WATER QUALITY AND RIVER FLOW OBJECTIVES

The NSW Water Quality Objectives are the agreed environmental values and long-term goals for NSW's surface waters. They set out:

- the community's values and uses for our rivers, creeks, estuaries and lakes (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water); and
- a range of water quality indicators to help us assess whether the current condition of our waterways supports those values and uses.

Water Quality Objectives have been agreed for Fresh and Estuarine surface waters and Marine Water Quality Objectives.

The Objectives are consistent with the agreed national framework for assessing water quality set out in the ANZECC 2000 Guidelines. These guidelines provide an agreed framework to assess water quality in terms of whether the water is suitable for a range of environmental values (including human uses). The Water Quality Objectives provide environmental values for NSW waters and the ANZECC 2000 Guidelines provide the technical guidance to assess the water quality needed to protect those values.

The River Flow Objectives are the agreed high-level goals for surface water flow management. They identify the key elements of the flow regime that protect river health and water quality for ecosystems and human uses.

4.2.3 HEALTHY RIVERS COMMISSION INQUIRY

The Healthy Rivers Commission was established in 1995 (under section 23 of the Pollution Control Act 1970) by the NSW Government as one element of water reforms. The Commissioner for Healthy Rivers is to make recommendations to Government on:

- suitable objectives for water quality, flows and other goals central to achieving ecologically sustainable development in a realistic time frame.
- the known or likely views of stakeholder groups on the recommended objectives
- the economic and environmental consequences of the recommended objectives
- and strategies, instruments and changes in management practices needed to implement the recommended objectives.

The Commission does this through conducting independent public Inquiries for selected rivers. The Inquiries assist the community to consider, in detail, the options that are available in terms of river health and the use of river resources for commercial and recreational purposes.

The interim environmental objectives described on the EPA website will apply until the NSW Government either:

- adopts the longer-term objectives resulting from recommendations by the Healthy Rivers Commission, or
- approves a river management plan for the catchment through the Ministers for Land and Water Conservation and for the Environment. In this case, the environmental objectives would apply for the duration of the plan, subject to review and audit.

At the time the interim environmental objectives were approved by the Government (September 1999) the Healthy Rivers Commission (HRC) had completed or substantially completed public inquiries for the Hawkesbury-Nepean River catchment. Interim environmental objectives are not provided for the Hawkesbury-Nepean River catchment.

4.2.4 AUSTRALIAN GUIDELINES FOR URBAN STORMWATER MANAGEMENT (2000)

The Australian Guidelines for Urban Stormwater Management (2000) aim to provide a nationally consistent approach for managing urban stormwater in an ecologically sustainable manner. The approaches represent current best practice in stormwater planning and management in Australia. In particular, the guidelines will help managers to identify objectives for stormwater management (including protecting social, environmental and economic values) and to integrate management activities at the catchment, waterway, and local development level.

The tools and approaches in the guidelines assist managers to undertake integrated storm water management planning in accordance with the values and conditions of the local environment, while integrating these activities into the catchment context.

4.2.5 MANAGING URBAN STORMWATER – SOILS AND CONSTRUCTION VOLUME 1 (2004)

The Managing Urban Stormwater: Soils and Construction Volume 1 (2004) guidelines are an important element of the NSW Governments' urban stormwater program which aims to improve the health, ecology and amenity of urban streams, rivers estuaries and beaches through better management of stormwater.

The guidelines will help mitigate the impacts of land disturbance activities on soils, landforms and receiving waters by focusing on erosion and sediment control. The aims are to:

- Reduce pollution to downstream areas and receiving waters.
- Reduce land degradation.
- Raise an awareness of ecologically sustainable development (ESD) principles and their application to development.

It is expected that management of stormwater will be required for the proposed development as the construction and operational activities have the potential to generate erosion and sediment impacts to the receiving water body.

4.3 Relevant National and NSW EPA Endorsed Guidelines

Approval for the disposal of groundwater to stormwater will be regulated by Council.

The adopted water quality guidelines for discharge waters are the:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).
- ANZECC/ARMCANZ (2000) Default Trigger Values (TVs) for Physical and Chemical Stressors (used in the absence of ANZG 2018 criteria).
- Guidelines for Managing Risks in recreational Water (NHMRC 2008) / Drinking Water Criteria (NHMRC updated 2022).

Use of the 95% protection level (for the ANZG 2018 Guidelines) is based on an assumption that the surrounding watercourses are moderately disturbed ecosystems (as receiving road and stormwater runoff from adjacent urbanised environment). In the absence of ANZG (2018) DGVs, the ANZECC (2000) trigger values (TVs) were adopted. The freshwater criterion were adopted due to the conditions of the groundwater at the site and the receiving environment.

5 Environmental Setting

5.1 Climate

Historical rainfall data from 1957 to 2025 was obtained from the SILO enhanced climate database (QLD DES, 2021). Based on the historical rainfall data, the average annual rainfall is 771.8 mm/year.

Groundwater recharge via rainfall is likely to be significant contributor to the groundwater system. As such, this rainfall data set allows assessment of the measured and predicted groundwater levels at the Site, as well as providing indicative prediction of a likely groundwater level response in the absence of measured/observed groundwater levels.

Groundwater recharge rate (i.e. the percentage of rainfall that infiltrates into the ground and replenishes the groundwater system) at the site is expected to be relatively low (approximately 3.50% based on regional diffuse groundwater recharge mapping (Lee, et al., 2024)). Therefore, diffuse groundwater recharge during an average rainfall year is expected to be 27.0 mm/year.

A summary of the long-term average rainfall and evaporation trends is provided in **Table 5-1** and visualised in **Figure 5-1** below.

Table 5-1 Monthly Average Rainfall/Evaporation (mm)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average Rainfall	86.94	97.35	95.69	64.41	52.12	62.61	38.2	45.5	35.99	56.44	72.61	63.98
Average evapotranspiration rate	130.3	106.81	88.84	52.45	26.88	17.88	19.09	32.24	55.91	87.31	109.24	128.59
Net water balance	-43.36	-9.46	6.85	11.96	25.24	44.73	19.94	14.56	-19.92	-30.87	-36.63	-64.61
Climatic condition	Drying	Drying	Wetting	Wetting	Wetting	Wetting	Wetting	Wetting	Drying	Drying	Drying	Drying

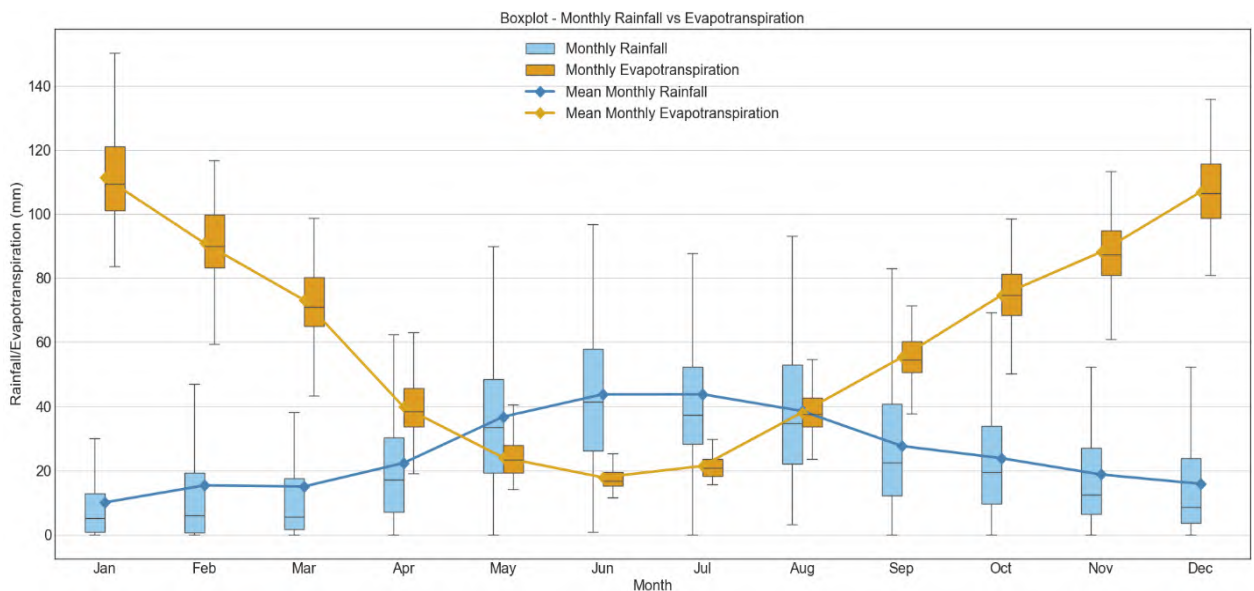


Figure 5-1 Monthly rainfall/evapotranspiration boxplot

A review of monthly rainfall trends indicate that rainfall amounts are generally higher in the Summer and Autumn months and lower during Winter and Spring. Due to seasonal temperature variation, evapotranspiration rates are typically highest in Spring and Summer. Groundwater recharge potential is expected to be higher during months with higher rainfall amounts, and lower evaporation rates. **Figure 5-1** indicates that groundwater recharge potential occurs

from March – August (where mean monthly rainfall exceeds mean monthly evapotranspiration), with “drying” conditions experienced over the remainder of the year.

Cumulative residual rainfall, known as residual mass, provides a strong indication of long-term rainfall trends relevant to groundwater fluctuation, as it better matches the temporal time scale of groundwater recharge behaviour than measurements of total rainfall over a period of time. **Figure 5-2** provides a plot of cumulative residuals of monthly rainfall from mean monthly rainfall. This plot provides an indication of the groundwater recharge potential, which in turn provides an indication of the state of groundwater storage in aquifers that are strongly influenced by rainfall, interpreted as follows:

- A positive slope indicates a wetter than average period and this is associated with high groundwater recharge potential
- A negative slope indicates a drier than average period and this is associated with low groundwater recharge potential
- A section with both positive and negative slopes indicates a period of (generally) “average” rainfall and is associated with groundwater recharge potential

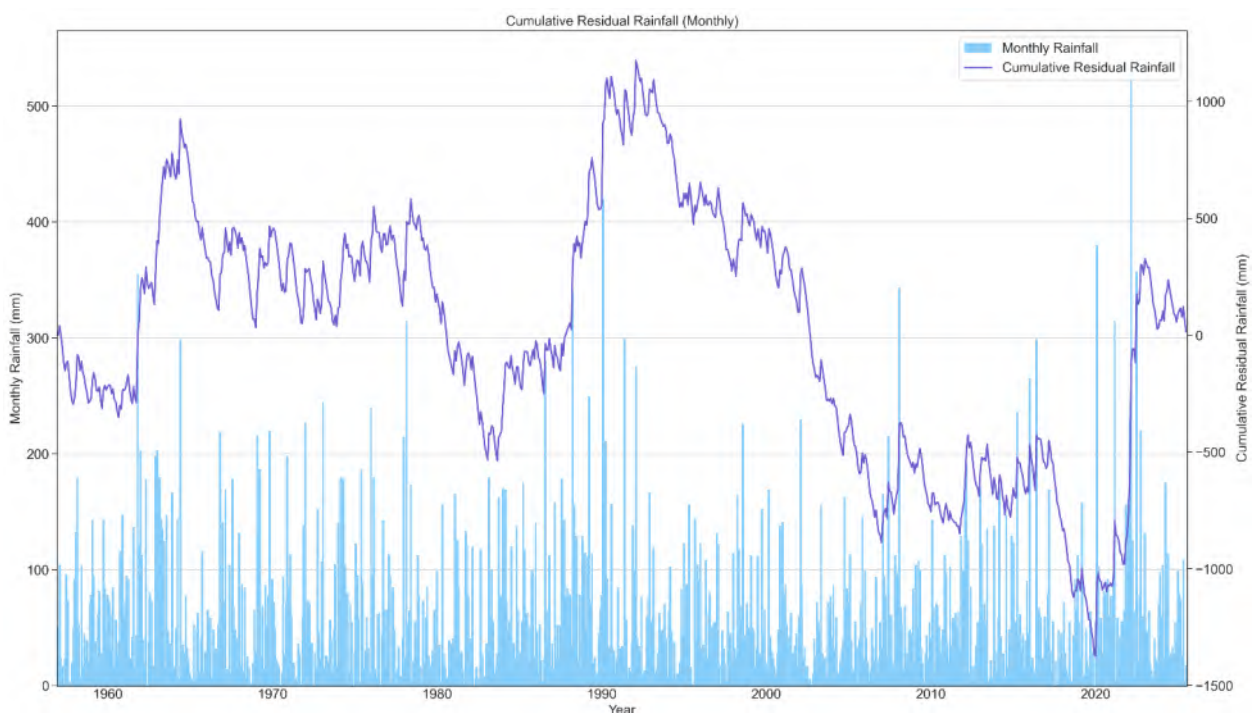


Figure 5-2 Cumulative Monthly Residual Rainfall from 1957 to 2025

It is apparent from **Figure 5-2** that since the significantly ‘wetter than average’ period occurred during 2022; subsequent rainfall patterns were generally consistent with average conditions. Therefore, it likely that the groundwater levels (discussed in **Section 5.4.2**) are likely to be representative of ‘average’ groundwater conditions.

5.2 Topography

Topography across the site ranges in elevation from approximately 85 – 95 m Australian Height Datum (AHD). The site generally follows a minor grade of approximately 3% towards the northwest. A survey of the site was completed in 2021 (SDG Pty Ltd), and has been provided in **Appendix D**. Topographic elevation contours are presented in **Figure 3, Appendix A**.

The topography slopes away from the site to the northwest towards an unnamed creek (located approximately 45m northwest of the site at ~80 mAHD) and to the east towards another unnamed creek (located approximately 800 m east of the site at ~75 mAHD).

The closest named watercourse is Kemps Creek, located approximately 1.35km to the east of the site. Kemps Creek is non-perennial to the East of the site and flows towards the south. The second closest names water body is Cabramatta Creek (~3.3km east of the site), which is also non-perennial and flows towards the south.

5.3 Geology

5.3.1 REGIONAL GEOLOGY

The Penrith 1:100,000 Geological Series Sheet 9030 indicated the site is underlain by middle-Triassic aged Bringelly Shale of the Wianamatta group. The lithology is described as shale, carbonaceous claystone, laminite, lithic sandstone, and rare coal. The Bringelly Shale geological unit is underlain by Minchinbury Sandstone which is described as fine to medium-grained quartz lithic sandstone. Regional geological mapping is provided in **Figure 4, Appendix A**.

A review of the WaterNSW Registered Groundwater Bore Database revealed two wells installed for irrigation purposes located approximately 1.5 km (GW058734) and 1.65km (GW058735) to the south-east of the site. These wells drilled to 191.4 and 173.7 mbgl respectively and indicated that the thickness of the Bringelly shale at these locations ranged from ~104 – 112m. This information was later incorporated into the hydrogeological conceptual site model (**Section 7**), with a copy of the drilling logs for these wells provided in **Appendix B**.

5.3.2 SITE SPECIFIC GEOLOGY

A total of two intrusive investigation programs have been completed at the site by ECS Group (2025 and Reditus (2025) as outlined in **Section 2.2.2**. Further, at the time of writing this report, El Australia is undertaking an additional intrusive investigation at the site. A copy of all available borelogs completed to date are provided in **Appendix D**, with the generalised site stratigraphy based on the findings of these investigations summarised in **Table 5-2** below.

Table 5-2 Site-specific geology summary

STRATIGRAPHIC LAYER	GENERALISED DESCRIPTION	AVERAGE THICKNESS (M)
Unconsolidated Fill	Fill (variable thickness of 1.0 to 2.0 m) generally comprising silty / sandy clays, medium plasticity clays, medium grained sand, brown / red / grey.	1.5
Residual Soils	Residual soils associated with the underlying Bringelly Shale (variable thickness of 0.4 to 7.6 m) generally comprising sandy silt / silty clays, low to medium plasticity, medium grained sand, pale grey or grey – black.	3.0
Weathered Bringelly Shale	Extremely weathered shale (variable thickness of 3.0 to 6.5 m), light grey to black, very low strength.	4.8
Bringelly Shale	Moderately - highly weathered shale / siltstones (encountered at approximately 3.05 -31.14 mBGL, thickness not measured), grey – black, low strength, laminate inclusions (siltstone / sandstone) noted from approximately 5 mBGL.	-

5.3.3 ACID SULFATE SOILS

Acid sulfate soils (ASS) occur predominantly on coastal land with elevations generally below 5 mAHD. These soils also occur further inland in saline seepage areas, rivers, lake beds and irrigation channels. Where present, drawdown of the local water table can expose ASS to oxidising conditions creating acidity and mobilising metals at potentially harmful concentrations.

Based on reviews of the Australian Soil Resource Information System and the NSW Government Acid Sulfate Soils Risk Map provided in the Sharing and Enabling Environmental Data (SEED) database (www.seed.nsw.gov.au), the site is not located within an area of known acid sulfate soils risk.

A review of the Camden Local Environmental Plan (2010) found that there was no ASS mapping indicating that the area has an extremely low probability of ASS occurring on site.

Based on the above, it was deemed not necessary to further assess ASS as part of this assessment.

5.4 Hydrogeology

The site is located within the Sydney Basin Central groundwater source, which is managed under the WMA 2000 through the Water Sharing Plan for the Greater Metropolitan Region 2023.

A review of Hydrogeology map of Australia (Geoscience Australia) indicates the aquifer type beneath the site are porous, extensive with low-moderate productivity.

5.4.1 GROUNDWATER MONITORING WELLS

A total of five (5) groundwater monitoring wells have been installed and monitored by Reditus and Environmental Consulting Services (ECS) at the site. Three (3) monitoring wells (BH1-BH3) were installed by ECS in April 2025 during a geotechnical investigation. A further two (2) groundwater monitoring wells were installed at the site by Reditus in May 2025. At the time of writing this Groundwater Impact Assessment, El Australia are undertaking an intrusive investigation which will include the installation of three additional monitoring wells to the Bulk Excavation Level (BEL). This report will be updated once the intrusive investigation is complete.

The groundwater monitoring well locations are provided in **Figure 5, Appendix A**, and the borehole logs are provided in **Appendix B**.

Groundwater monitoring wells installed at the site are summarised in **Table 5-3** as follows:

- BH1 to BH3 were installed by ECS (April 2025).
 - The monitoring wells were installed to RL depths of 78.379 (BH2), 84.13 (BH1) and 85.459 mAHD (BH3).
- RED_BH4 and RED_BH5 were installed by Reditus in May 2025.
 - These monitoring wells were both installed to RL depths of 81.6 mAHD.

Monitoring wells installed by ECS and Reditus are no longer installed to the BEL with the increase in basement levels. As such, El Australia are installing wells to the update BEL at the time of writing this report.



Table 5-3 Summary of groundwater monitoring wells at the site

LOCATION ID	EASTING	NORTHING	TOC ELEVATION (MAHD)	SCREEN TOP (MBGL)	SCREEN BOTTOM (MBGL)	STRATIGRAPHIC UNIT
BH1	297495.603	6240511.23	94.805	3.5	9.5	Residual Clay / Weathered Bringelly Shale
BH2	297373.005	6240528.914	89.594	3.8	9.8	Residual Clay / Weathered Bringelly Shale
BH3	297549.249	6240472.524	96.439	3.7	9.7	Residual Clay / Weathered Bringelly Shale
RED_BH4	297498.542	6240594.093	92.636	8.2	10.2	Weathered Bringelly Shale
RED_BH5	297592.918	6240485.396	96.05	12.6	14.6	Weathered Bringelly Shale

5.4.2 GROUNDWATER ELEVATIONS AND INFERRED FLOW DIRECTION

Manual Measurements

A summary of the groundwater monitoring wells, and manual measurements recorded is provided in Table 5-4 below.

Table 5-4 Manual Groundwater Elevation Measurements

WELL ID	DATE	TOC (RL MAHD)	DEPTH OF WELL (MBTOC / MAHD)	DEPTH TO WATER (MBTOC)	DEPTH TO WATER (RL MAHD)
BH1	21/05/2025	94.805	10.675 / 84.130	10.265	84.540
	3/06/2025		10.680 / 84.125	9.710	85.095
	22/08/2025		10.590 / 84.215	9.160	85.645
BH2	21/05/2025	89.341 ¹	11.215 ¹ / 78.632	9.44 ¹	80.156
	22/05/2025	89.594	10.940 / 78.654	10.29	79.302
	3/06/2025		10.920 / 78.674	9.26	80.334
	22/08/2025		11.050 / 78.544	8.84	80.754
BH3	21/05/2025	96.439	10.980 / 85.459	10.49	85.948
	3/06/2025		10.730 / 85.709	10.27	86.169
	22/08/2025		10.860 / 85.579	9.65	86.789
RED_BH4	22/05/2025	92.636	11.015 / 81.62	9.325	83.311
	3/06/2025		10.900 / 81.736	9.47	83.166
	22/08/2025		10.902 / 81.734	6.902	85.734
RED_BH5	3/06/2025	96.050	14.370 / 81.680	10.97	85.080
	22/08/2025		14.430 / 81.620	7.795	88.255
Minimum:				6.902	79.302
Maximum:				10.040	88.255
Mean:				8.764	84.019
Median:				8.840	85.080

TOC – top of casing

RL mAHd – Reduced level metres Australian Height Datum

mbTOC – metres below top of casing

mbgl – metres below ground level

5.4.3 DATA LOGGERS

Data loggers were installed within BH2, RED_BH4 and RED_BH5 and recorded groundwater elevation measurements every three hours over 93 days (approximately 3 months), between 22 May 2025 to 22 August 2025. Standing groundwater levels (SWL, mAHd), overlain with the recorded rainfall during this period (Bringelly Maryland AWS 67015) have been plotted in **Figure 5-3** below.

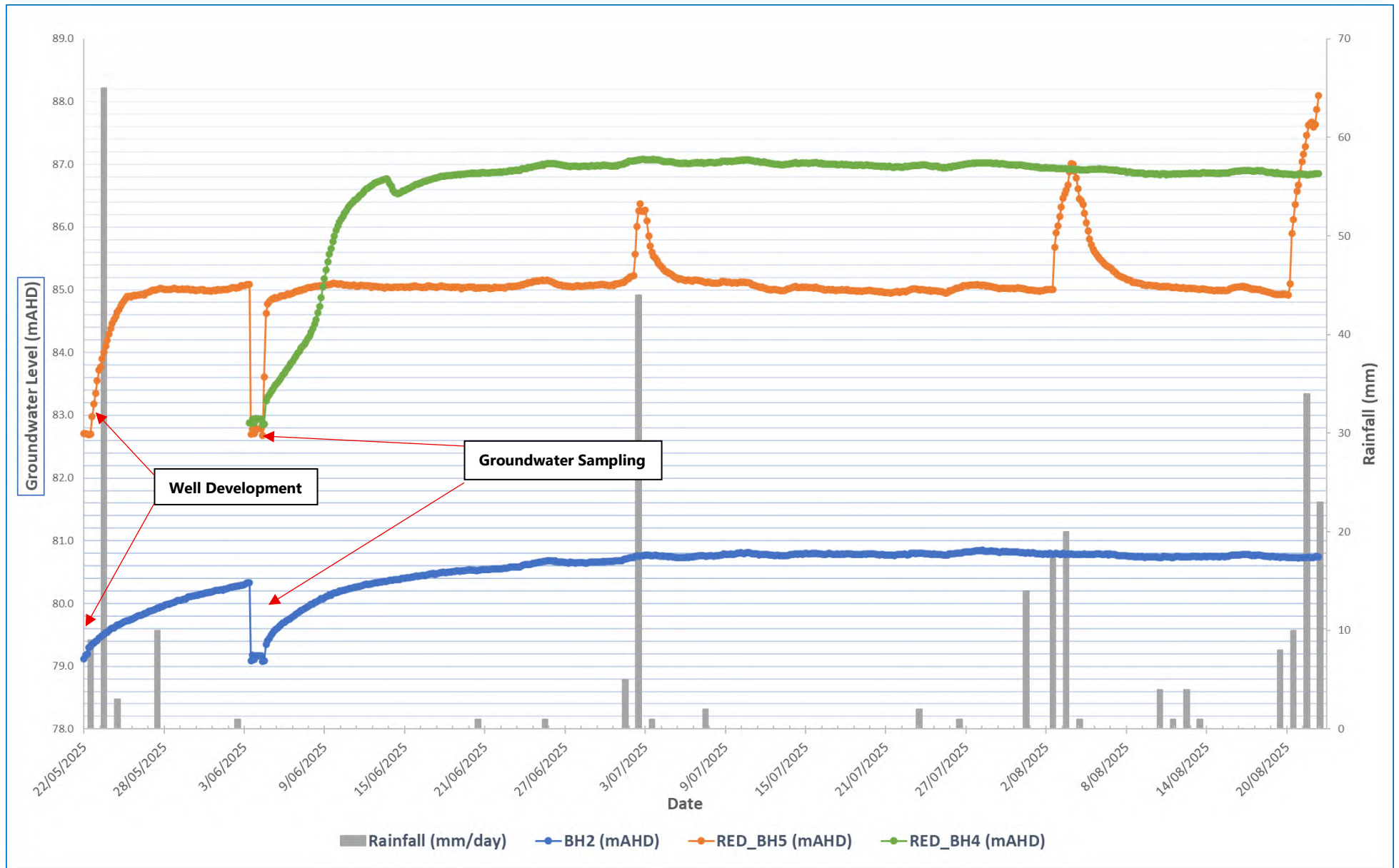


Figure 5-3 Long-term Groundwater Elevation Measurements and Rainfall over 93-day period (approximately 3 months)

The following key findings were reported from the long-term groundwater elevation monitoring:

- Groundwater elevations within all monitoring wells (BH1, BH2, BH3, RED_BH4 and RED_BH5) fluctuated between a highest logged level of 88.10 mAHD (RED_BH5) to a lowest logged level of 79.12 mAHD (BH2) during the 3-month monitoring period at the site.
- The maximum standing water levels recorded at each location over the three-month monitoring period area as follows (refer to **Figure 5-3** above):
 - BH2: 8.75 m below top of casing (mbTOC) and 80.85 mAHD.
 - RED_BH4: 5.57 mbTOC and 87.08 mAHD.
 - RED_BH5: 7.95 mbTOC and 88.10 mAHD.
- Standing groundwater levels at the site were responsive to local rainfall events at RED_BH5 only, with rises in groundwater levels of up to 2.5m during repeated rainfall events in August. Conversely, groundwater levels at both RED_BH4 and BH2 did not appear to be significantly impacted by local rainfall.

5.4.4 INFERRED FLOW DIRECTION

Based on gauged groundwater standing levels and surveyed top of casing data from June and August 2025, groundwater is inferred to conform with the local topography, flowing east to west, towards BH2. Groundwater contour and flow direction data has been presented in **Figure 6a** and **Figure 6b** in **Appendix A**.

5.4.5 HYDRAULIC CONDUCTIVITY

Variable head testing was obtained from all groundwater monitoring wells at the site. as outlined in **Table 5-3**, with the outputs generated from computational software presented in **Appendix E**. This test was completed to measure the change in hydraulic head over time and to determine the aquifer characteristics of the well. The selected wells were spaced across the site and were completed on wells that had depths similar to the inferred base of excavation for the previously proposed development. Slug tests will subsequently be completed on the wells currently being installed by El Australia, and this report will be updated.

Estimates for hydraulic conductivity completed by Reditus were developed using both the Bouwer-Rice and Hvorslev methods. The average hydraulic conductivity measured at each location was calculated and are summarised in **Table 5-5** below.

Table 5-5. Estimates of Hydraulic Conductivity

WELL ID	TARGETED MATERIAL	DATE	TEST TYPE	INTERPRETED HYDRAULIC CONDUCTIVITY (M/DAY)	AVERAGE HYDRAULIC CONDUCTIVITY (M/DAY)
BH2	Residual Clay / Bringelly Shale	03/06/2025	Falling Head Test	0.00916	0.00527
		04/06/2025	Rising Head Test	0.00139	
RED_BH4	Bringelly Shale	04/06/2025	Rising Head Test	0.00186	0.00186
RED_BH5	Bringelly Shale	03/06/2025	Falling Head Test	0.00825	0.0115
		03/06/2025	Rising Head Test	0.00751	
		04/06/2025	Rising Head Test	0.0285	

The above estimates of hydraulic conductivity are noted to be significantly higher compared to literature values for clay and shale (Fitts, C.R. 2013 Groundwater Science (2nd ed. Academic Press)). It is noted that the residual soils were classified as sandy silt / silty clay overlying shale.

5.4.6 PHYSIOCHEMICAL PROPERTIES

Groundwater physiochemical parameters were recorded from three (3) onsite monitoring wells (BH2, RED_BH4 and RED_BH5) during the groundwater sampling event conducted on 3 June 2025, with stabilised measurements summarised in **Table 5-6** below.

Table 5-6. Groundwater Physiological Parameters (Reditus, 2025)

WELL ID	TEMPERATURE (°C)	PH	DISSOLVED OXYGEN (PPM)	REDOX / ORP (MV)	ELECTRICAL CONDUCTIVITY (µS/CM)	APPEARANCE / ODOUR
BH2	16.62	7.18	2.98	60.1	12,490	Turbid, brown, no odour
RED_BH4 ¹	17.69	7.29	3.40	60.3	20,700	Turbid, brown, organic odour
RED_BH5	19.25	7.18	2.32	-52.5	8,729	"Milky" colour, no odour

Notes:

1: Field parameters did not reach stabilisation before sampling due to limited available volume in well

* 199mV have been added to redox field values to adjust to Standard Hydrogen Electrode (SHE) results.

Based on the physicochemical parameters recorded during the groundwater monitoring event the following observations have been made:

The following conclusions can be made regarding the above physio-chemical parameter data collected at the site:

- pH ranges between 7.18 and 7.29, indicating neutral conditions
- Dissolved oxygen concentrations ranged between 2.32 and 3.40 ppm, indicating that groundwater at the site is slightly aerobic.
- Electrical conductivity results were between 8,729 and 20,700 $\mu\text{S}/\text{cm}$, indicating groundwater is brackish.
- Redox potential results ranged between -52.5 and +60.3 mV, indicating that groundwater conditions range from reducing (RED_BH5) to oxidising (BH2 and RED_BH4) across the site.

5.4.7 GROUNDWATER QUALITY SAMPLING RESULTS

Collection and analysis of groundwater samples from three (3) onsite monitoring wells (BH2, RED_BH4 and RED_BH5) was completed by Reditus Consulting on 3 June 2025. The groundwater monitoring well locations are presented in **Figure 5, Appendix A**, with tabulated analytical results are provided as **Appendix F**, and copies of the laboratory reports are provided as **Appendix G**.

The groundwater samples were submitted to the NATA accredited laboratory ALS for the analysis of:

- Nutrient suite includes ammonia as N (NH_3), nitrite (NO_2), Nitrate (NO_3), Total Kjeldahl Nitrogen (TKN), total nitrogen (N), total phosphorus (P) and reactive phosphorus.
- Metals including aluminium (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), lithium (Li), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), strontium (Sr), uranium (U), vanadium (V) & zinc (Zn)
- Ionic balance suite including calcium (Ca), sodium (Na), potassium (K), Magnesium (Mg), chloride (Cl), sulfate (SO_4), carbonate (CO_3), bicarbonate (HCO_3), Hardness, Total Alkalinity (OH).
- Total recoverable hydrocarbons (TRH).
- Benzene, toluene, ethylbenzene, and xylene (BTEX).
- Polycyclic aromatic hydrocarbons (PAHs).
- Silica (SiO_2)
- Pathogens including faecal coliforms, faecal enterococci, and E.coli.

The following groundwater assessment criteria were adopted from the following sources in order to assess water quality at the site:

- **ANZG (2018) DGVs & ANZECC (2000)** Australian and New Zealand Guidelines for Water Quality. Trigger values for Fresh Water under the 95% protection levels. These trigger values represent toxicity to biota.
- **ANZECC (2000)** Default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems in lowland rivers. ANZG (2018) do not currently provide DGV for physical and chemical stressors, therefore the ANZECC (2000) trigger values have been adopted.

A comparison of the laboratory analytical results against the adopted groundwater assessment is provided in **Table 5-7** below.

Table 5-7: Groundwater Quality Analytical Results Summary

ANALYTE GROUP	RESULTS
Inorganics	Concentrations of all inorganic analytes were reported below either the laboratory limit of reporting (LOR), or the adopted assessment criteria, with the exception of nitrogen, nitrate + nitrite and phosphorus. The reported exceeding concentrations were as follows: Total Nitrogen (ANZECC DGV for south-east Australia – lowland rivers – 500 $\mu\text{g}/\text{L}$) • BH2 – 7,500 $\mu\text{g}/\text{L}$ • DUP01 – 1,500 $\mu\text{g}/\text{L}$

ANALYTE GROUP	RESULTS
	• RED_BH4 – 11.200 µg/L • RED_BH5 – 1,500 µg/L Nitrate + Nitrite as N (ANZECC DGV for south-east Australia – lowland rivers – 40 µg/L) • DUP01 – 160 µg/L • RED_BH4 – 50 µg/L • RED_BH5 – 180 µg/L Total Phosphorus (ANZECC DGV for south-east Australia – lowland rivers – 20 µg/L) • BH2 – 4,260 µg/L • DUP01 – 120 µg/L • RED_BH4 – 4,750 µg/L • RED_BH5 – 110 µg/L It is noted that these inorganic concentrations are generally consistent with background concentrations of the aquifer in the environment based on previous land usage (e.g farm land).
Metals	Groundwater analytical results reported all concentrations of metals below the adopted guideline values for freshwater, with the exception of aluminium, copper, nickel and zinc. The reported exceeding concentrations were as follows: Aluminium (ANZG 95% freshwater – 55 µg/L) • BH2 – 650 µg/L • RED_BH4 – 150 µg/L Copper (ANZG 95% freshwater – 1.4 µg/L) • RED_BH4 – 4 µg/L • RED_BH5 - 3 µg/L • DUP01 – 3 µg/L Nickel (ANZG 95% freshwater – 11 µg/L) • BH2 – 18 µg/L • RED_BH4 – 15 µg/L • RED_BH5 – 21 µg/L • DUP01 – 18 µg/L Zinc (ANZG 95% freshwater – 8 µg/L) • BH2 – 22 µg/L • RED_BH4 – 13 µg/L • RED_BH5 – 1,650 µg/L • DUP01 – 1,560 µg/L

ANALYTE GROUP	RESULTS
	It is noted that these concentrations of metals are generally consistent with natural background conditions of the aquifer in an urban environment and are unlikely to be a result of anthropogenic contamination.
BTEX	Concentrations of BTEX in all groundwater samples submitted for analysis were reported below the adopted groundwater assessment criteria and the laboratory limit of reporting (LOR).
TRH	Concentrations of TRH in all groundwater samples submitted for analysis were reported below either the adopted groundwater assessment criteria or LOR.
PAHs	Concentrations of PAHs in all groundwater samples submitted for analysis were reported below the adopted groundwater assessment criteria and the laboratory limit of reporting (LOR).
Pathogens	Concentrations of pathogens were reported in all samples as follows: • Thermotolerant Coliform concentrations ranging from 30 cfu / 100ml (BH2) to 23,000 cfu / 100ml (RED_BH4) • E.coli concentrations ranging from 1 cfu / 100ml (RED_BH5) to 220 cfu / 100ml (RED_BH4) • Faecal enterococci concentrations ranging from 160 cfu / 100ml (RED_BH5) to 10,000 cfu / 100ml (RED_BH4) It is unlikely that the results above are representative of the groundwater aquifer and may have been instead caused by cross contamination during well installation and/or sampling. Additional monitoring of these analytes is required as part of a future Dewatering Management Plan to understand background levels of pathogens at the site. These results therefore do not preclude a drained basement.

5.4.8 LOCAL GROUNDWATER USERS

A search of the WaterNSW Registered Groundwater Bore Database (<https://realtime.data.watersnsw.com.au/water.stm>) indicated there are twenty (20) registered groundwater bores with a 2 km radius of the site. A summary of these registered bores is presented in **Table 5-8** below.

Table 5-8. Summary of registered bores

BORE ID	USE	DEPTH OF BORE (M)	STANDING WATER LEVEL (MBGL)	DISTANCE/DIRECTION FROM SITE
GW112660	Monitoring	6.0	-	Approx. 1.5 km south-west
GW110358	Monitoring	7.0	4.9	Approx. 1.5 km south
GW110357	Monitoring	5.0	4.4	Approx. 1.5 km south
GW110361	Monitoring	6.0	3.5	Approx. 1.5 km south
GW110359	Monitoring	6.0	2.9	Approx. 1.5 km south
GW110360	Monitoring	6.0	2.8	Approx. 1.5 km south
GW110356	Monitoring	6.0	2.5	Approx. 1.5 km south
GW110364	Monitoring	6.0	2.8	Approx. 1.5 km south
GW110355	Monitoring	6.0	2.2	Approx. 1.5 km south
GW110362	Monitoring	5.0	1.8	Approx. 1.5 km south
GW110363	Monitoring	6.0	2.4	Approx. 1.5 km south
GW058734	Irrigation	191.4	91.4	Approx. 1.5 km south-east
GW112659	Monitoring	8.6	-	Approx. 1.6 km east
GW111851	Monitoring	8.6	2.49	Approx. 1.6 km east
GW112662	Monitoring	8.9	-	Approx. 1.6 km east
GW112663	Monitoring	9.0	-	Approx. 1.6 km east
GW058735	Irrigation	173.7	91.4	Approx. 1.65 km south-east
GW113116	Monitoring	9.0	-	Approx. 1.75 km south
GW112435	Monitoring	9.0	8.5	Approx. 1.75 m west
GW111852	Monitoring	6.0	1.5	Approx. 1.78 km south-east

mbgl: metres below ground level.

Based on the limited number of water supply bores in the surrounding area, and the relatively low permeability of the residual soils and Bringelly Shale, beneficial usage of groundwater within the area is limited.

5.4.9 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater dependent ecosystems (GDEs) are a diverse and important component of biological diversity. The term GDE takes into account ecosystems that use groundwater as part of their survival strategies. GDEs can potentially include wetlands, vegetation, mound springs, river base flows, cave ecosystems, playa lakes and saline discharges, springs, mangroves, river pools, billabongs and hanging swamps and near-shore marine ecosystems.

Risk assessment guidelines for groundwater dependent ecosystems have been developed to operate within the regulatory and licensing framework provided by the Water Management Act 2000 and Water Sharing Plans (WSPs). The guidelines are based on an assessment of various ecological and risk factors that are important to decisions on allowing a proposed activity or development. The site is located within the following WSP:

- Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023 – Sydney Basin Central Groundwater Source.

The WSP define the extent and locations of High Priority GDE, which are mapped within the WSP as groundwater dependant vegetation ecosystems. NSW DCCEEW has adopted the Guidelines for Identifying High Ecological Value Aquatic Ecosystems (HEVAE) framework developed by the Australian Commonwealth Government to establish the High Priority GDEs mapped within the WSPs. The mapped High Priority GDEs referred to in the WSP represent the 'Very High' and 'High' categories of the HEVAE zones.

It is noted that no High Priority GDEs are located within a 2.0 km radius of the site. The nearest High Priority GDE is located approximately 3.0 km south-west of the site. The proposed dewatering activities at the site are therefore not considered to present a risk to GDEs.

5.5 Contaminated Sites

A search was undertaken (May 2026) of the NSW EPA Contaminated Land Register and the NSW EPA List of Notified Sites under the Contaminated Land Management Act (1997), which identified the following:

- The site is not listed on the NSW EPA record of notices under Section 60 of the Contaminated Land Management Act (1997).
- There are no sites within a 1 km radius of the site that are listed on the NSW EPA List of Notified Sites under the Contaminated Land Management Act (1997).
- A search of records held under the Protection of the Environment Operations Act (1997) identified that the site does not contain an Environmental Protection License nor was the site listed on the Contaminated Land Record of Notices.
- A search of records held under the Protection of the Environment Operations Act (1997) did not identify any sites within a 1 km radius of the site on the Contaminated Land Record of Notices:

Therefore, based on the above, it is considered unlikely that potentially contaminating activities would influence the status of the soil or groundwater at the site

6 Hydrogeological Conceptual Model

This section describes the development of the Hydrogeological Conceptual Site Model (HCSM) for the site, which characterises the subsurface conditions, including aquifer geometry, hydraulic properties, and groundwater flow dynamics. The HCSM provides a framework for reflecting the groundwater system using a 3D numerical groundwater model (MODFLOW-USG) to allow prediction of groundwater behaviour and groundwater take resulting from the proposed drained basement design. Based on the above compilation and assessment of site data (geology, hydrogeology and excavation design) the following H-CSM has been developed. A diagram of the conceptual flow model used for the numerical modelling is provided in **Figure 6-1** below.

- The development will include excavation works for both a seven-level basement carpark and deep soil drainage zone.
 - The Basement Excavation will be approximately 215 m in length and 95 m in width, with an approximate area of 20,305 m². The 7-level basement parking requires a Bulk Excavation Level (BEL) of RL 63.5 mAHD, which will require excavation depths of up to approximately 37.5 m below the existing ground levels at the site.
 - The Deep Soil Area Excavation will be approximately 170 m in length and 14 m in width, with an approximate area of 2,320 m². This area will require a BEL of RL 78.5 mAHD, which will require excavation depths of up to approximately 15.0 m below the existing ground levels at the site.
 - The basement parking will be proposed to be constructed as 'drained' basement, however, the deep soil drainage zone only needs to be dewatered during the construction process. It is anticipated that traditional sub-slab drainage systems and vertical strip drains behind the basement walls will be used during construction. The basement walls are proposed to be constructed via bore pile shoring (soldier pile walls), with external anchors.
- Groundwater recharge via rainfall is likely the main contributor to the groundwater system. Groundwater recharge rate (i.e. the percentage of rainfall that infiltrates into the ground and replenishes the groundwater system) at the site is expected to be relatively low (approximately 3.50% based on regional diffuse groundwater recharge mapping (Lee, et al., 2024)). Therefore, diffuse groundwater recharge during an average rainfall year is expected to be 27.0 mm/year.
- The topography slopes away from the site to the northwest towards an unnamed creek (located approximately 45m northwest of the site at ~80 mAHD) and to the east towards another unnamed creek (located approximately 800 m east of the site at ~75 mAHD). It is likely that groundwater discharges into these creeks (i.e. 'gaining streams').
- The site is underlain by unconsolidated fill (average thickness of 1.5 m), residual soils (average thickness of 3.0 m), weathered Bringelly Shale (average thickness of 4.8 m), and Bringelly Shale from ~9.3 mBGL.
- Groundwater level measurements within the weathered Bringelly Shale / Bringelly Shale range between approximately 79 - 88 mAHD. Standing groundwater levels in the Bringelly Shale do not show significant response to local rainfall events (except at RED_BH4), likely due to the relatively low permeability of the overlying residual soils. Groundwater is inferred to flow west to east towards BH2.
- The average hydraulic conductivity measured in the residual soils and Bringelly Shale was 0.005273m/day and 0.011522 m/day respectively. In the absence of site-specific hydraulic testing of the unconsolidated fill weathered Bringelly Shale layers, representative hydraulic conductivity values have been assumed. In the high strength bedrock materials, it is assumed that horizontal conductivity is greater than vertical conductivity by a factor of 10 (anisotropic) whereas the low strength/weathered bedrock, residual soils and unconsolidated fill are assumed to be isotropic (hydraulic conductivity equal in all directions).
- There are twenty (20) registered bores within a 2 km radius of the site. The majority of the bores (18 of 20) are used for monitoring purposes and the other two (2) are used for irrigation purposes located 1.5km and 1.65km south-east of the site. Based on the absence of water supply bores within close proximity to the site, and the relatively low permeability of the residual soils and Bringelly Shale, beneficial use of groundwater within the area is limited.

- There are no very-high or high Priority GDEs (NSW DCCEEW High Ecological Value Aquatic Ecosystems Map 2018) within a 2km radius of the site.

Based on site-specific geology observations and hydraulic testing results collected during geotechnical investigations, several hydrostratigraphic units (generalised grouping of geologic materials that form a distinct hydrologic unit with respect to the flow and behaviour of groundwater) are present at the site. A summary of the hydrostratigraphic units and interpreted hydrogeological properties is presented in **Table 6-1**. A visual representation of the H-CSM is provided in **Figure 6-1** below.



Table 6-1 Summary of Hydrostratigraphic Units and Hydraulic Conductivities

HYDROSTRATIGRAPHIC UNIT	LAYER NUMBER	LAYER TYPE	APPROXIMATE THICKNESS (M)	HORIZONTAL / VERTICAL ANISOTROPY RATIO	MINIMUM HORIZONTAL HYDRAULIC CONDUCTIVITY (m/day)	REPRESENTATIVE HORIZONTAL HYDRAULIC CONDUCTIVITY (m/day)	MAXIMUM HORIZONTAL HYDRAULIC CONDUCTIVITY (m/day)	MINIMUM VERTICAL HYDRAULIC CONDUCTIVITY (m/day)	REPRESENTATIVE VERTICAL HYDRAULIC CONDUCTIVITY (m/day)	MAXIMUM VERTICAL HYDRAULIC CONDUCTIVITY (m/day)
Unconsolidated Fill	1	Unconfined	1.5	1	0.500	0.500	5.00	0.500	0.500	5.00
Residual Soils	2	Unconfined	3.0	1	0.00139	0.00527	0.00916	0.00139	0.00527	0.00916
Weathered Bringelly Shale	3	Unconfined	4.8	1	0.0186	0.115	0.285	0.0186	0.115	0.285
Bringelly Shale	4	Unconfined	50	0.1	0.00186	0.0115	0.0285	0.000186	0.0115	0.00285

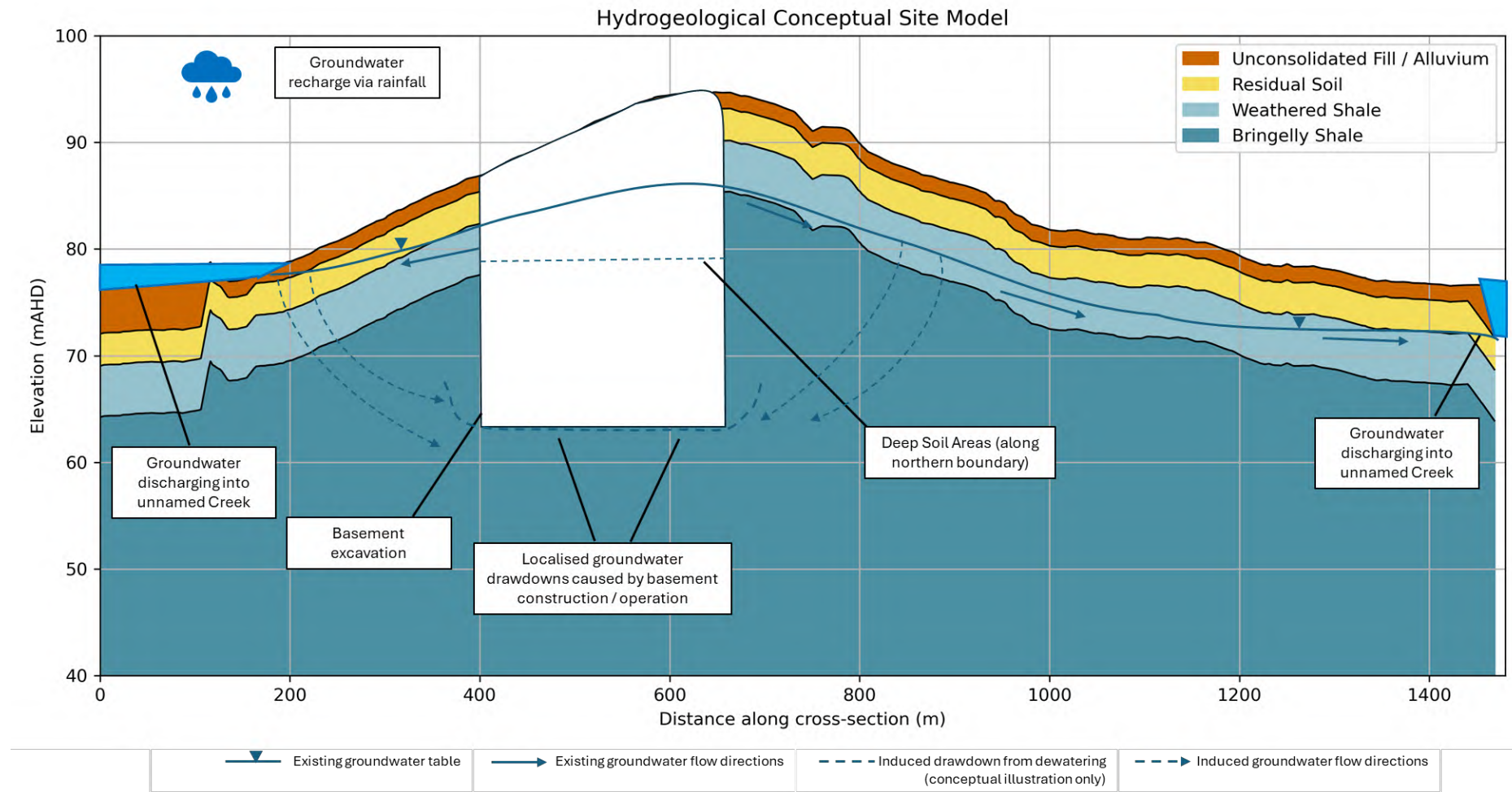


Figure 6-1 Hydrogeological Conceptual Site Model Diagram from west (left) to east (right)

7 Numerical Groundwater Flow Model (MODFLOW)

7.1 Model Selection

A three-dimensional finite difference numerical groundwater model, using Groundwater Vistas software, was selected to simulate groundwater inflows and drawdown extent for the proposed drained basements. This type of numerical groundwater model was selected as it is capable of reproducing groundwater flow into drain cells reflecting constant-head groundwater extraction depth from the drained basement area and defined depths, permitting the geospatial characteristics of the basement location/depth relative to the Site hydrogeological profile/layers.

MODFLOW-USG was selected as the finite difference engine for this process and Groundwater Vistas Version 9.05 Build 6 was used as the interface for constructing and running the model. MODFLOW-USG supports the use of unstructured / nested grids, which allows for a higher resolution of grid cells in the area of interest whilst not requiring the finer grid on the outer areas of the model.

This numerical groundwater model allows both manual and automated model calibration, so that the satisfactorily reproduce measured real-world conditions to best replicate initial groundwater head conditions of representative 'snapshot' data sets. The primary objective of the model calibration was to find model parameters (in this case hydraulic conductivity and recharge) that allowed the model to predict future behaviour with as much confidence as possible whilst maintaining the measured hydraulic conductivity established from site-specific measurements. Following successful calibration to steady-state 'snapshot' groundwater levels, the model was expended to a transient (time-varying) model, which allowed predictions of groundwater inflow rates over nominal assessment periods of construction and ongoing operation of the drained basement (incorporating aquifer storativity and changes to aquifer storage over time).

7.2 Units

All numbers used in the model were in the following units as listed in **Table 7-1** below.

Table 7-1 List of Units Used in Model

PARAMETER	UNIT
Time	day
Length	metres
Elevation	metres Australian Height Datum
Recharge	metres/day
Hydraulic Conductivity	metres/day
Aquifer Storage (Specific Yield & Specific Storage)	proportion (unitless)
Porosity	proportion (unitless)

7.3 Model Design and Construction

The site hydrogeological data (**Section 5**) and H-CSM (**Section 6**) has been used to form the basis of the numerical groundwater model design and construction. The design stage involves describing how the modeller intends to represent the conceptual model in a quantitative (mathematics-based) framework. Construction is the implementation of that approach in that a model is created through the use of appropriate software (model code and graphical user interface (GUI)).

The design and construction process focuses on selection of a suitable software platform in which to construct and run the model as well as deciding on model dimensionality, the model size, the way it is discretised spatially and temporally, the type and location of boundary conditions, and parameterisation of the model.

7.3.1 DOMAIN

The model domain was selected to cover the entire area of interest with a spatial buffer to ensure that the limits of the model domain are sufficiently remote to reduce the impact of the assumed boundary conditions on the model outcomes.

A modelled area of 9.5 km east-west x 9.5 km north-south (~6,928 ha) was adopted to allow incorporation of regional scale topographic/hydrological features surrounding the Site, including:

- South Creek to the west
- Cabramatta Creek to the east
- Various tributaries connecting South Creek, Kemps Creek and Cabramatta Creek to the north
- Key topographical features / ridgelines to the south, inferred to act a 'groundwater divide'.

The features were used to bound the model domain as they act as regional controls on groundwater into/out of the model. Given that the site is approximately 135 m in length x 260 m in width, the model extent was considered to be a broad enough area (more than 10x of site dimensions surrounding the site itself) to cover the potential influence of site dewatering on the surrounding area without encountering artificial boundary conditions.

The model domain is illustrated in **Figure 7** in **Appendix B**, along with the topographical contours and hydrological features listed above to help understand the rationale for the domain's configuration.

7.3.2 LAYERS

Four (4) layers representing were used to represent the H-CSM on the site and surrounding area for simplicity, to replicate the observed site hydrogeological system. The layers used are summarised in **Table 7-2** below.

The contoured elevations of the top of each layer are illustrated in **Figures 9a to 9e** in **Appendix B**.

Table 7-2 Model Layers

MODEL LAYER NUMBER	DESCRIPTION	LAYER DEFINITION ACROSS MODEL DOMAIN (RL mAHD)
Layer 1	Unconsolidated Fill	Top defined by DEM surface topography. Uniform thickness. Bottom defined as 1.5 m below top of layer (average thickness of fill observed during geotechnical investigations).
Layer 2	Residual Soils	Top of layer defined by bottom of Layer 1 Uniform thickness. Bottom defined as 3.0 m below top of layer (average thickness of residual soils observed during geotechnical investigations).
Layer 3	Weathered Bringelly Shale	Top defined by bottom of Layer 2 Uniform thickness. Bottom defined as 4.8 m below top of layer (average thickness of extremely to highly weathered shale observed during geotechnical investigations).

MODEL LAYER NUMBER	DESCRIPTION	LAYER DEFINITION ACROSS MODEL DOMAIN (RL mAHD)
Layer 4	Bringelly Shale	Top defined by bottom of Layer 3 Uniform thickness. Bottom defined as 50 m below top of layer.

7.3.3 GRID

The model domain was discretised using a regular structured rectangular grid, with a higher degree of grid refinement closer to areas that require a higher resolution in the model (e.g. basement extents).

The structured rectangular grid was refined around key features of the hydrogeological conceptual model as follows:

- Basement extents (high degree of refinement)
- Unnamed creeks to the east and west of the site (moderate degree of refinement)
- Model edges and other rivers/creeks (low degree of refinement)

The resulting grid comprised 48,942 cells per layer (195,768 in total). Grid cell areas ranged from ~1.32 ha near the outskirts of the model domain, to 91.82 m² at the edges of the basement. The grid layout is provided in **Figure 8, Appendix B**, with an excerpt focused on the Site provided in **Figure 7-1** below.



Figure 7-1 Model grid design at the site.

7.3.4 BOUNDARY CONDITIONS

Constant hydraulic head boundaries were used in the model to provide regional control of groundwater levels in accordance with the hydrogeological conceptual model. This included the creeks listed below, where the constant head value for each cell intersected by the creeks was defined by the corresponding ground surface elevation in the Digital Elevation Model (DEM) depicted in **Figure 7, Appendix B**.

- Kemps Creek
- South Creek
- Cabramatta Creek
- Hinchinbrook Creek
- Riley's Creek

Drain boundaries were also used to represent areas where water can flow out of the model. These included the various non-perennial streams within the model domain, with the drain elevation value for each cell defined by the corresponding ground surface elevation in the Digital Elevation Model (DEM). The elevation data for each drain cell was set by subtracting 0.5 m from ground surface elevation.

The boundaries used in the model are presented in **Figure 10, Appendix B**, with an excerpt provided in **Figure 7-2** Error! Reference source not found. below.

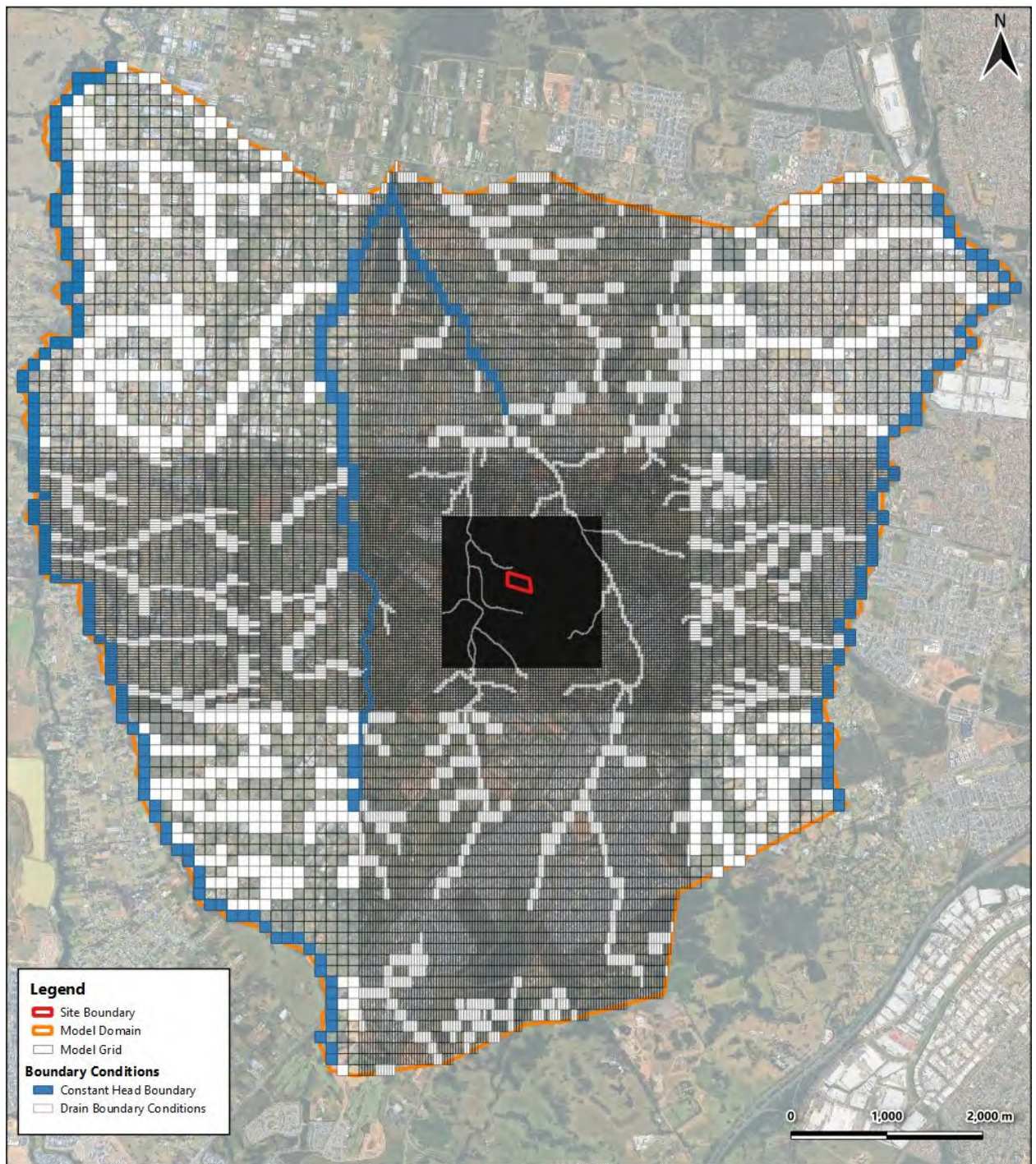


Figure 7-2 Boundary conditions used in model setup

Based on the boundaries, the regional groundwater flow direction from the central portion of the model towards the confluence of Kemps Creek (North-west) was expected, with localised flow directions towards the two unnamed creeks to the west and east of the site, corresponding to the topography of the area.

7.3.5 RECHARGE / EVAPOTRANSPIRATION

In addition to the hydraulic conductivity, the model was also calibrated through adjustment of recharge. For simplicity, a singular recharge zone was assigned across the model grid. Groundwater recharge rate (i.e. the percentage of rainfall that infiltrates into the ground and replenishes the groundwater system) at the site is expected to be relatively low (approximately 3.50% based on regional diffuse groundwater recharge mapping (Lee, et al., 2024)). Therefore, diffuse groundwater recharge during an average rainfall year is expected to be 27.0 mm/year.

A singular evapotranspiration zone was assigned across the uppermost cells of the model grid. Conversely to recharge, evapotranspiration rate is expected to be relatively high due to the vegetation cover across the site. Evapotranspiration was estimated at 598 mm/year based on available climate data. An extinction depth for evapotranspiration of 2 m was selected for the model.

7.3.6 HYDRAULIC CONDUCTIVITY

Further to the discussion in **Section 0** and the hydrostratigraphic units presented in **Table 5-5**, the hydraulic conductivities in the model layers were initial assigned the following hydraulic conductivities as four (4) distinct zones (1 per layer). The adopted the upper and lower bounds (also included in **Table 5-1**) to achieve calibration via PEST were also adopted.

7.4 Storativity, Porosity and Effective Porosity

Consistent storativity and porosity were adopted laterally within each layer across the model as listed in **Table 7-3** below.

Table 7-3 Storativity, Porosity and Effective Porosity Literature Values

LAYER	LAYER TYPE	SPECIFIC YIELD	POROSITY	SOURCE / COMMENT
Layer 1 (Unconsolidated fill)	Unconfined	0.02	0.50	Fetter (2001)
Layer 2 (Residual Soils)	Unconfined	0.04	0.40	Increasing silt / sand content compared to the above layer. Assumed double the specific yield of the layer 1
Layer 3 (Weathered Bringelly Shale)	Unconfined	0.05	0.1	Morris & Johnson (1967)
Layer 4 (Bringelly Shale)	Unconfined	0.01	0.01	1/5 th of the specific yield of the above layer. Specific yield / porosity values on the lower end of literature values from Morris & Johnson (1967)

Storativity values were not measured on the site (typically determined through pumping test with observation wells). As such values typical of soils and fractured rock aquifers were assumed based on literature values presented in **Table 7-3** above. Reditus note that the steady-state long-term active groundwater inflow prediction and drawdown extent is independent of the storativity and is only used for the transient model at different time steps. As such, the inherent uncertainty of the storativity value does not influence the steady-state long-term active groundwater inflow prediction and drawdown extent modelled for the drained basement.

Storativity and porosity used were based on literature estimates. Note that the values adopted for storativity and porosity, which affect both the volume of water required to be removed from the basement itself as well as the lateral extent of off-site drawdown under transient modelling conditions, are representative values for the materials based on professional experience and published literature and are not based on site specific testing. As such, there is uncertainty regarding exact values. The implications of uncertainty and sensitivity in these values are addressed in **Section 9**.

7.5 Calibration

Calibration of a model is demonstration that the model can satisfactorily reproduce measured real-world conditions.

The first objective of calibration is to find values of model parameters that allow a model to fit historical measurements of various kinds. The ultimate objective is to find model parameters that allow a model to predict future behaviour with as much confidence as possible.

7.5.1 GROUNDWATER FLOW CALIBRATION

The groundwater model was calibrated in steady-state to replicate the groundwater levels measured in the monitoring wells on 3 June 2025 (refer to **Table 5-4**). This enabled calibration of the hydraulic conductivity and recharge based on a steady-state 'snapshot' of groundwater SWLs at one single point in time whilst providing sufficient site coverage to produce spatially representative conditions, reflecting the site-specific hydraulic conductivity measured.

7.5.2 CALIBRATION ACCURACY

The groundwater flow calibration accuracy was assessed through comparison of the head residuals (difference between the observed and modelled values for groundwater levels). A negative residual indicates that the modelled value is smaller than the measured value, and a positive value indicates that the modelled value is greater than the measured value. It is rare to have residual values of 0, however the aim of calibration is to reduce the residuals to be as close to zero as possible.

Assessment of the calibration is typically conducted through statistical analysis, particularly the mean, standard deviation and root mean square (RMS). It is also important to consider the scale of the model when looking at the residual values and it is common to correct the measurements with reference to the range of observed values. For example, a residual mean of 0.1m can be large if the measured change in head across the model is 0.05m, but is small if the measured change in head is 2m. Scaling of the values is commonly conducted using the formula:

$$\text{Scaled Residual} = \frac{\text{Raw Residual}}{\text{Range of Observations}}$$

7.5.3 PRE-CALIBRATION GROUNDWATER FLOW RESULTS

Prior to calibration of the model, steady-state groundwater flow was modelled using the initial parameters specified above. The pre-calibration groundwater elevation contours and associated statistics are presented in **Figure 11a** (Layer 3), and **Figure 11b** (Layer 4) in **Appendix B**.

Whilst the initial pre-calibration values provided an approximation of the groundwater flow across the study area, the results reported a scaled RMS error of 0.36 (36%). Ideal calibration is considered to be represented by a scaled RMS error of 0%, and in all practical applications a scaled RMS error of 10% or less is considered to represent suitable accuracy for reliable predictions. As such, further detailed calibration of the model was required to reflect observed conditions.

7.5.4 PEST (PARAMETER ESTIMATION)

PEST (Parameter ESTimation) is a non-linear parameter and optimisation modelling software produced by Watermark Computing which has become the industry standard for calibration of complex models. Through the use of PEST software, the calibration process is partially automated and a rigorous mathematical methodology is applied that increases the reproducibility of the calibration process, compared to trial-and-error calibration.

PEST has been integrated into the Groundwater Vistas interface and was used in this model to calibrate the model for geospatial hydraulic conductivity values and recharge to reproduce the groundwater SWL measured at the Site. The parameter ranges adopted for the PEST calibration for hydraulic conductivity are consistent with the range of hydraulic conductivities provided in **Table 5-5**. Recharge calibration targets were set between 5% (1.06×10^{-4} m/day) and 1% (2.113×10^{-5} m/day) of average annual rainfall. Similarly, evapotranspiration calibration targets were set between 5% (8.19×10^{-5} m/day) and 1% (1.64×10^{-5} m/day).

7.5.5 CALIBRATION RESULTS AND ANALYSIS

The calibrated groundwater levels predicted by the model are shown in **Figure 12a** (Layer 3) and **Figure 12b** (Layer 4), **Appendix B**. The calibrated recharge and evapotranspiration rates, and hydraulic conductivity results from the model are presented below in **Table 7-4** below.

Table 7-4: PEST Estimation Results

PARAMETER	DESCRIPTION	VALUE (M/DAY)
Kx1 (m/day)	Horizontal hydraulic conductivity of layer 1 (fill)	4.988
Kz1 (m/day)	Vertical hydraulic conductivity of layer 1 (fill)	0.511
Kx2 (m/day)	Horizontal hydraulic conductivity of layer 2 (residual soils)	5.825×10^{-3}
Kz2 (m/day)	Vertical hydraulic conductivity of layer 2 (residual soils)	8.631×10^{-3}
Kx3 (m/day)	Horizontal hydraulic conductivity of layer 3 (weathered Bringelly Shale)	2.083×10^{-2}
Kz3 (m/day)	Vertical hydraulic conductivity of layer 3 (weathered Bringelly Shale)	0.114
Kx4 (m/day)	Horizontal hydraulic conductivity of layer 4 (Bringelly Shale)	6.456×10^{-3}
Kz4 (m/day)	Vertical hydraulic conductivity of layer 4 (Bringelly Shale)	8.858×10^{-4}
r1	Recharge rate	3.645×10^{-5}
et1	Evapotranspiration rate	8.170×10^{-5}

Overall, the calibration results of the modelled groundwater levels show a residual mean of -0.59 m and an absolute residual mean (treating all residuals as positive) of 0.59 m. This indicates that the modelled values produce an average water table equal to within +0.6 m of the measured average level (slightly overestimating heads on average, introducing a level of conservatism to the modelled groundwater inflows) and the reproduction of water levels at individual points is, on average, within 0.59 m of the measured value.

The scaled absolute residual mean is 0.100 m overall, indicating that the model is accurate to better than 10% (scaled RM of 0.1 = 10%) of the observed range of values. The scaled RMS error (equivalent to normalised root mean square deviation) is a common measure of accuracy for values predicted by a model or an estimator and the values actually observed – in this case the scaled RMS error is 0.224 (22.4%).

Reditus notes that the majority of calibration error is attributable to BH2, with a residual of -2.93 m which is an outlier. If this value was excluded, the scaled absolute residual mean would become 0.000008 m overall, indicating that the model is accurate to better than 0.0008% (scaled RM of 0.1 = 10%) of the observed range of values. In this case the scaled RMS error is 0.000014 (0.0014%). The majority of groundwater take of the proposed basement drainage system will occur in Layer 4 (Bringelly Shale), therefore the conservative modelled value in BH2 is insignificant to the purposes of this assessment.

Ideal calibration is considered to be represented by a scaled RMS error of 0%, and in all practical applications a scaled RMS error of 10% or less is considered to represent suitable accuracy for reliable predictions. The model is therefore considered to be well calibrated for the purposed of this assessment. Based on these calibration results, Reditus considers that the model is sufficiently calibrated to reproduce groundwater level conditions that reflect the geospatial variation of the measure hydraulic conductivity and suitable to allow the predictions of groundwater inflows (and subsequent drawdown extent) for the proposed drained basement design.

The calibration can also be shown graphically by plotting the measured water level against the predicted water level. Ideal calibration occurs along the 1:1 line. This is shown in the graph of Observed vs Computed Target Values provided in **Figure 7-3** below, which indicates successful calibration with a linear relationship between the heads measured at the site and the heads simulated by the model.

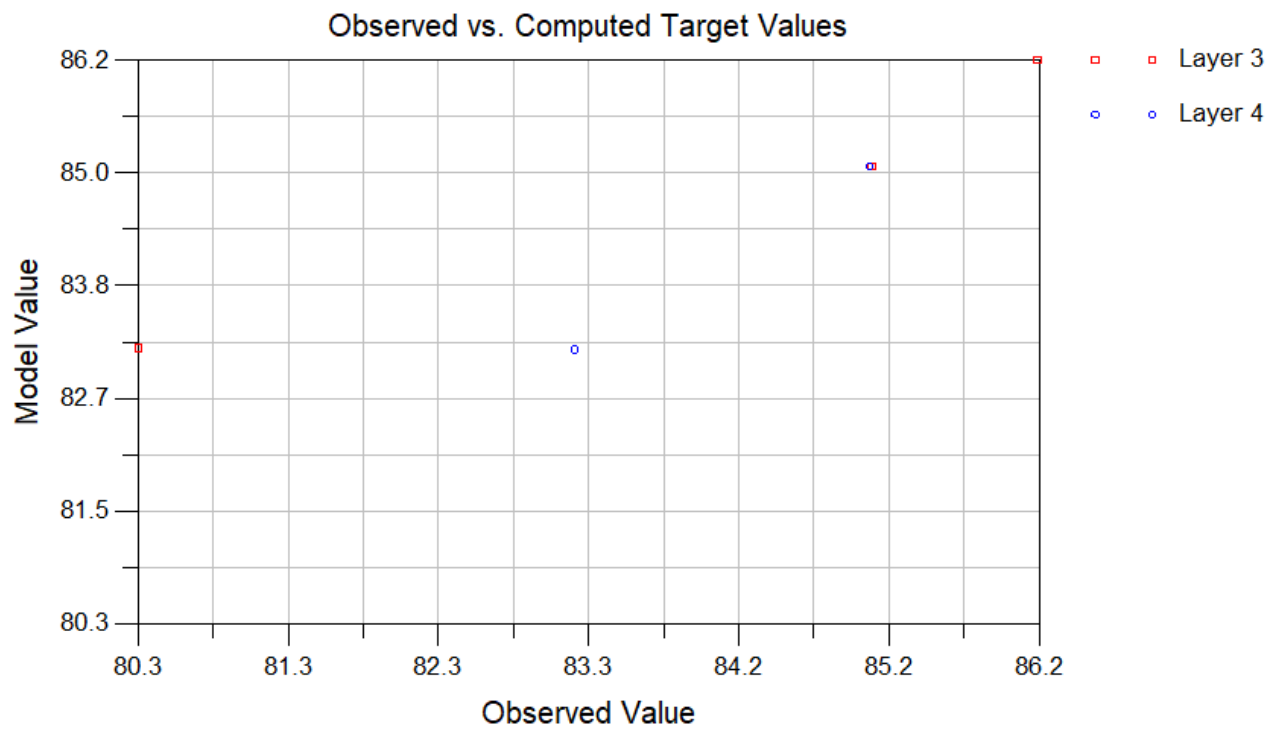


Figure 7-3 Post-Calibration: Observed vs Computed Target Values

The analysis of calibration data indicates that the model is demonstrated statistically to be adequately calibrated for the required purpose, as the flow directions and water levels are consistent with the observed values.

7.6 Modelled Scenario

To represent the drained basement dewatering scenarios, MODFLOW “DRAIN” cells were used to replicate the alignment of the drainage layer within the proposed basement. Additionally, “DRAIN” cells within layers 1-3 were added along the perimeter of each basement to simulate the effect of the strip drains. These “DRAIN” cells are presented in **Figure 7-4** below.



Figure 7-4 Drain boundary conditions

These “DRAIN” cells will remove as much water as is required to achieve the desired drawdown level (DRAIN cell stage height) and are a useful tool to allow prediction of groundwater take and drawdown from the proposed Drained Basement design. The basement footprints were filled with MODFLOW “DRAIN” cells set to have a stage-height (water extraction level) of the BELs outlined in **Table 3-1** within Layer 3 (Weathered Bringelly Shale) and Layer 4 (Bringelly Shale).

Expansion of the calibrated model was completed to replicate the proposed dewatering during operation of the drained basement. This was a transient (time varying) model, which predicted groundwater inflow rates over nominal assessment periods of construction and ongoing operation (incorporating aquifer storage parameters), also providing estimate the extent of offsite groundwater drawdown (both lateral and vertical). The model was run to provide nominal yearly snapshots, extending to 100 years to enable calculation of annual groundwater inflows over the operational lifetime of the drained basement.

- Stress Period 1 – steady state, no dewatering, replicated calibrated conditions and used as a base to calculate relative drawdown;
- Stress Period 2 – transient, active construction dewatering, 30 days divided into 30 time steps (1 day intervals)
- Stress Period 3 – transient, active construction dewatering, 335 days divided into 11 time steps (1 month intervals);



- Stress Period 4 – transient, active operation of drained basements 3,650 days divided in 9 time steps (1 year intervals);
- Stress Period 5 – transient, active operation of drained basements 32,850, divided in 9 time steps (10 year intervals).

8 Summary of Results

8.1 Groundwater Inflows

The groundwater model predicted the rate of water removal by the DRAIN cells, with representative groundwater inflow rates listed in **Table 8-1** below.

Table 8-1 Predicted Steady-state Groundwater Inflow Rates Under Drained Basement Design

SCENARIO	GROUNDWATER TAKE LONG-TERM OPERATION	
	Basement Excavation (BEL = RL 63.5 mAHD)	Deep Soils Area Excavation (BEL = RL 78.5 mAHD)
Scenario 1: Operational drained basement	8.9 ML/year	0 ML/year

Expansion of the calibrated model was completed to replicate the proposed dewatering during both the construction and operational period. This was a transient (time varying) model, which predicted groundwater inflow rates over nominal assessment periods of construction and ongoing operation (incorporating aquifer storage parameters), also providing estimate the extent of offsite groundwater drawdown (both lateral and vertical). The transient groundwater inflow rates are listed in **Table 8-2** and illustrated in **Figure 8-1** below. Note that the inflow rates and volumes presented below are primarily related to the Basement excavation only, as transient modelling predicted minimal inflows within the Deep Soil Area excavation during construction (~1.4ML), and that groundwater levels are rapidly dewatered below the Deep Soil Areas' BEL (~90 days).

Table 8-2 Predicted Groundwater Take (Transient) During Construction and Long-Term Operation

DURING CONSTRUCTION AND LONG-TERM OPERATION	INFLOW RATE (ML/YEAR)
Year 1 (Construction)	23.2
Year 2 (Operational)	18.7
Year 5 (Operational)	13.7
Year 10 (Operational)	11.3
Year 20 (Operational)	10.2
Year 50 (Operational)	9.6
Year 100 (Operational) – Steady State	8.9

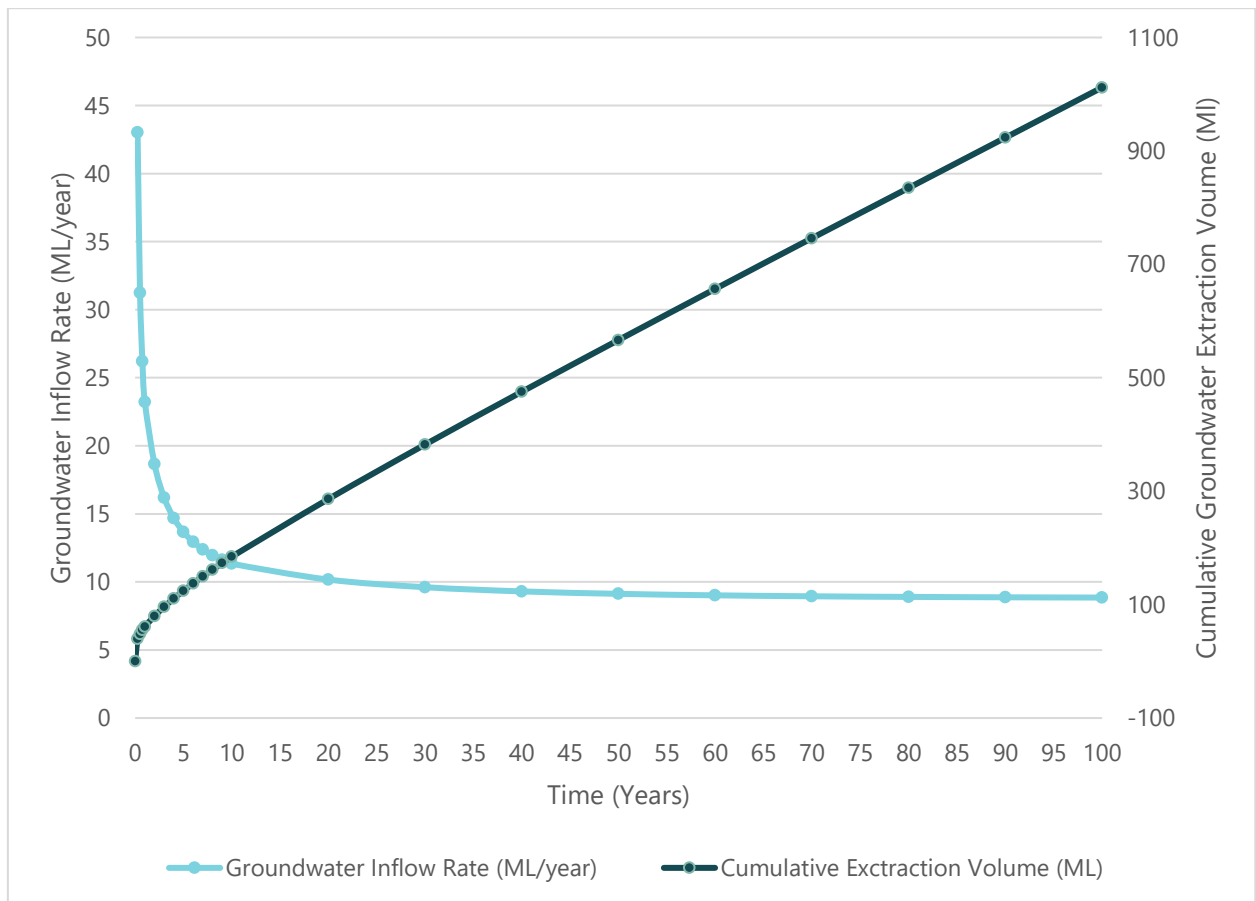


Figure 8-1 Predicted Groundwater Take (Transient) During Construction and Long-Term Operation

The predicted groundwater inflow rates are based on modelled predictions, and these values are required to be validated during excavation to verify inflows and required storage tank sizes. It should be noted that simulated groundwater inflow rates (ML/year) may not be representative in the early time steps following commencement of dewatering, as this model applies the drain cells instantaneously at the bulk excavation level, whereas dewatering would occur progressively during excavation before bulk excavation is reached. However, the cumulative groundwater take is representative, as it reflects the total groundwater volume removed from storage and the aquifer matrix, providing a reliable basis for assessing overall groundwater take. It is also noted that the steady-state model is irrespective of aquifer storage conditions.

The groundwater inflow and required dewatering rate declines as the site is dewatered which is typical of prolonged pumping of groundwater as stored water is removed from the system.

Based on the findings of the groundwater model for the Groundwater Take and Impact Assessment, Reditus predicts a total groundwater take of 23.2 ML during construction of the basement (i.e. excavation and establishment of the basement drainage systems). After construction (i.e. operation) of the drained basement groundwater take will reduce to 8.9 ML/year over time.

8.2 Groundwater Drawdowns

Simulated drawdown contours (i.e. simulated groundwater levels relative to the initial heads) at both the cessation of construction operations, and for steady state conditions, are illustrated in **Figure 13a** and **Figure 13b** of **Appendix A**. An excerpt of steady state drawdown has also been provided in **Figure 8-2** below.

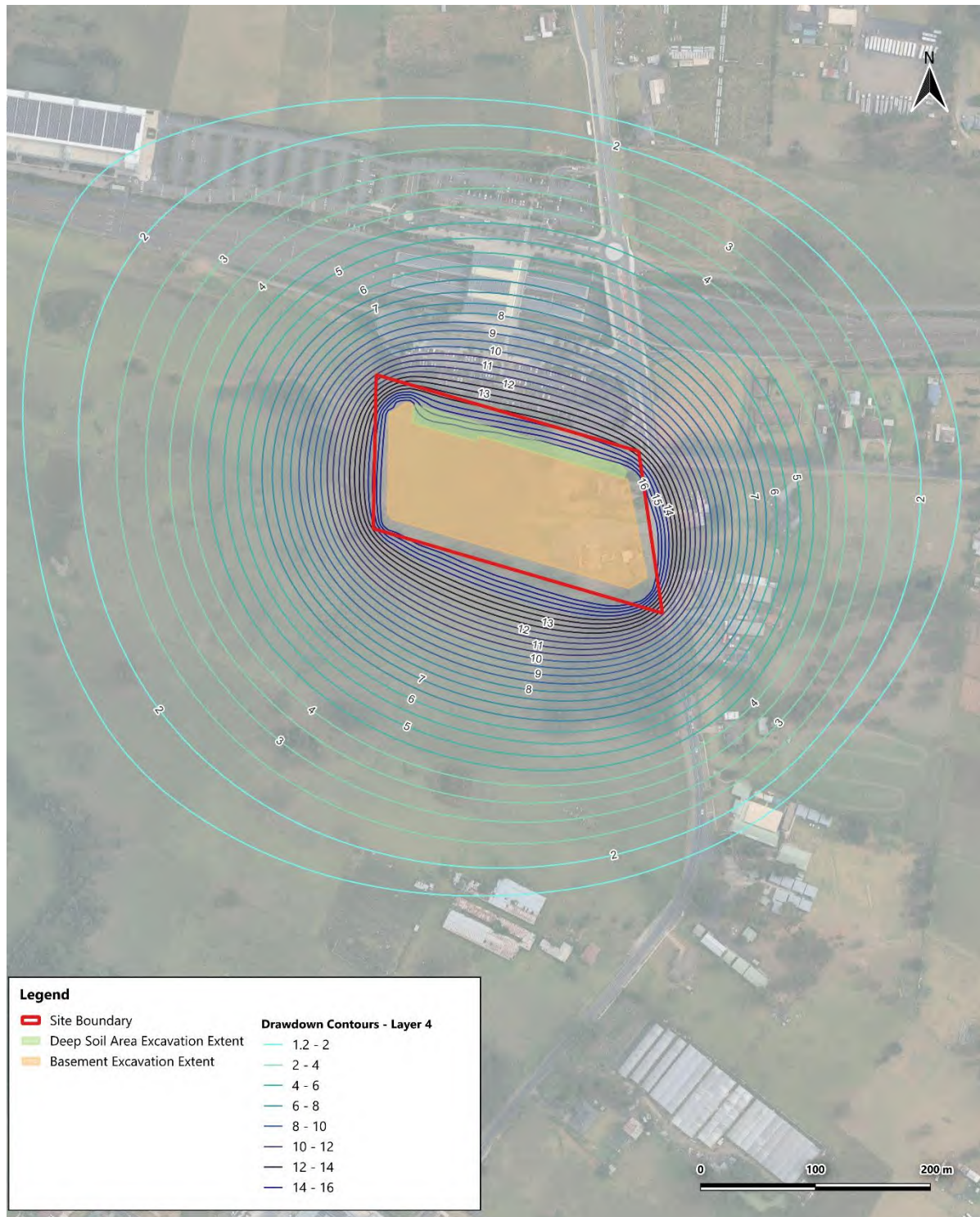


Figure 8-2 Predicted steady-state groundwater drawdown contours – Bringelly Shale

As shown in **Figure 8-2** above, the predicted long-term drawdown in the Bringelly Ashfield Shale aquifer from drained basement operation were <1.5 m beyond 310 m of the basement walls. Given that the majority of the predicted drawdowns are within the Bringelly Shale only, the potential for these drawdowns to induce settlement in overlying buildings is considered to be low. A suitability qualified geotechnical consultant will be required to determine the potential settlement impacts caused by the potential drawdown as a result of the proposed dewatering activities. Detailed geotechnical considerations are beyond the scope of this assessment.

Whilst every effort has been made to make accurate predictions in the dewatering volumes and off-site effects, it is strongly recommended that water levels be monitored regularly in the dewatered area and in surrounding properties

during construction dewatering to ensure that local variations in hydraulic properties in the aquifer do not result in unacceptable groundwater depression. Reditus note that this is a typical condition and requirement under a 'Water Supply Works Apporval' for consturciton dewatering.

9 Sensitivity and Uncertainty

Of particular interest in any numerical model are issues of uncertainty in the data and predictions. Uncertainties arise from the necessary fact that the model is an imperfect representation of real-world conditions.

9.1 Uncertainty

Uncertainty refers to aspects of the model which are not well defined. In this case there is uncertainty around the following:

- Temporal variation in groundwater level across the site;
- Ranges of hydraulic conductivity offsite and water storage capacity in the various aquifer materials (storativity and porosity have not been measured at the site and therefore literature values have been relied upon);
- Temporal variation of recharge and spatial variation of the recharge across the study area;
- Fine variation in stratigraphy. The modelled stratigraphy is a simplification of real world layered structures into broader hydrostratigraphic units
- Literature values and reasonable estimates have been used to substitute for site measurements where required.

Sensitivity analysis has been used to assess the impact of this uncertainty on the model predictions in relation to various aquifer properties.

9.2 Sensitivity

Sensitivity refers to the degree to which the model output will vary in response to a unit change in a particular input parameter. A 1:1 response is considered sensitive, a greater than 1:1 response is highly sensitive and as response less than 1:1 indicates low sensitivity. Values to which the model is sensitive should have priority in measurement to reduce uncertainty in the model predictions, and the degree of potential variation in model predictions from changes in these values should be understood.

Sensitivity analysis of the flow model was conducted to ascertain which aspects of the model had the greatest influence on the simulated groundwater elevations. Assessment was conducted with respect to hydraulic conductivity, groundwater recharge rate and evapotranspiration rate.

The model was run with each target property modified by a factor between 0.7 and 1.3 in steps of 0.1 and the resulting change in residual means was plotted. The greater the slope of a line, the greater the sensitivity of the model to the associated parameter. The resulting sensitivity analysis is presented in **Figure 9-1**. Results indicate that the model's accuracy in replicated measured groundwater levels at the site was mostly governed by the groundwater recharge rate.

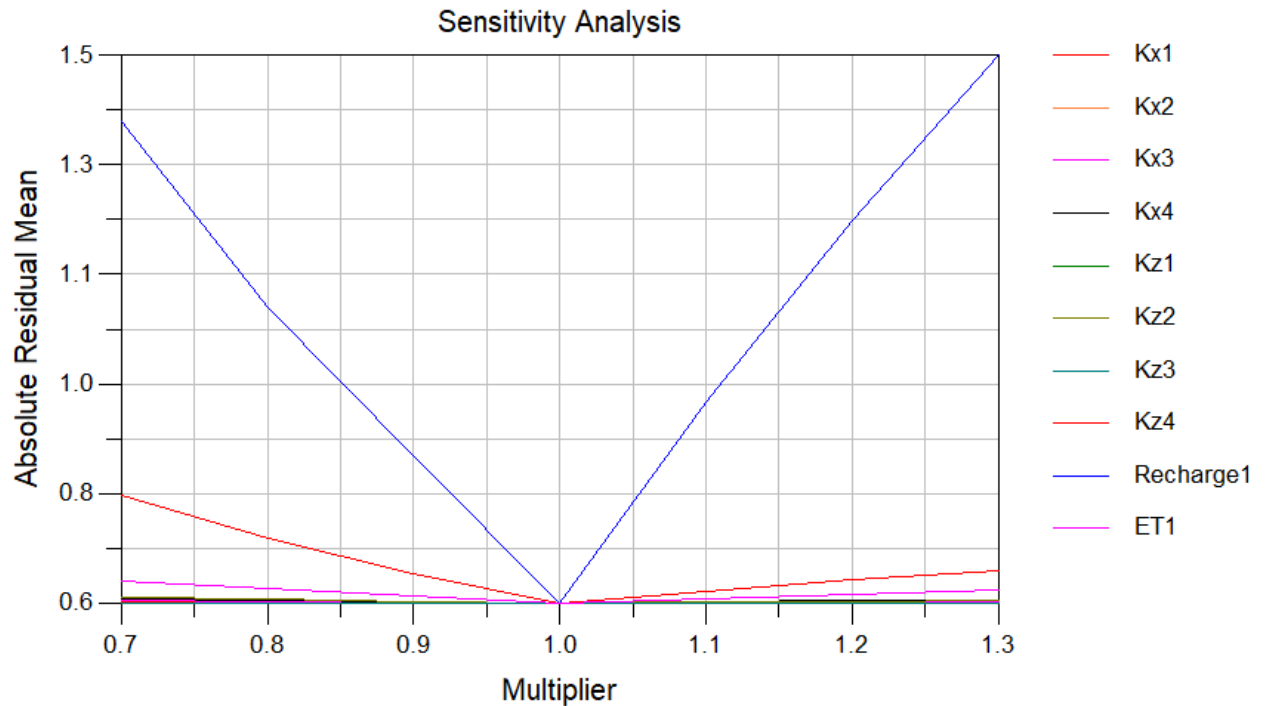


Figure 9-1: Groundwater model sensitivity analysis

The groundwater flow model was simulated and calibrated as a steady state model. Accordingly, the model is sensitive to the variation in hydraulic conductivity across the site (areas of higher and lower conductivity, and the proportional difference between them). The model is also directly sensitive to the head at the constant head boundaries, as these values control the groundwater level near this feature, however, more importantly, these control the groundwater gradient and flow direction. The boundaries were set by the natural conditions within the model domain to match the expected regional groundwater flow directions/gradients as discussed in **Section 7.3.4**.

Reditus note that the steady-state long-term active groundwater inflow prediction and drawdown extent is independent of the storativity, which is only used for the transient model component. As such, the inherent uncertainty of the storativity value does not influence the steady-state long-term active groundwater inflow prediction and drawdown extent modelled for the Drained Basement. Therefore, the steady state model is not sensitive to the storativity. A steady state flow model is, by definition, insensitive to the simulated time period.

Whilst a quantitative sensitivity analysis was included above, the model calibration allowed for these aspects through automated calibration of hydraulic conductivity and recharge rates. This allowed the model freedom in selecting optimum values for these sensitive parameters to result in the best fit for the measured groundwater levels

10 Groundwater Impact Assessment

10.1 Minimal Impact Considerations

The WMA 2000 includes the concept of ensuring “no more than minimal harm” for both the granting of water access licences and the granting of aquifer interference approvals.

The Aquifer Interference Policy includes a set of minimal impact considerations for assessing the impacts of all aquifer interference activities, including those regulated under the WMA 2000, the Water Act 1912 and those decided under other legislation. The NSW DPE (2023) Groundwater Impact Assessment Criteria provides a framework for the Minimal Impact threshold criteria.

Aquifer interference approvals are not to be granted unless the Minister is satisfied that adequate arrangements are in force to ensure that no more than minimal harm will be done to any water source, or its dependent ecosystems, as a consequence of its being interfered with in the course of the activities to which the approval relates.

Whilst aquifer interference approvals are not required to be granted, the minimal harm test under the WMA is not activated for the assessment of impacts. Therefore, this Policy establishes and objectively defines minimal impact considerations as they relate to water-dependent assets and these considerations will be used as the basis for providing advice to the Minister.

All NSW groundwater sources have been categorised as being either highly productive or less productive, based on the general character of the water source meeting or not meeting the criteria of 1500 mg/L total dissolved solids and a bore yield rate of greater than 5 L/s. This categorisation applies to a whole groundwater source as it is defined in a water sharing plan, not to the specific groundwater conditions at a particular location. The minimal impact considerations for the highly productive groundwater sources are different to those for the less productive groundwater sources.

The proposed basement drainage design will take water from the Sydney Basin Central Groundwater Source. The Bringelly Shale aquifer was considered a “Less Productive” fractured rock aquifer based on the relatively low number of registered water supply bores and expected low yields (<5 L/s).

Thresholds for minimal impact considerations have been developed for each groundwater source in NSW. The thresholds relate to impacts on groundwater table and pressure, and to groundwater and surface water quality.

Table 10-1 below provides the Impact assessment criteria for the potentially impacted groundwater sources. Based on the results of the groundwater impact assessment, the proposed drained basement water take activities are considered to be of **Minimal Impact** under the NSW DPI (2012) Aquifer Interference Policy, Water Management Act 2000 and the NSW DPE (2023) Groundwater Impact Assessment Criteria. Therefore, the proposed drained basement application for a Water Supply Works approval would likely be authorised.

Table 10-1 NSW DPE (2023) Groundwater Impact Assessment Criteria and Results – Bringelly Shale

GROUNDWATER SOURCE	#	IMPACT ASSESSMENT CRITERIA	ASSESSMENT RESULTS
Fractured Rock (Bringelly Shale)	1	Cumulative drawdown over a ten-year period must not cause drawdown to exceed 0.1 metres from the current recovered water level, at any: - GDE identified in the Water Sharing Plan - High priority culturally significant site	No high priority GDEs or high priority culturally significant sites have been identified within a 2 km radius of the site, and drawdowns exceeding 0.1m at a distance of 2 km from the site have not been predicted during modelling.
	2	Cumulative extraction over a ten-year period must not cause drawdown to exceed 10% of the Total Available Drawdown to a maximum of 2 metres at any: 3rd or higher order connected surface water source - Vegetation GDE identified in the Water Sharing Plan	The proposed drained basements are not expected to cause the water level in the Bringelly Shale aquifer to drop below 10% of the Total Available Drawdown (TAD) at either a 200m distance of a production bore, nor at any other water supply work, based on the following: - The TAD of the Bringelly Shale aquifer was estimated assuming a unit thickness of 50m in the study area, of which 10% of the TAD equates to 5m drawdown. Therefore, the maximum value of 2m applies. - There are no connected surface water sources or vegetation GDEs identified within the predicted extents of drawdown >2m.
	3	Cumulative extraction over a ten-year period must not cause the recovered water level (metres below ground level) to drop below 25% of the Relative Total Available Drawdown at: - a distance of 200 metres from any production water supply works - any other water supply work (e.g. at any basic landholder rights bores).	The proposed drained basements are not expected to cause the water level in the Bringelly Shale aquifer to drop below 25% of the relative Total Available Drawdown (TAD) at either a 200m distance of a production bore, nor at any other water supply work, based on the following: - The Relative TAD of the Bringelly Shale aquifer was estimated assuming a unit thickness of 50m in the study area. Of which, 25% of the relative TAD equates to 12.5m drawdown. - Whilst the predicted steady-state drawdown in the Bringelly Shale unit was >12.5m within approximately 20m of the basement excavation, there are no water supply works identified within the predicted extents of drawdown >2m.
	4	Additional drawdown over a ten-year period cannot exceed 10% of the Total Available Drawdown to a maximum of 2 metres at any 3rd - party water supply work	100% of the TAD is approximately 50 m (saturated thickness of the Bringelly Shale aquifer). Based on this, 10% of the TAD is 5 metres. Therefore, the drawdown limit is the maximum of 2 metres. - There are no water supply works identified within the predicted extents of drawdown >2m as a result of the proposed drained basements.

11 Construction Impact Assessment

11.1 Construction Impacts / Risk Assessment

Assessment of surface water and groundwater potential impacts, associated risks during construction works and mitigation measures is presented in **Table 11-1** below.

Table 11-1. Potential Construction Risks and Mitigation Measures

RISK	IMPACT TYPE	POTENTIAL IMPACTS	MITIGATION MEASURES
Construction activities that disturb soils from excavation, dust suppression and land clearing works	Surface water	Pollute receiving waterbodies (local stormwater network and Brisbane Water) with increased sediment mobilisation, especially during rain events	Soil and water management plans incorporated in a Construction Environmental Management Plan (CEMP) to manage risk.
Stockpiling of soils and sandstone during basement construction works	Surface water	Pollute the receiving water bodies with increased sediments from improper stockpiling and containment of materials	Erosion and sediment control measures in accordance with Blue Book (DECC, 2008).
Chemical spills	Surface water and groundwater	Contaminate surface water via run-off into receiving waterbodies or underlying groundwater via seepage into the ground	Storage of hazardous liquids and refuelling operations to take place in bunded areas to reduce chance of spillage causing impacts
Intercepting and dewatering of groundwater during basement construction	Groundwater	Impacts to potential surrounding GDEs, and water supply bores within the vicinity of the basement construction caused by drawdown during dewatering activities	Minimise groundwater ingress during dewatering activities (such as grout injection into water bearing fractures). Minimise depths of excavation below groundwater table during basement construction.
Discharge of groundwater during construction dewatering	Surface water	Contamination of receiving water body (stormwater network and Brisbane Water) and associated water courses down-stream of the groundwater discharge point	All water to be discharged during basement construction dewatering to comply with adopted discharge water quality criteria (DWQC) and Council requirements (if necessary))
Construction of access tracks which can reduce rainwater infiltration and increase runoff into waterbodies	Surface water	Increase run-off during rain events has potential to transport contaminants and sediments into surface water bodies	Minimise area to be repurposed as access tracks where possible.

RISK	IMPACT TYPE	POTENTIAL IMPACTS	MITIGATION MEASURES
Impacts on GDEs and local registered bores	Groundwater and surface water	Impact to local high priority GDEs and groundwater users from drawdown impact of basement excavation	Impacts to GDEs and local groundwater users as a result of construction activities have not been identified in the numerical modelling and impact assessment.

11.2 Surface Water Impacts

11.2.1 WATER QUALITY IMPACTS

The construction activities associated with the proposed development that have the potential to impact the receiving water body water quality include:

- Accidental spills of chemicals, oils, grease and hydrocarbons from plant equipment used during construction works.
- Heavy metals from plant equipment during construction works.
- Erosion and sedimentation caused by mobilised soils from exposed areas and stockpiles.

11.2.2 FLOW REGIME

There is a potential for the proposed development, including groundwater extraction during the basement construction phase, to adversely affect the natural flow regime of nearby surface water bodies (including the unnamed creeks to the east and west of the site) by increasing the volume of natural flow during dewatering discharge to local stormwater and the receiving surface water. Surface water bodies in the vicinity of the site are expected to receive rainfall runoff from the surrounding urban environment and therefore flow is expected to be from rainfall fluctuation.

Given the dominant influence of rainfall on surface water levels and flows, there is a potential for adverse impacts to the nature flow regime of nearby creek systems as a result of groundwater discharge to stormwater during basement dewatering activities.

11.3 Groundwater Impacts

11.3.1 WATER QUALITY IMPACTS

The pollutants identified that have the potential to impact the groundwater quality during the construction phase works of the proposed development include:

- Accidental spills of chemicals, oils, grease and hydrocarbons from plant equipment used during construction works which can leach into the groundwater.
- Heavy metals from plant equipment during construction works leaching into the groundwater.
- Dewatering during construction phase basement excavation works.

Dewatering groundwater during basement construction can impact the water quality of receiving water body, associated water courses and environmental receptors. Based on groundwater quality results discussed in **Section 5.4.7**, the water to be discharge to stormwater during the construction phase of the development will require treatment to adhere to relevant guidelines and the following criteria at a minimum:

- Concentration of suspended solids must not exceed 50 mg/L.
- The pH of the water must be between 6.5 and 8.4.
- The water must contain no visible oil or grease.
- The turbidity of the water must not exceed 10 NTU.

- The water must not contain any substance known to be toxic to aquatic life.

Based on the results of the groundwater sampling undertaken at the site to date, the quality of the water that is to be discharged during construction phase dewatering will require management in order to meet the above criteria which can be addressed in a Dewatering Management Plan (DMP).

Currently all data collected from the site supports that the underlying groundwater does not meet the minimum threshold for discharge to stormwater due to impacts of turbidity, nutrients and select heavy metals (aluminium, copper, nickel and zinc). Reditus advise that the groundwater is treated to an acceptable level prior to discharge.

11.3.2 GROUNDWATER DRAWDOWN IMPACTS

As discussed in **Section 8.2** and the assessment of minimal impact considerations in accordance with the AIP (2012) and NSW DPE (2023) Groundwater Impact Assessment Criteria (**Table 10-1**), the predicted steady-state drawdown in the Sydney Basin-Central Groundwater Source in the Bringelly Shale (layer 4) was <1.5 m within 310 m of the development. It is noted that drawdown during the construction phase (year 1) is expected to be lower than the long-term (steady-state) drawdown.

Additionally, no drawdown impacts to high priority GDEs or high priority culturally significant sites were identified in the groundwater model drawdown extent.

12 Operational Impact Assessment

12.1 Operational Impacts / Risk Assessment

Assessment of surface water and groundwater potential impacts and associated risks during the operation phase of the development as well as the mitigation measures is presented in **Table 12-1** below.

Table 12-1. Operational Phase Impacts, Risks and Mitigation Measures

RISK	IMPACT TYPE	POTENTIAL IMPACTS	MITIGATION MEASURES
Increase in hardstand areas across the site	Surface water and groundwater	Increase the potential pollution generation and surface water runoff Decrease in groundwater recharge	Limit hardstand to areas that it is required.
Increase vehicle movement and parking	Groundwater	Fuel and oil spillages potentially contaminating the underlying groundwater via seepage into the ground	Basement hardstand likely to prevent any potential seepage into the ground
Soils stabilised incorrectly and failed revegetation leading to loose soils across site	Surface water	Soils and sediments become mobile and pollute local stormwater network and receiving surface water bodies	Ensure soils are stabilised and revegetation is effective by implementing revegetation management measures and soil erosion management plans Soil management including revegetation and soil compaction will form part of the CEMP
Discharge of groundwater during operational phase dewatering	Surface water and groundwater	Contamination of stormwater network and receiving surface water bodies	All water to be discharged during operational phase dewatering to comply with adopted discharge water quality criteria (DWQC) to be outlined within the future/updated site DMP.
Impacts on GDEs and local registered bores	Surface water and groundwater	Impact to GDEs and groundwater users from drawdown impact of basement excavation	Impacts to GDEs and local groundwater users as a result of construction activities have not been identified in the numerical modelling and impact assessment.

12.2 Surface Water Impacts

12.2.1 WATER QUALITY IMPACTS

The operational phase activities associated with the proposed development that have the potential to impact the local stormwater network and receiving surface water body water quality include:

- Spills or litter generated from major maintenance activities
- Erosion and sedimentation caused by mobilised soils from exposed areas.

12.2.2 FLOW REGIME

It is considered that there is a very low potential for the proposed development, including any groundwater extraction during the operational phase, to adversely affect the natural flow regime of nearby surface water bodies (Adjacent unnamed creeks and Kemps Creek). Surface water bodies in the vicinity of the site are expected to receive rainfall runoff from the surrounding urban environment and therefore flow is expected to be from rainfall fluctuation.

Given the dominant influence of rainfall on surface water levels and flows, there is a potential for adverse impacts to the nature flow regime of nearby creek systems as a result of groundwater discharge to stormwater during basement dewatering activities.

12.3 Groundwater Impacts

12.3.1 WATER QUALITY IMPACTS

The pollutants identified that have the potential to impact the groundwater quality during the operational phase works of the proposed development include:

- Dewatering during operational phase of the proposed 'drained basement'.

Continued dewatering of groundwater can impact the water quality of receiving water body, associated water courses and environmental receptors. Based on groundwater quality results discussed in **Section 5.4.7**, the water to be discharge to stormwater during the ongoing operational phase of the development will require treatment to adhere to the following criteria at a minimum:

- Concentration of suspended solids must not exceed 50 mg/L.
- The pH of the water must be between 6.5 and 8.5.
- The water must contain no visible oil or grease.
- The turbidity of the water must not exceed 25 NTU.
- The water must not contain any substance known to be toxic to aquatic life.

Based on the results of the groundwater sampling undertaken at the site to date, the quality of the water that is to be discharged by continued dewatering will require management in order to meet the above criteria which can be addressed in a future Long-term Dewatering Management Plan (LTDMP).

Currently all data collected from the site supports that the underlying groundwater does not meet the minimum threshold for discharge to stormwater due to criteria exceedances of nutrients and metals. Reditus advise that the groundwater is treated to an acceptable level prior to discharge.

12.3.2 GROUNDWATER DRAWDOWN IMPACTS

As discussed in **Section 8.2** and the assessment of minimal impact considerations in accordance with the AIP (2012) and NSW DPE (2023) Groundwater Impact Assessment Criteria (**Table 10-1**), the predicted steady-state drawdown in the Sydney Basin Central Groundwater Source in the Bringelly Shale (layer 4) was <1.5 m within 310 m of the development. It is noted that drawdown during the construction phase (year 1) is expected to be lower than the long-term (steady-state) drawdown.

Additionally, no drawdown impacts to high priority GDEs or high priority culturally significant sites were identified in the groundwater model drawdown extent.

13 Cumulative Impacts

Assessment of potential cumulative impacts for the proposed development includes review of surrounding land zoning, as well as developments and proposals that have the potential to increase the risk to surface water and groundwater at the site.

Review of the State Environmental Planning Policy (Precincts – Western Parkland City) – Southwest Growth Centre 2021 land zoning map indicates the surrounding land is zoned as follows:

- **North:** Infrastructure (SP2 Rail) for the railway corridor, then Mixed Use (B4) and Public Recreation (RE1)
- **South:** Commercial Core (B3), then (SP2 Road) for Rickard Road, then Business Park (B7)
- **East:** Infrastructure (SP2 Road) for Rickard Road, then Business Park (B7) and Public Recreation (RE1)
- **West:** Mixed Use (B4), then Public Recreation (RE1) and Infrastructure (SP2 Drainage) comprising local drainage for an unnamed creek.

The Mixed Use (B4), Commercial Core (B3) and Business Park (B7) land zoning to the north, south and east of the site will allow for other significant developments to occur within the vicinity of the site, which could have cumulative impacts, particularly if ongoing dewatering activities are also proposed. Additionally, **Table 13-1** below identifies current and potential future projects that have either been approved, or under construction, and their cumulative impact considerations.

It is noted that all projects listed below are either beyond the expected maximum drawdown extent from the site or do not involve the construction of a drained basement.

The biggest risk for surface water and groundwater cumulative impacts from the proposed development relates to the proposed ongoing dewatering activities at the site (i.e., proposed 'drained basement'). Given that several other basements are currently under approval within the vicinity of the site (refer to **Table 13-1** below), there are potential cumulative impacts that may exist as a result of the combined dewatering activities from such developments. Reditus notes that steady drawdowns of up to ~4m were predicted within the closest proposed basement development (156-166 Rickard Road – approximately 125m south east of the site), and therefore further consideration of cumulative impacts is warranted.

Table 13-1 Identified development projects

REFERENCE	DEVELOPMENT DESCRIPTION	STATUS	DIRECTION
SSD-84430209	156-166 Rickard Road, Leppington (Leppington Residential Core Precinct – Site B) Mixed-use residential precinct comprising 1500 apartments across 10 buildings, commercial/retail floor space and open space. Basement carparking noted on lower ground and basement levels.	Scoping report issued May 2025. SEARs issued June 2025, EIS preparation in progress	125 m southeast
SSD-94455963	122 Dickson Road, Leppington Build-to-Rent development with up to 800 dwellings. Stage 1 comprises approximately 100 dwellings, including basement parking, landscaping, internal roads and associated works.	SEARs issued October 2025, Environmental Impact Statement preparation in progress.	550 m west
SSD-82157706	213 Bringelly Road, Leppington Mixed-use development including construction of two residential flat buildings and on shop-top housing development with 544 dwellings.	SEARs expired	600 m northeast
SSD-87123457	297 Bringelly Road, Leppington Mixed use development comprising 1015 apartments, basement parking and 20,000 m² of commercial floor space.	SEARs issued July 2025, Environmental Impact Statement preparation in progress.	490 m northeast
SSD-82158457	230 Rickard Road, Leppington Mixed-use development inclusive of residential, retail, office premises, childcare centre and hotel uses (approximately 900 dwellings).	SEARs expired	400 m north
DA2025/455	141 Byron Road, Leppington Mixed-use development including construction of twelve buildings, shop top housing for 865 apartments, ground floor commercial	Returned to council.	550 m southeast



tenancies and four levels of
basement car parking.

DA2024/313

182 Byron Road, Leppington

Includes construction of 283
apartments across four residential
flat buildings and basement car
parks.

Preliminary Assessment
completed July 2024, with DA
lodged with Camden Council in
May 2026.

560 m east

Additional information was
requested from Council on the
25th of May 2026.

14 Mitigation and Management Measures

14.1 Construction Phase

14.1.1 DEWATERING MANAGEMENT AND MEASURES

Monitoring of the discharge water is to be completed in accordance with the future DMP. Construction phase groundwater monitoring is to be completed by a suitably qualified person, using calibrated equipment to collect and analyse samples that are representative of the water to be discharge from the basement excavation works. Results will be compared to discharge water quality criteria. Council will be notified if any results indicate an adverse impact to the environment.

14.1.2 DRAWDOWN IMPACT MEASURES AND MITIGATION

Potential impacts to surface water and groundwater as a result of drawdown of the water table during basement excavation and construction dewatering activities has been discussed previously in **Section 11**.

Mitigation and management measures for the identified potential impacts are to be included in an updated / future DMP or as part of future Groundwater Management Plan (GMP). The DMP / GMP would include strategies to manage potential impacts, including:

- Monitoring of groundwater elevations surrounding the basement excavation during the construction period including off-site drawdown monitoring.
- Outlining mitigation and management measures in the instance that groundwater discharge quantities exceed the expected discharge quantity which would include ceasing of dewatering activities.

14.1.3 POLLUTION OF SURFACE WATER AND GROUNDWATER

To appropriately manage the impacts of pollutants and sediments on surface water and groundwater during the construction works. A Construction Environment Management Plan (CEMP) is to be implemented. The CEMP will address the potential risks and impacts to the receiving water body associated with hazardous chemical spillages, loose soil and increased run-off from increased hardstand areas, and will develop adequate mitigation measures that would typically include:

- Bunding of storage areas that contain hazardous goods
- Staging of construction works to minimise impacts
- Implement adequate site drainage to prevent ponding of water in active areas that can potentially mobilise contaminants and seep into groundwater or run-off into surface water bodies.
- Soil management plans to appropriately manage revegetation and proper compaction of soils to reduce sedimentation impact to receiving water bodies.
- Implement stormwater management designs that appropriately manage potentially contaminated surface water run-off.

Construction related risks such as earthworks, spills and stockpiling of soils will be generally managed in accordance with the Blue Book (Landcom 2004/DECC, 2008).

14.2 Operational Phase

14.2.1 DEWATERING MANAGEMENT AND MEASURES

Operational long-term dewatering for the life of the development will be required for the proposed drained basement. Implementation of filtration systems that will allow constant management of groundwater discharge is required to ensure that the water being collected in the basement sump meets the discharge water quality criteria before being discharge to the stormwater system and the receiving surface water environment. Discussion, recommendations and implementation of the systems required for drained basement groundwater discharge, investigation and management will be presented in a future site Long Term Dewatering Management Plan (LTDMP).

14.2.2 DRAWDOWN IMPACT MEASURES AND MITIGATION

The impacts associated with drawdown during the operational phase of the development are to be managed via long-term monitoring of groundwater levels over the life of the development. Although it is expected that the water table will stabilise, climatic conditions including prolonged wet or dry periods can have significant impacts to groundwater levels. The change in water level caused by climatic conditions and the basement carpark could potentially create a cumulative effect on the groundwater level. Mitigation measures for the operational phase drawdown impacts will be presented in the future site LTDMP.

14.2.3 POLLUTION OF SURFACE WATER AND GROUNDWATER

Operational phase risk of potential pollution to surface water and groundwater is considered to be minimal. However, potential risks including risks associated with mobilisation of dissolved metals leaching in groundwater and surface waters will be addressed in the future site LTDMP.

14.3 Reporting

Appropriate management systems will include the reporting and recording of monitoring outcomes, significant water quality impacts and associated intervention measures should occur as frequently as once a month for the construction period and the operational period of the development, or when necessary, such in the instance that an incident was to occur. The requirements, roles and responsibilities of the principal contractors including reporting responsibilities to the relevant government bodies will be discussed in further detail in the DMP.

15 Conclusion

The findings of this report include characterisation of the existing environment at the site, a review of the of potential impacts to the surface water and groundwater environment from the proposed development, review of relevant legislation and policy relating to the development and mitigating measures for the identified impacts. The report considers the impacts that have the potential to adversely affect the surface water and groundwater in the context of the construction phase and the operational phase of the development.

Surface water run-off from the site is expected to flow towards two separate unnamed creeks, located approximately 45m northwest and 800m east of the site. It is anticipated that surface water will ultimately flow along the ephemeral waterways of Kemps Creek, and South Creek, before ultimately discharging into the Hawkesbury River, located approximately 38.5 km northwest of the site. No water quality data is available for the potential surface water run-off or the receiving environment. Based on groundwater quality data collected at the site to date, groundwater discharged as part of the proposed dewatering activities will likely require treatment to meet the minimum threshold for discharge to stormwater.

The groundwater impacts associated with the basement excavation have been primarily assessed based on the modelled inflow calculations and probable drawdown expectations during the construction phase and operational phase of the development. Given the absence of groundwater users (registered water supply works) or Groundwater Dependant Ecosystems (GDEs) within the estimated drawdown extent of the proposed drained basement, impacts to these receptors were considered low risk.

Based on the results from the numerical groundwater model completed for the site, the predicted long-term steady-state groundwater take was **8.09 ML/year**, whilst the predicted groundwater take during the construction phase (year 1) was **23.2 ML/year**. Reditus consider that the predicted groundwater inflows can be effectively managed under a 'drained basement' design, with the estimated inflows and drawdown meeting the relevant impact assessment criteria of 'Minimal Impact' under the AIP 2012 and WMA 2000.

It is noted that a Water Access Licence (WAL) and Water Supply Works Approval will likely be required for the ongoing operational phase dewatering activities given the expected inflow volumes exceed the 3 ML/year exemption limit.

Other potential impacts to surface water and groundwater during both the construction and operational phase of the proposed development including potential chemical spillages, increase in hardstand areas, increase in potentially contaminating activities such as vehicle movement, incorrect soil stabilisation and other construction related impacts and are considered to be manageable with appropriate mitigation measures and management plans.

16 Limitations

The report or document does not purport to provide legal advice and any conclusions or recommendations made should not be relied upon as a substitute for such advice.

The report does not constitute a recommendation by Reditus for the client (Leppington (1) 88 Development Pty Ltd) or any other party to engage in any commercial or financial transaction and any decision by the client or other party to engage in such activities is strictly a matter for the client.

The report relies upon data, surveys, measurements and results taken at or under the site at particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the client. Furthermore, the report has been prepared solely for use by the client and Reditus accepts no responsibility for its use by other parties. The client agrees that Reditus' report or associated correspondence will not be used or reproduced in full or in part for promotional purposes and cannot be used or relied upon by any other individual, party, group or company in any prospectus or offering. Any individual, party, group or company seeking to rely this report cannot do so and should seek their own independent advice.

No warranties, express or implied, are made. Subject to the scope of work undertaken, Reditus assessment is limited strictly to identifying typical environmental conditions associated with the subject property based on the scope of work and testing undertaken and does not include and evaluation of the structural conditions of any buildings on the subject property or any other issues that relate to the operation of the site and operational compliance of the site with state or federal laws, guidelines, standards or other industry recommendations or best practice. Scope of work undertaken for assessments are agreed in advance with the client and may not necessarily comply with state or federal laws or industry guidelines for the type of assessment conducted.

Additionally, unless otherwise stated Reditus did not conduct soil, air or wastewater analyses including asbestos or perform contaminated sampling of any kind. Nor did Reditus investigate any waste material from the property that may have been disposed off the site, or undertake an assessment or review of related site waste management practices.

The results of this assessment are based upon (if undertaken as part of the scope work) a site inspection conducted by Reditus personnel and/or information from interviews with people who have knowledge of site conditions and/or information provided by regulatory agencies. All conclusions and recommendations regarding the property are the professional opinions of the Reditus personnel involved with the project, subject to the qualifications made above.

While normal assessments of data reliability have been made, Reditus assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of Reditus, or developments resulting from situations outside the scope of this project/assessment.

Reditus is not engaged in environmental auditing and/or reporting of any kind for the purpose of advertising sales promoting, or endorsement of any client's interests, including raising investment capital, recommending investment decisions, or other publicity purposes. Reditus assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of Reditus, or developments resulting from situations outside the scope of this project.

Information relating to soil, groundwater, waste, air or other matrix conditions in this document is considered to be accurate at the date of issue. Surface, subsurface and atmospheric conditions can vary across a particular site or region, which cannot be wholly defined by investigation. As a result, it is unlikely that the results and estimations presented in this report will represent the extremes of conditions within the site that may exist. Subsurface conditions including contaminant concentrations can change in a limited period of time and typically have a high level of spatial heterogeneity.

From a technical perspective, there is a high degree of uncertainty associated with the assessment of subsurface, aquatic and atmospheric environments. They are prone to be heterogeneous, complex environments, in which small subsurface features or changes in geologic conditions or other environmental anomalies can have substantial impact on water, air and chemical movement.

Major uncertainties can also occur with source characterisation, assessment of chemical fate and transport in the environment, assessment of exposure risks and health effects, and remedial action performance. These factors make uncertainty an inherent feature of potentially impacted sites. Technical uncertainties are characteristically several orders of magnitude greater at impacted sites than for other kinds of projects.

Reditus' professional opinions are based upon its professional judgment, experience, and training. These opinions are also based upon data derived from the limited testing and analysis described in this report or reports reviewed. It is possible that additional testing and analysis might produce different results and/or different opinions or other opinions. Reditus has limited its investigation(s) to the scope agreed upon with its client. Reditus believes that its opinions are reasonably supported by the testing and analysis that has been undertaken (if any), and that those opinions have been developed according to the professional standard of care for the environmental consulting profession in this area at this time. Other opinions and interpretations may be possible. That standard of care may change and new methods and practices of exploration, testing and analysis may develop in the future, which might produce different results.

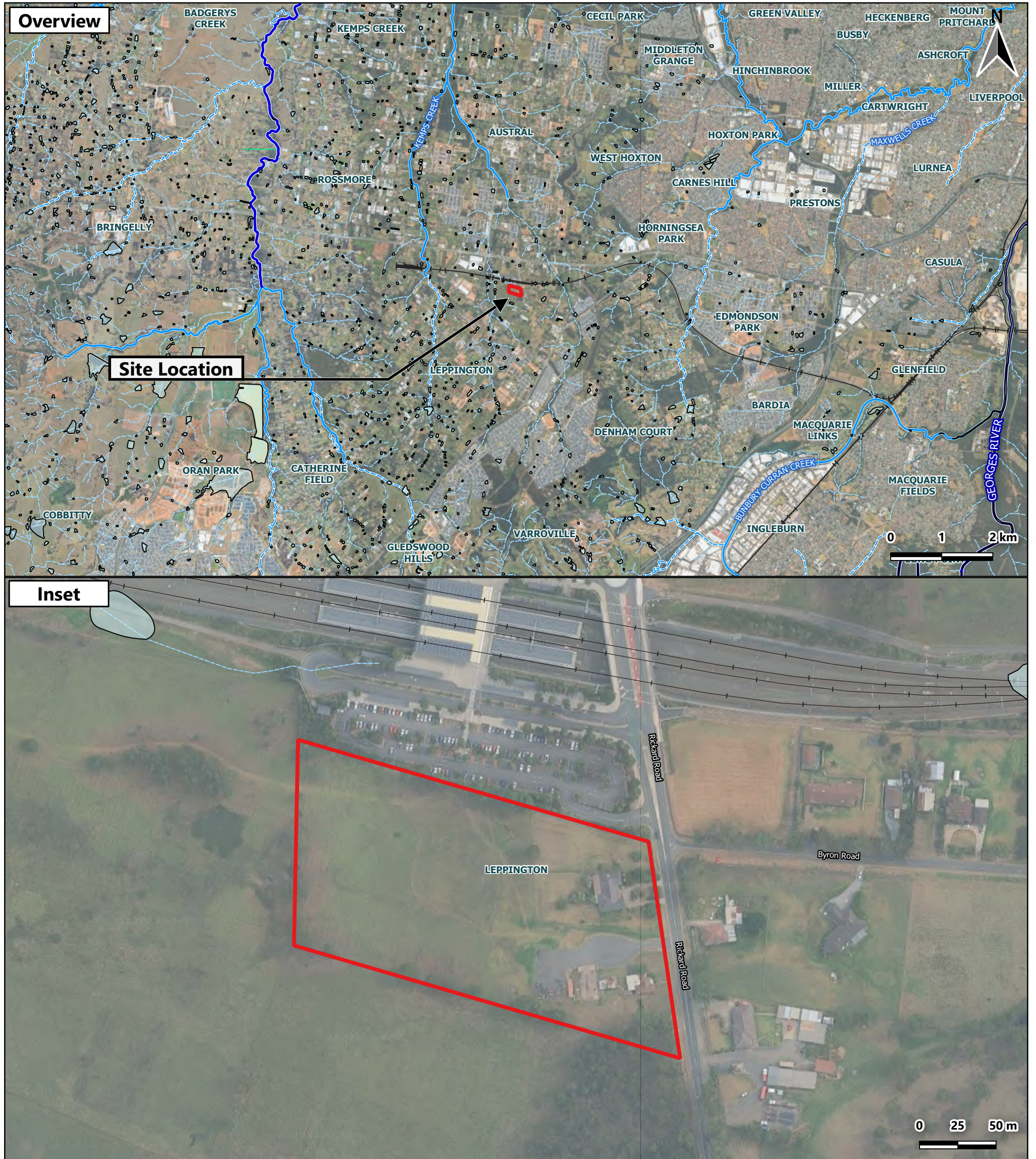
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Figures

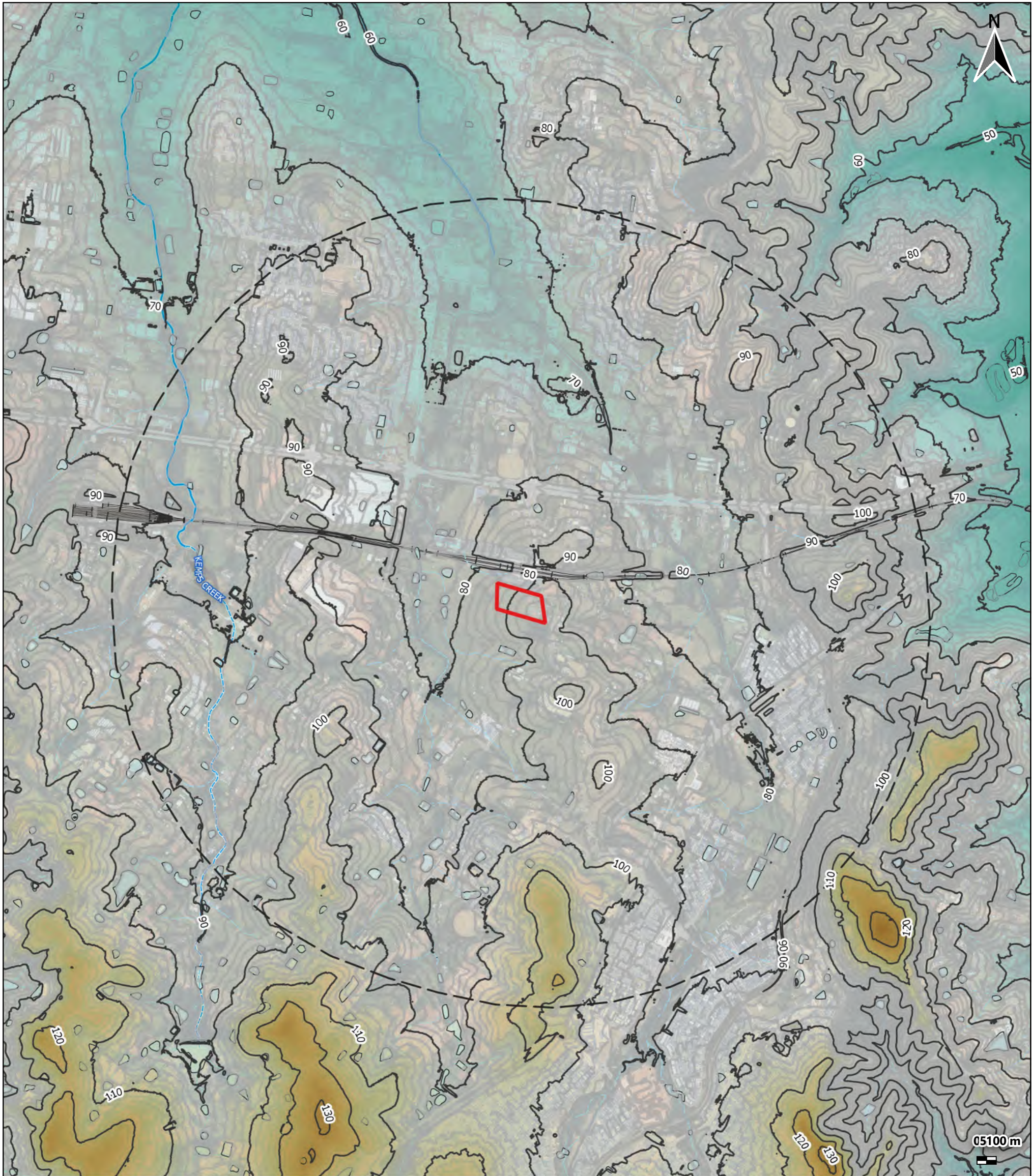




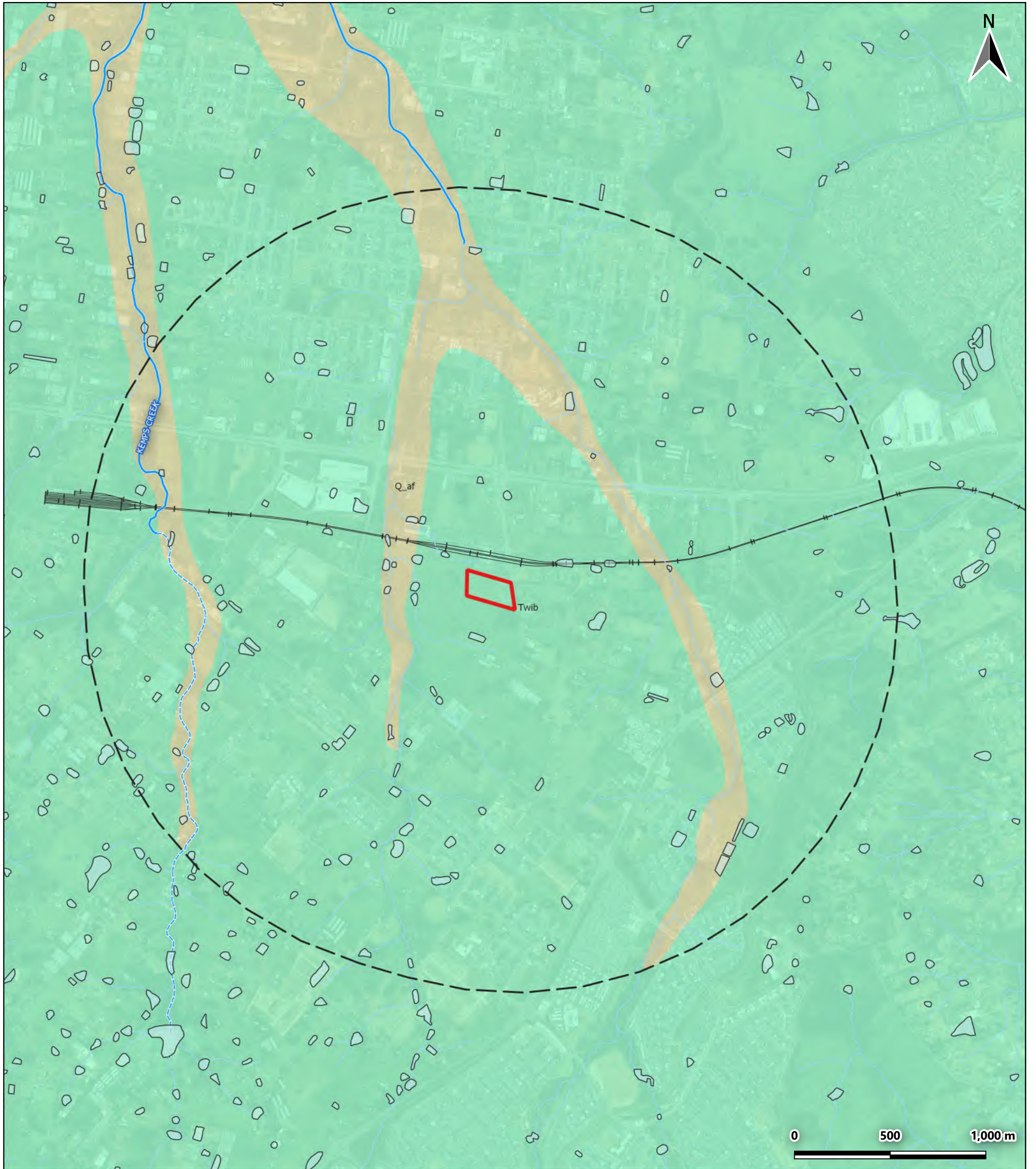
Map 26157 rp01 f01_siteloc v01		Legend SiteBoundary Railways Surface Water Watercourses Rivers Stream (Perennial) Stream (Non-Perennial) Unnamed Stream (Non-Perennial) Other Channels	Figure 1 - Site Location 173 & 183 Rickard Road, Leppington 26157 - Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd
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Author TL	Approver		
Data Source Metromap, Google Maps, Open Street Map, NSW Government			



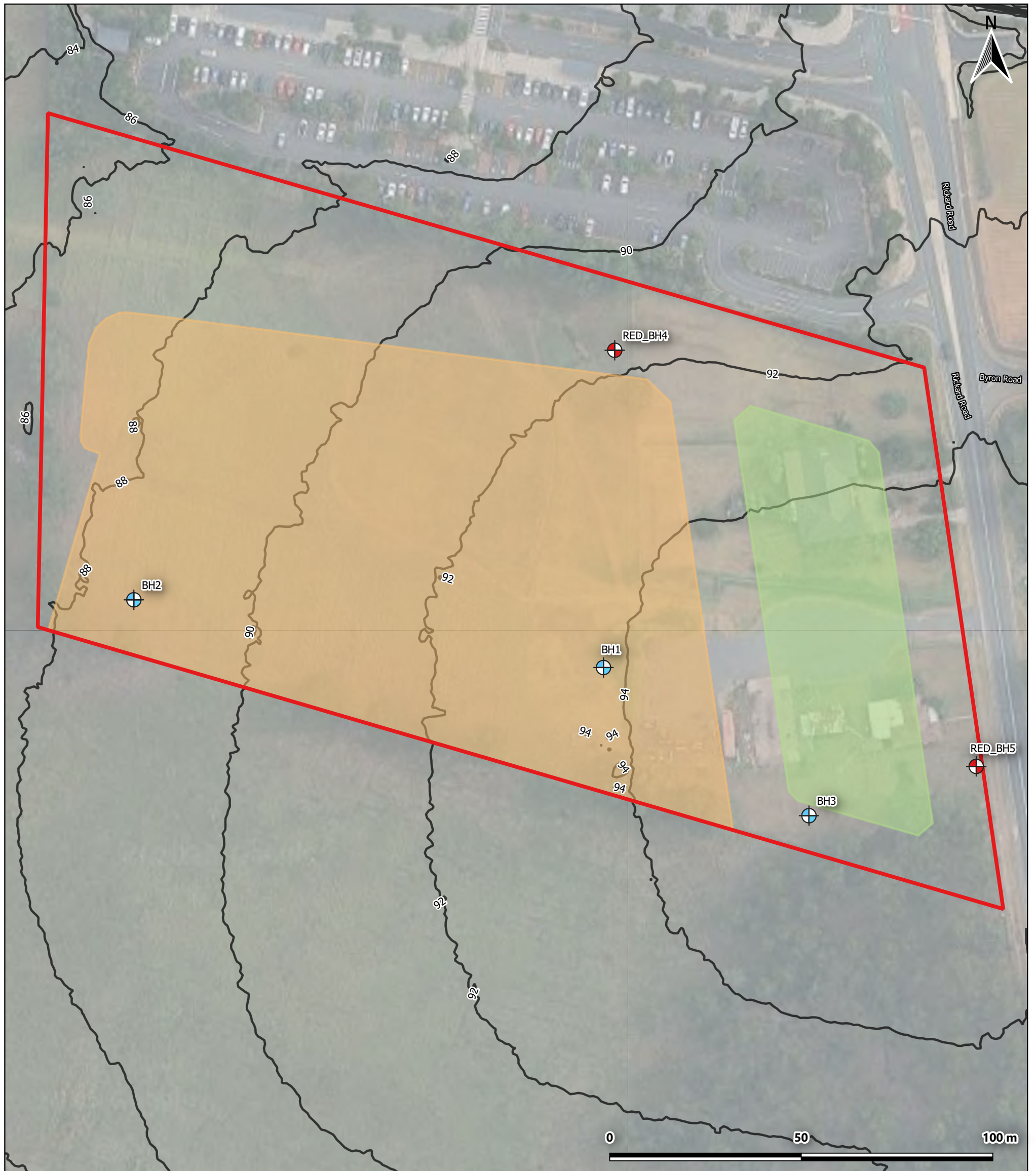
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Date of Export 28/05/2026	Map Scale (approx. at A3) 1:1,250		
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Data Source Metromap, Google Maps, Open Street Map, Geoscience Australia			



Map		Legend		Figure 3 - Regional Topography	
26157_rp01_f03_topography_v01	Map Scale (approx. at A3)	 Site Boundary	Watercourses	Sydney DEM_1m	173 & 183 Rickard Road, Leppington 26157 Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd
Date of Export	1:20,000	 2km Buffer	 Rivers	Elevation (mAHD)	
23/07/2025		 Railways	 Stream (Perennial)	 161.423	
Author	Approver	 Surface Water	 Stream (Non-Perennial)	 12.804	
TL			 Unnamed Stream (Non-Perennial)	 Topographic Contours (10 m)	
Data Source			 Other Channels	 Topographic Contours (2 m)	
Metromap, Google Maps, Open Street Map, Geoscience Australia					



Map 25122_rp01_f04_geology_v01		Legend SiteBoundary 2km Buffer Railways Surface Water RockUnits Q_af - Alluvial floodplain deposits Twib - Bringelly Shale Watercourses Stream (Perennial) Stream (Non-Perennial) Unnamed Stream (Non-Perennial) <td colspan="2">Figure 4 - Regional Geology 173 & 183 Rickard Road, Leppington 25122 Site Hydrogeology / Groundwater Modelling Report Leppington Main 88 Pty Ltd</td>	Figure 4 - Regional Geology 173 & 183 Rickard Road, Leppington 25122 Site Hydrogeology / Groundwater Modelling Report Leppington Main 88 Pty Ltd	
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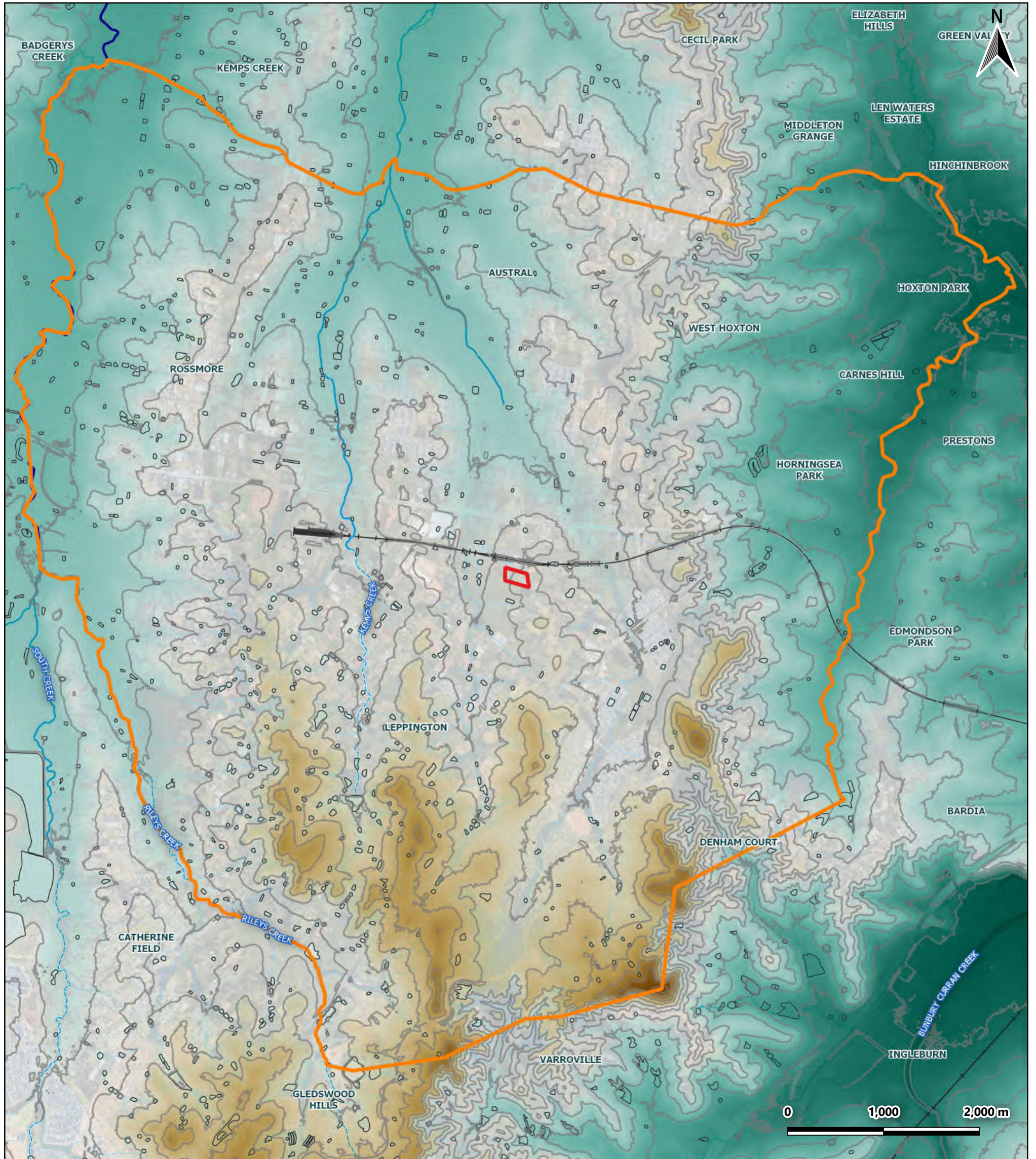
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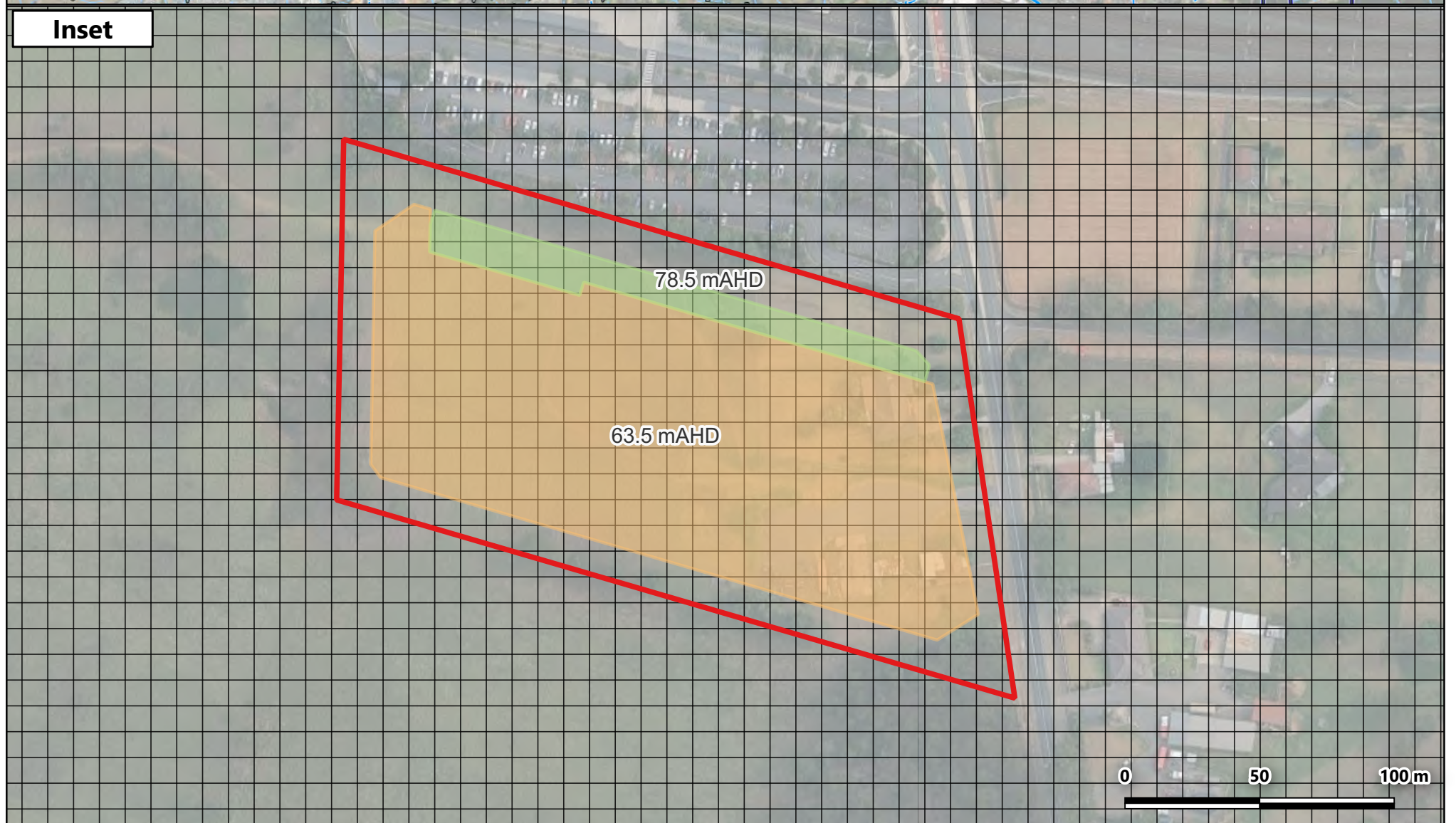
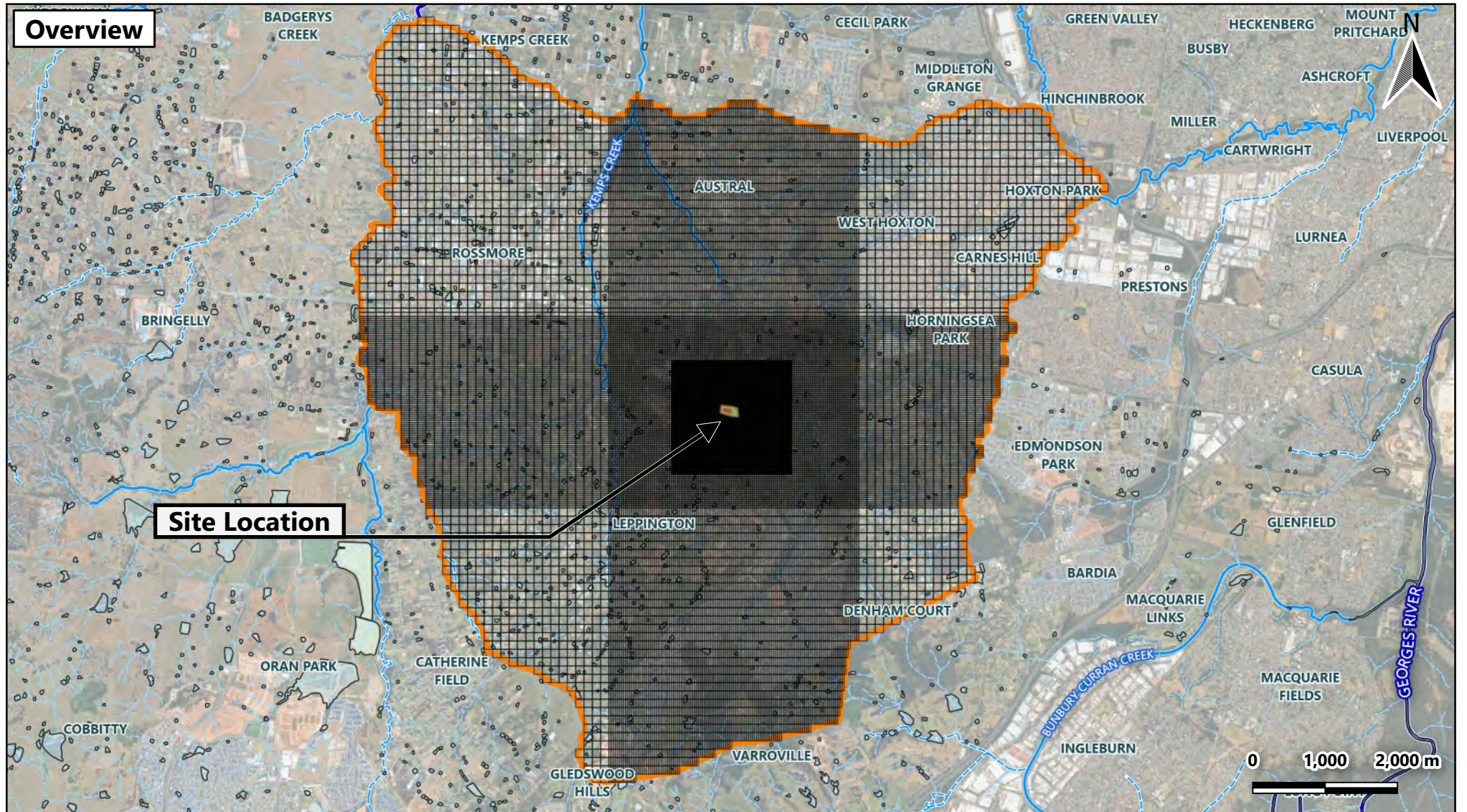
Map 26157-rp01-f06a-gwcontours-june-v01		Legend  SiteBoundary  Groundwater Wells  Groundwater Contours - 0.2m Interval (mAHD)  Groundwater Flow Direction	 1:1,250 Approximate Scale at A3	Figure 6a - Groundwater Elevation Contours - 03 June 2025 173 & 183 Rickard Road, Leppington 26157 - Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd
Date of Export 25/08/2025				
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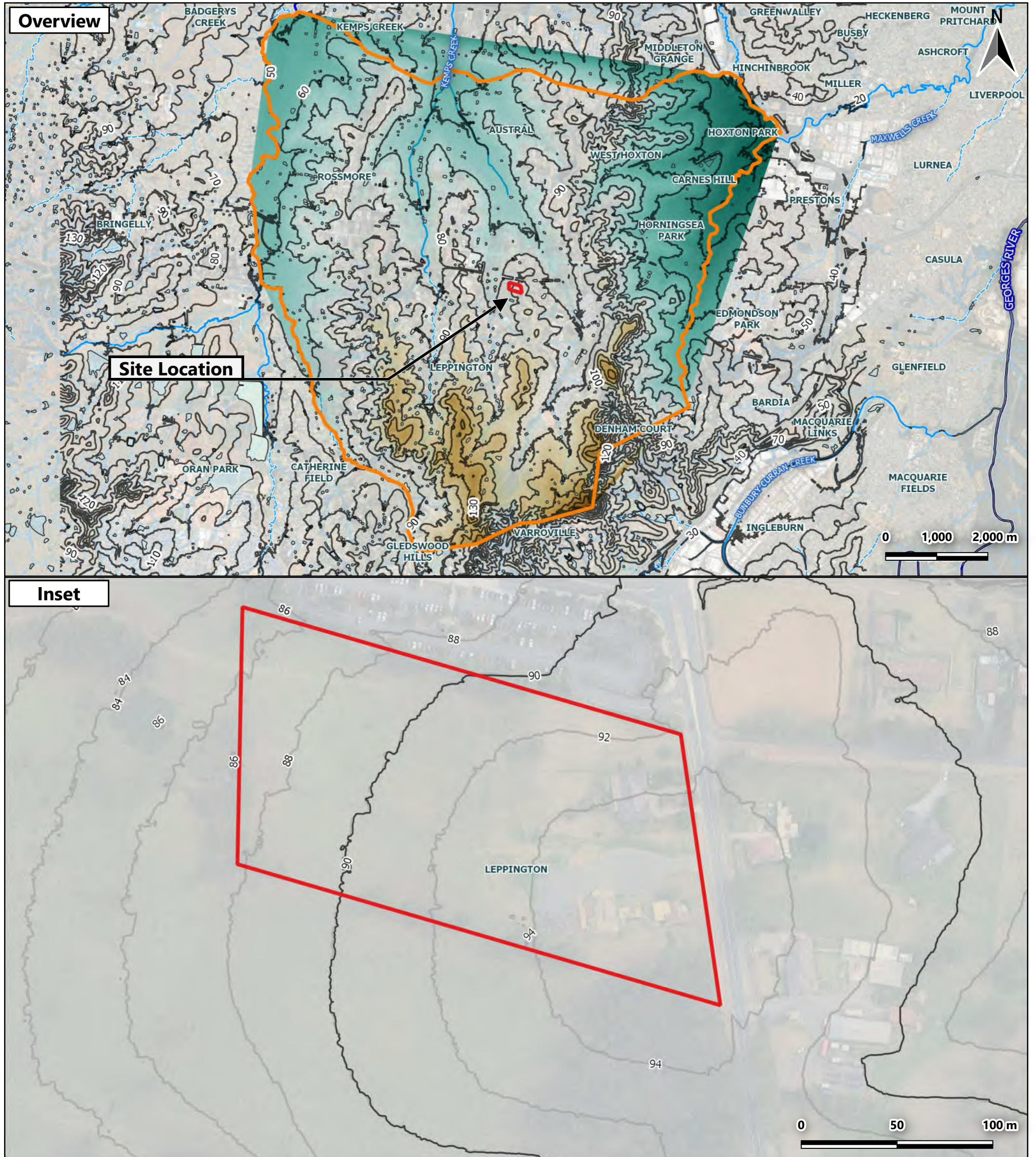
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Date of Export 25/08/2025				
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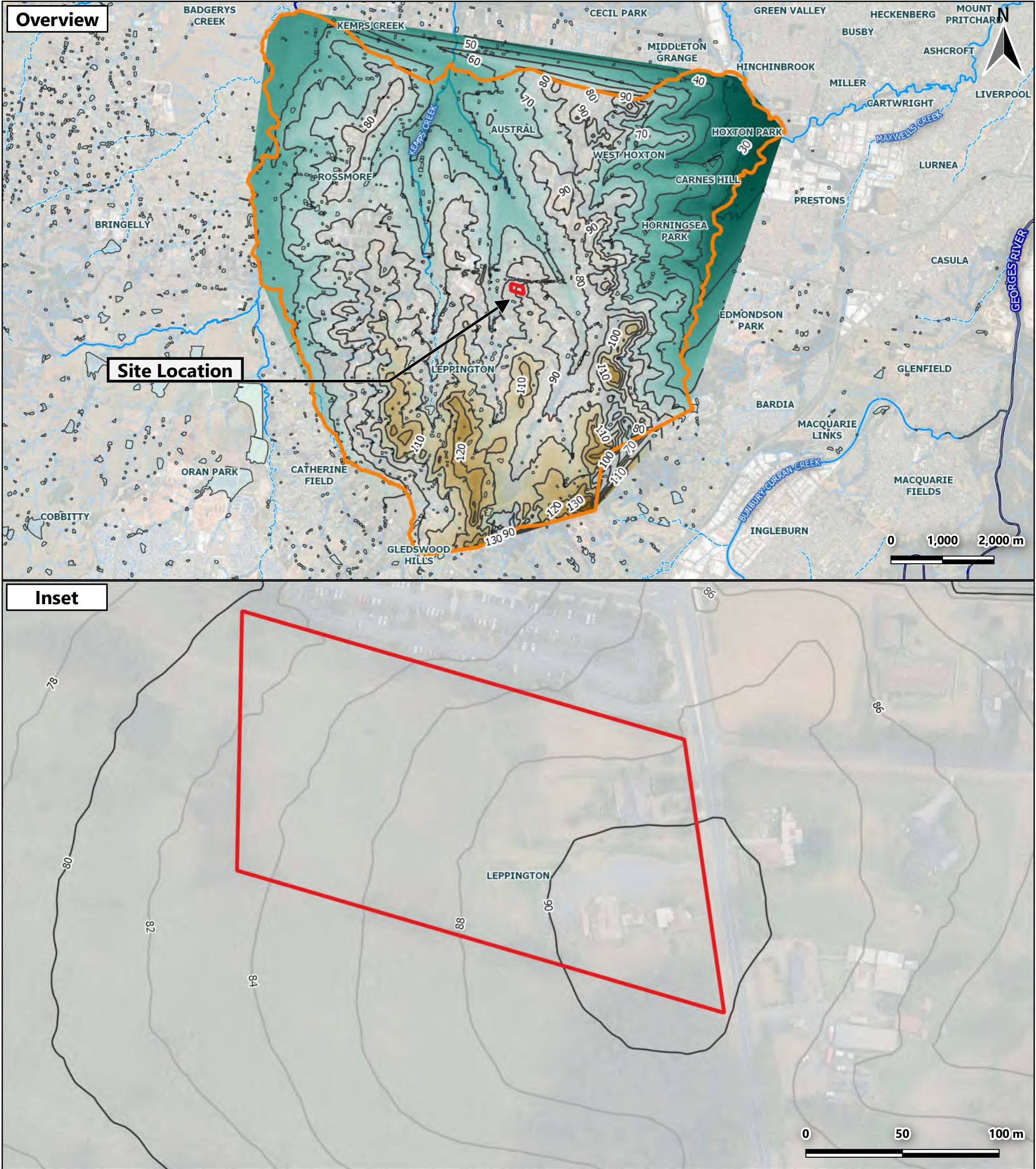
Map		Legend SiteBoundary Model Domain Railways Surface Water Watercourses Rivers Stream (Perennial) Stream (Non-Perennial) Unnamed Stream (Non-Perennial) Sydney_DEM_1m Elevation (mAHD) 161.423 12.804 Topographic Contours _10 m	Figure 7 - Model Domain (with topography / hydrological features)	
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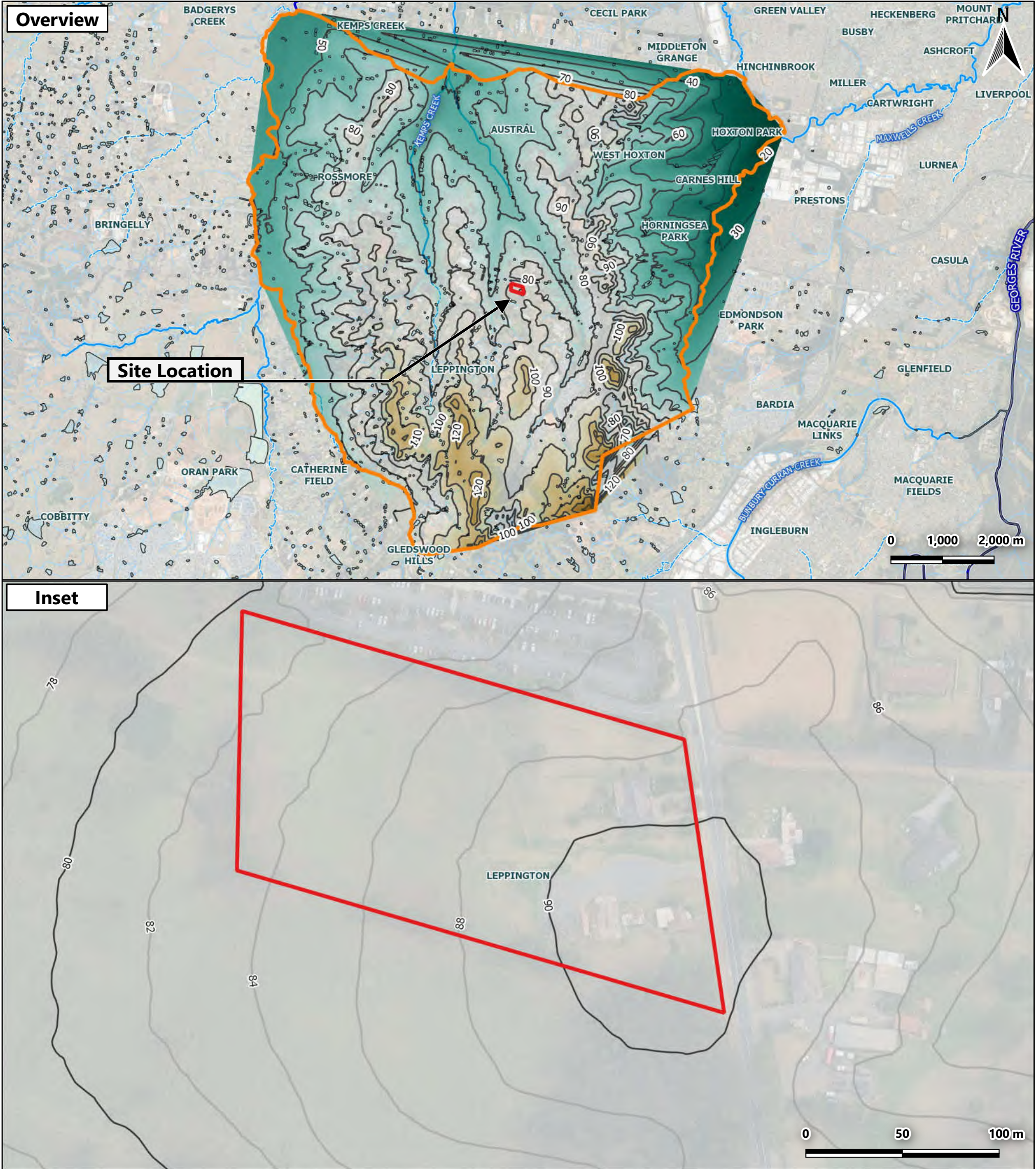
Map 26157_rp01_f08_modgrid_v01		Legend  Site Boundary  Model Domain  Model Grid  Basement Excavation (BEL in mAHD)  Deep Soil Areas (BEL in mAHD)  Surface Water Watercourses  Rivers  Stream (Perennial)  Stream (Non-Perennial)  Unnamed Stream (Non-Perennial)	Figure 8 - Model Grid	
Date of Export 29/05/2026			173 & 183 Rickard Road, Leppington	
Author TL	Approver LD		26157 - Groundwater Impact Assessment	
Data Source Metromap, Google Maps, Open Street Map, NSW Government			Leppington (1) 88 Development Pty Ltd	



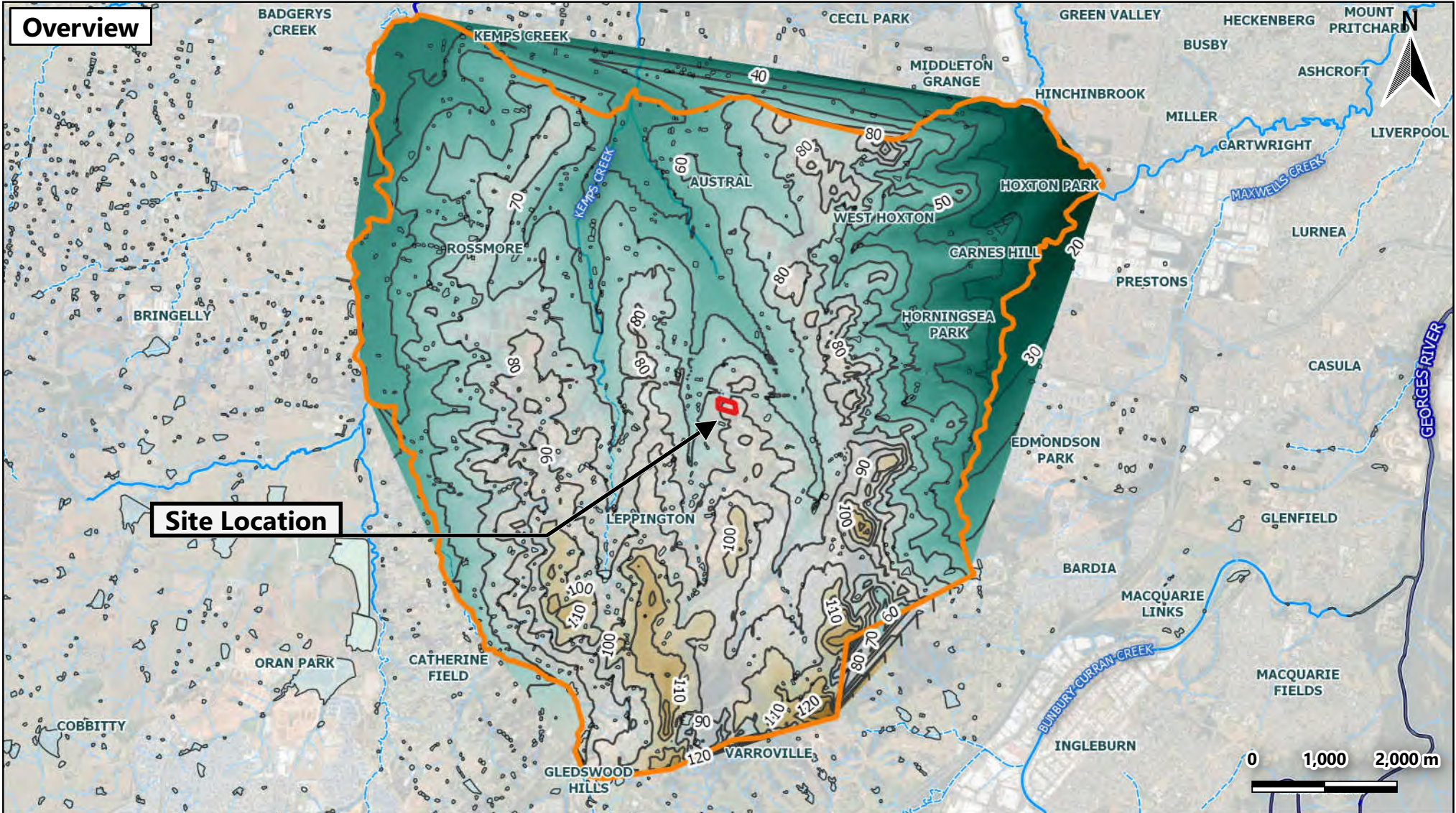
Map		Legend Model Domain Site Boundary Surface Water Watercourses Rivers Stream (Perennial) Stream (Non-Perennial) Unnamed Stream (Non-Perennial)	Figure 9a - Model Layers - Top of Layer 1 (Ground Surface) 173 & 183 Rickard Road, Leppington 26157 - Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd
26157 rp01 f09a_modlay1_v01			
Date of Export			
27/08/2025			
Author	Approver		
TL	LD		
Data Source			
Metromap, Google Maps, Open Street Map, NSW Government		Top of Layer 1 Elevation (mAHD) 161.423 12.804 10m Elevation Contours_GS 2m Elevation Contours_GS	



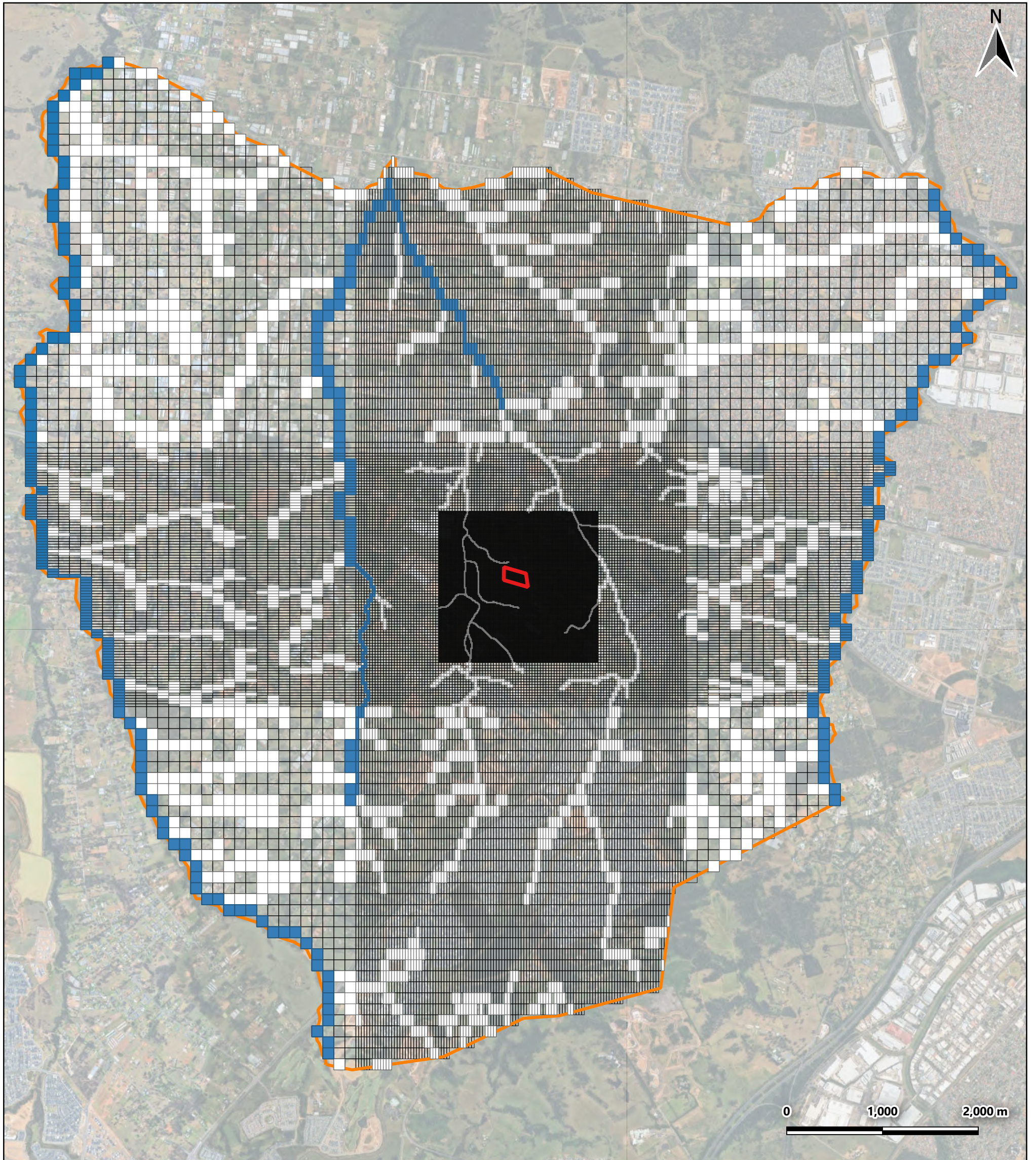
Map 26157 rp01 f09b modlay2 v01		Legend Model Domain Site Boundary Surface Water Watercourses Rivers Stream (Perennial) Stream (Non-Perennial) Unnamed Stream (Non-Perennial)	Figure 9b - Model Layers - Top of Layer 2 (Residual) 173 & 183 Rickard Road, Leppington 26157 - Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd
Date of Export 27/08/2025			
Author TL	Approver LD		
Data Source Metromap, Google Maps, Open Street Map, NSW Government			



Map 26157 rp01 f09c modlay3_v01		Legend Model Domain Site Boundary Surface Water Top of Layer 3 Elevation (mAHD) 161.423 12.804 10m Elevation Contours 2m Elevation Contours Watercourses Rivers Stream (Perennial) Stream (Non-Perennial) Unnamed Stream (Non-Perennial)	Figure 9c - Model Layers - Top of Layer 3 (Weathered Bringelly Shale)
Date of Export 27/08/2025			173 & 183 Rickard Road, Leppington
Author TL	Approver LD		26157 - Groundwater Impact Assessment
Data Source Metromap, Google Maps, Open Street Map, NSW Government			Leppington (1) 88 Development Pty Ltd



Map		Model Domain Site Boundary Surface Water Top of Layer 3 Elevation (mAHD) 161.423 12.804 10m Elevation Contours 2m Elevation Contours Watercourses Rivers Stream (Perennial) Stream (Non-Perennial) Unnamed Stream (Non-Perennial)	Figure 9d - Model Layers - Top of Layer 4 (Bringelly Shale) 173 & 183 Rickard Road, Leppington 26157 - Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd
26157 rp01 f09d modlay4 v01			
Date of Export			
27/08/2025			
Author	Approver		
TL	LD		
Data Source			
Metromap, Google Maps, Open Street Map, NSW Government			



Map 26157-rp01-f10-modBC-v01		Legend Site Boundary Model Domain Model Grid Boundary Conditions Constant Head Boundary Drain Boundary Conditions	Figure 10 - Boundary Conditions 173 & 183 Rickard Road, Leppington 26157 - Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd
Date of Export 27/08/2025	Map Scale (approx at A3) 1: 40,000		
Author TL	Approver LD		
Data Source Metromap, Google Maps, Open Street Map, NSW Government			

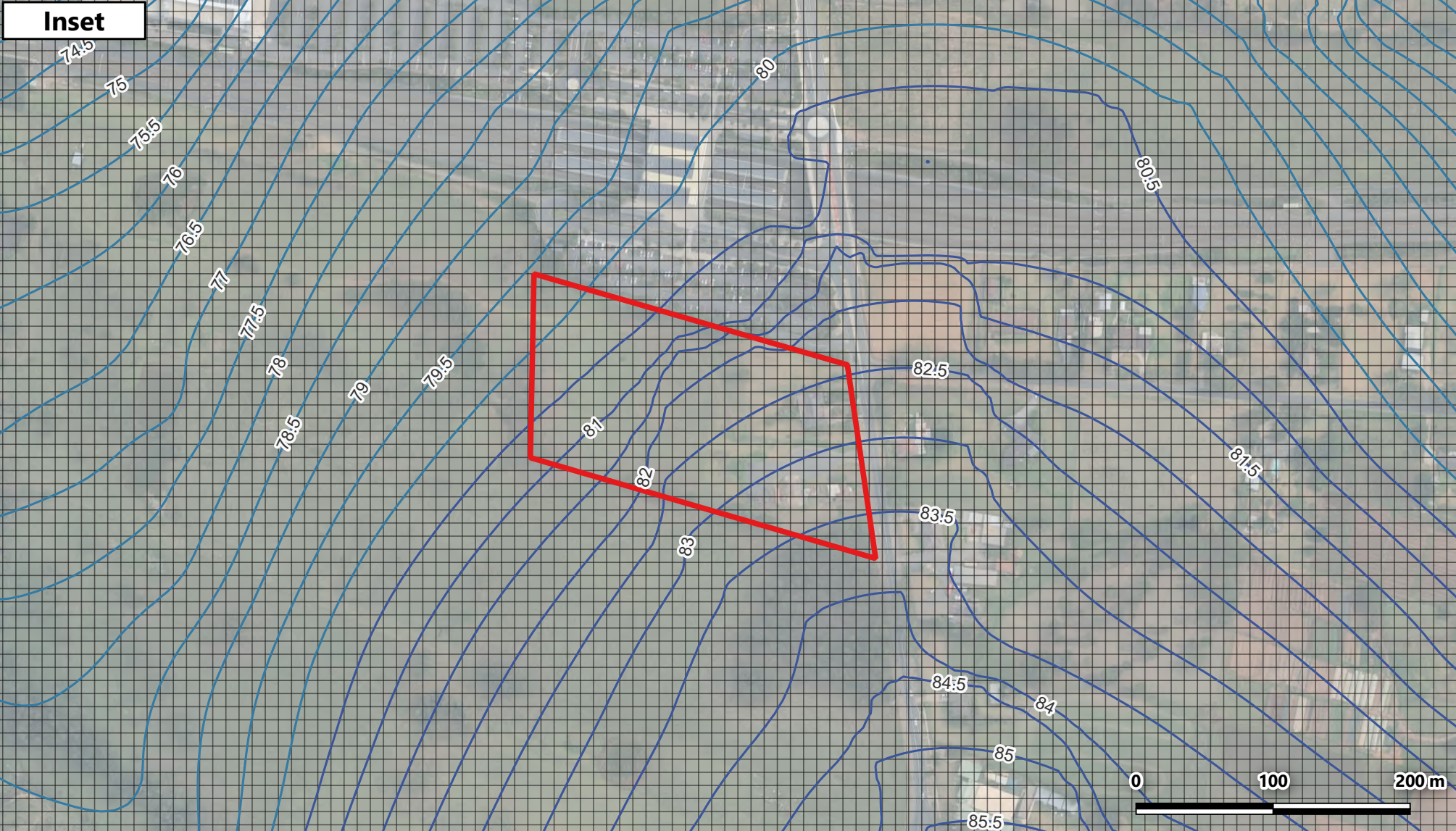


Overview

Residual Mean	1.7508
Absolute Residual Mean	1.9949
Residual Std. Deviation	1.2059
Sum of Squares	22.5978
RMS Error	2.1259
Min. Residual	-0.6103
Max. Residual	2.7141
Number of Observations	5.0000
Range in Observations	5.8350
Scaled Residual Std. Deviation	0.2067
Scaled Absolute Residual Mean	0.3419
Scaled RMS Error	0.3643
Scaled Residual Mean	0.3001

Site Location

Inset



Map	
26157-rp01-f11a-precalheads3-v01	
Date of Export	
27/08/2025	
Author	Approver
TL	LD
Data Source	
Metromap, Google Maps, Open Street Map, NSW Government	

Legend

- Model Domain
- Site Boundary
- Model Grid

Pre Calibration Head Contours - Layer 3 (mAHd)

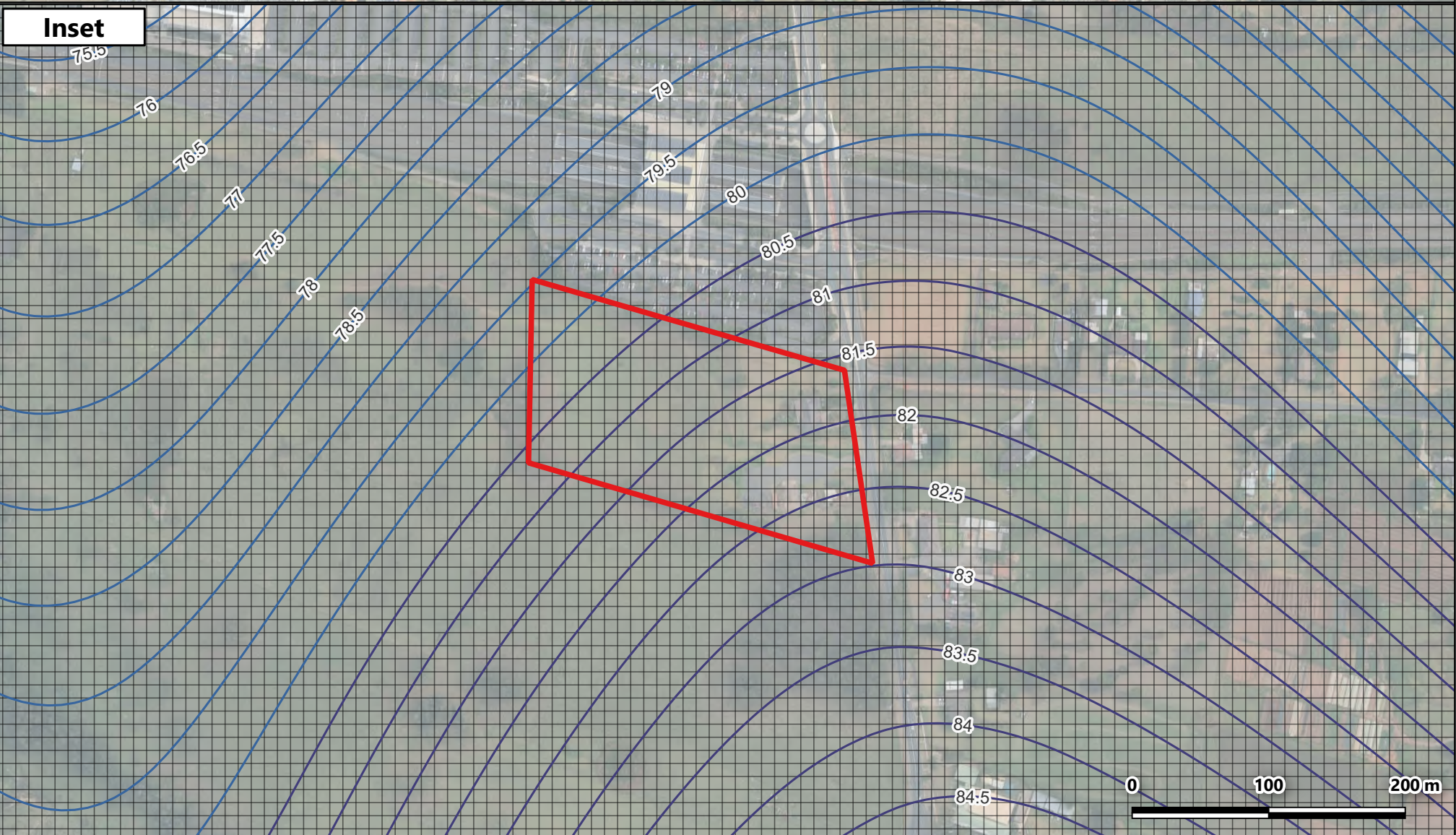
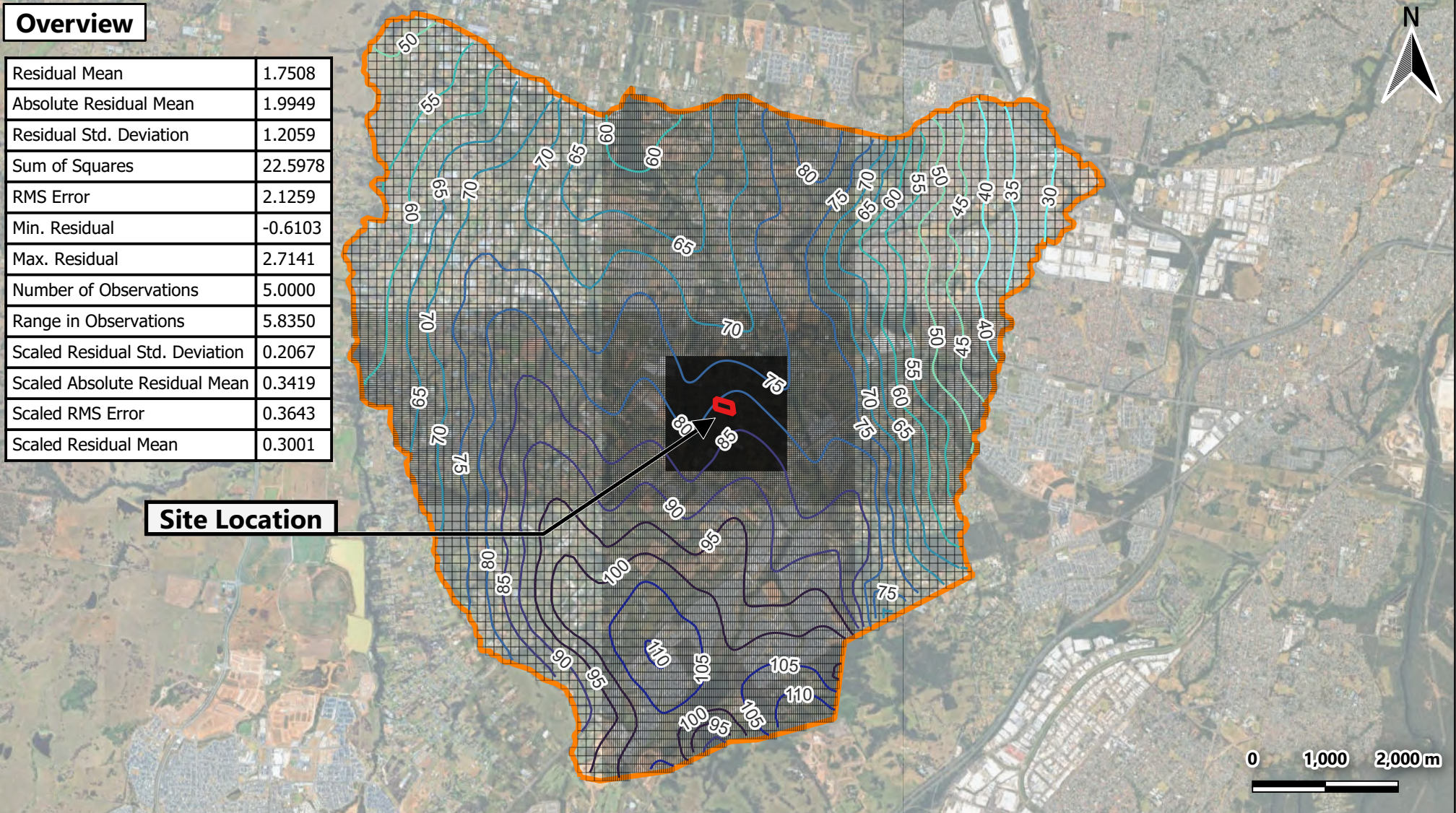
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110

Figure 11a - Pre-Calibrated Heads - Layer 3 (Weathered Bringelly Shale)

173 & 183 Rickard Road, Leppington

26157 - Groundwater Impact Assessment

Leppington (1) 88 Development Pty Ltd



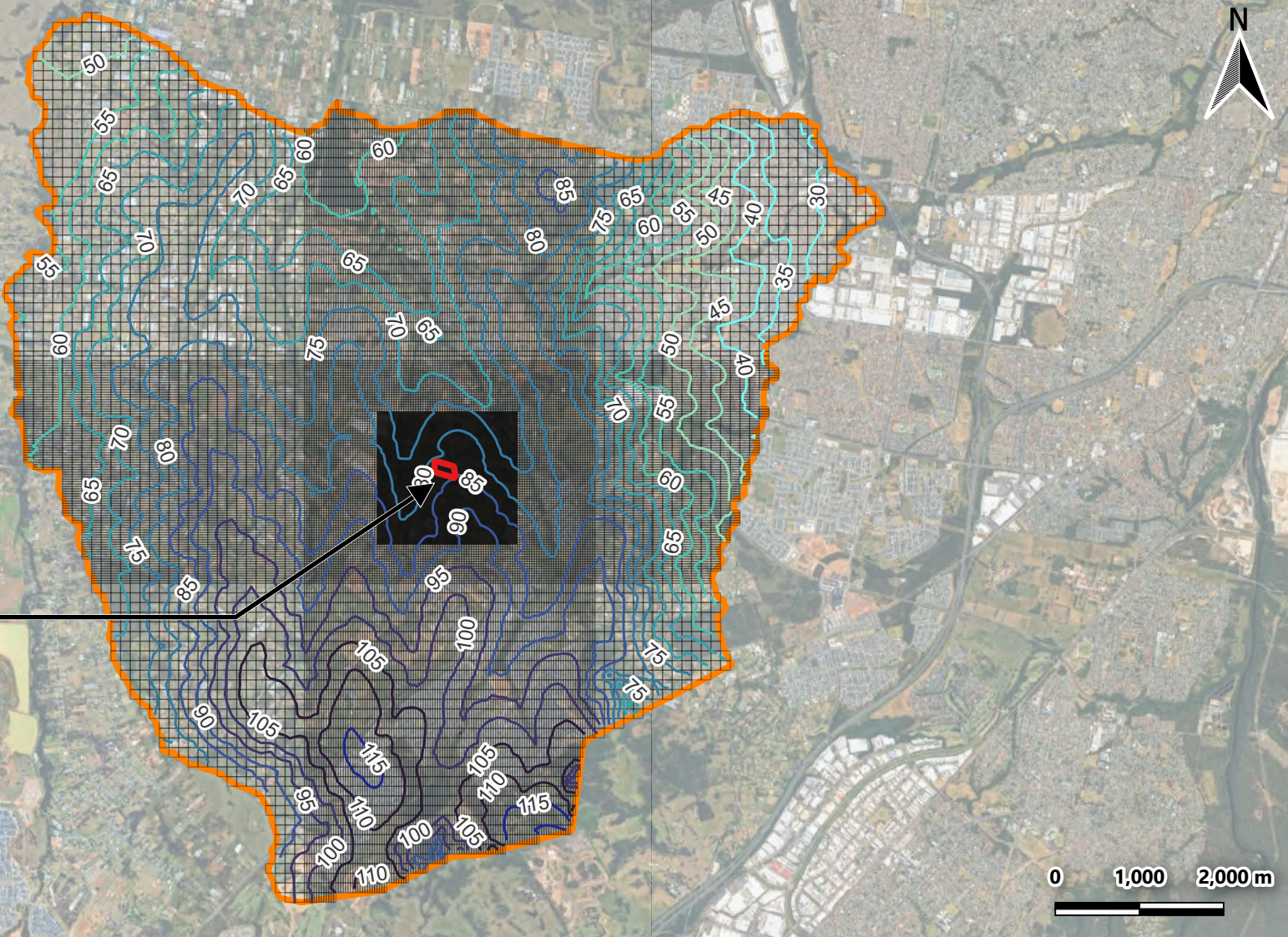
Map 26157-rp01-f11b-precaltheds4-v01 Date of Export 27/08/2025 Author TL Approver LD Data Source Metromap, Google Maps, Open Street Map, NSW Government	Legend Model Domain Site Boundary Model Grid Pre-Calibration Heads - Layer 4 (mAHD) 30 - 40 40 - 50 50 - 60 60 - 70 70 - 80 80 - 90 90 - 100 100 - 110	Figure 11b - Pre-Calibrated Heads - Layer 4 (Bringelly Shale) 173 & 183 Rickard Road, Leppington 26157 - Groundwater Impact Assessment Leppington (1) Development 88 Pty Ltd
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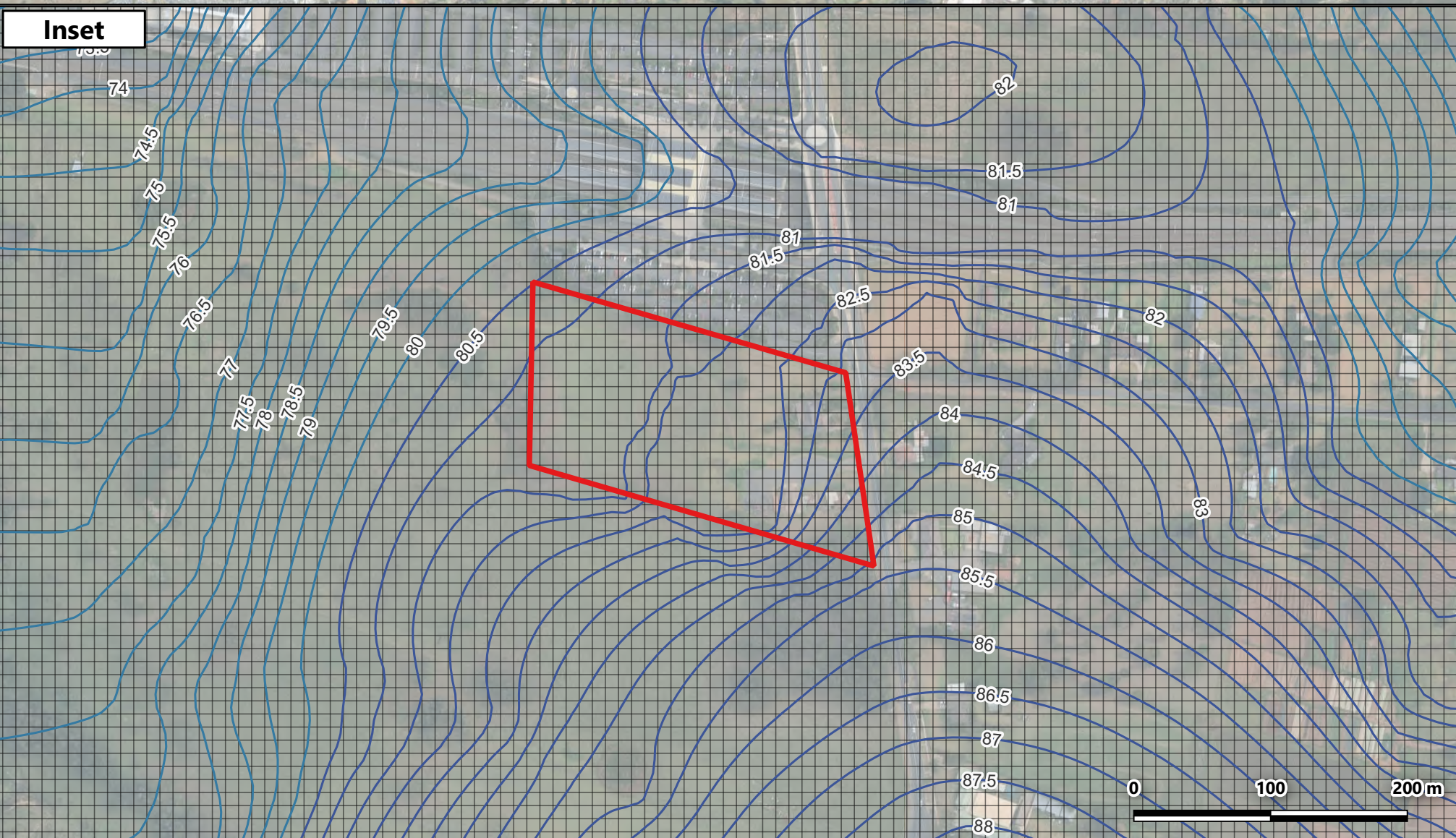
Overview

Residual Mean	-0.5856
Absolute Residual Mean	0.5856
Residual Std. Deviation	1.1712
Sum of Squares	8.5737
RMS Error	1.3095
Min. Residual	-2.9281
Max. Residual	0.0001
Number of Observations	5.0000
Range in Observations	5.8350
Scaled Residual Std. Deviation	0.2007
Scaled Absolute Residual Mean	0.1004
Scaled RMS Error	0.2244
Scaled Residual Mean	-0.1004

Site Location



Inset



Map

26157-rp01-f12a-postcalheads3-v01

Date of Export

27/08/2025

Author

TL

Approver

LD

Data Source

Metromap, Google Maps, Open Street Map,
NSW Government

Legend

- Model Domain
- Site Boundary
- Model Grid

Post-Calibration Head Contours_Layer3 (mAHD)

- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110
- 110 - 120

Figure 12a - Post-Calibrated Heads - Layer 3
(Weathered Bringelly Shale)

173 & 183 Rickard Road, Leppington

26157 - Groundwater Impact Assessment

Leppington (1) 88 Development Pty Ltd

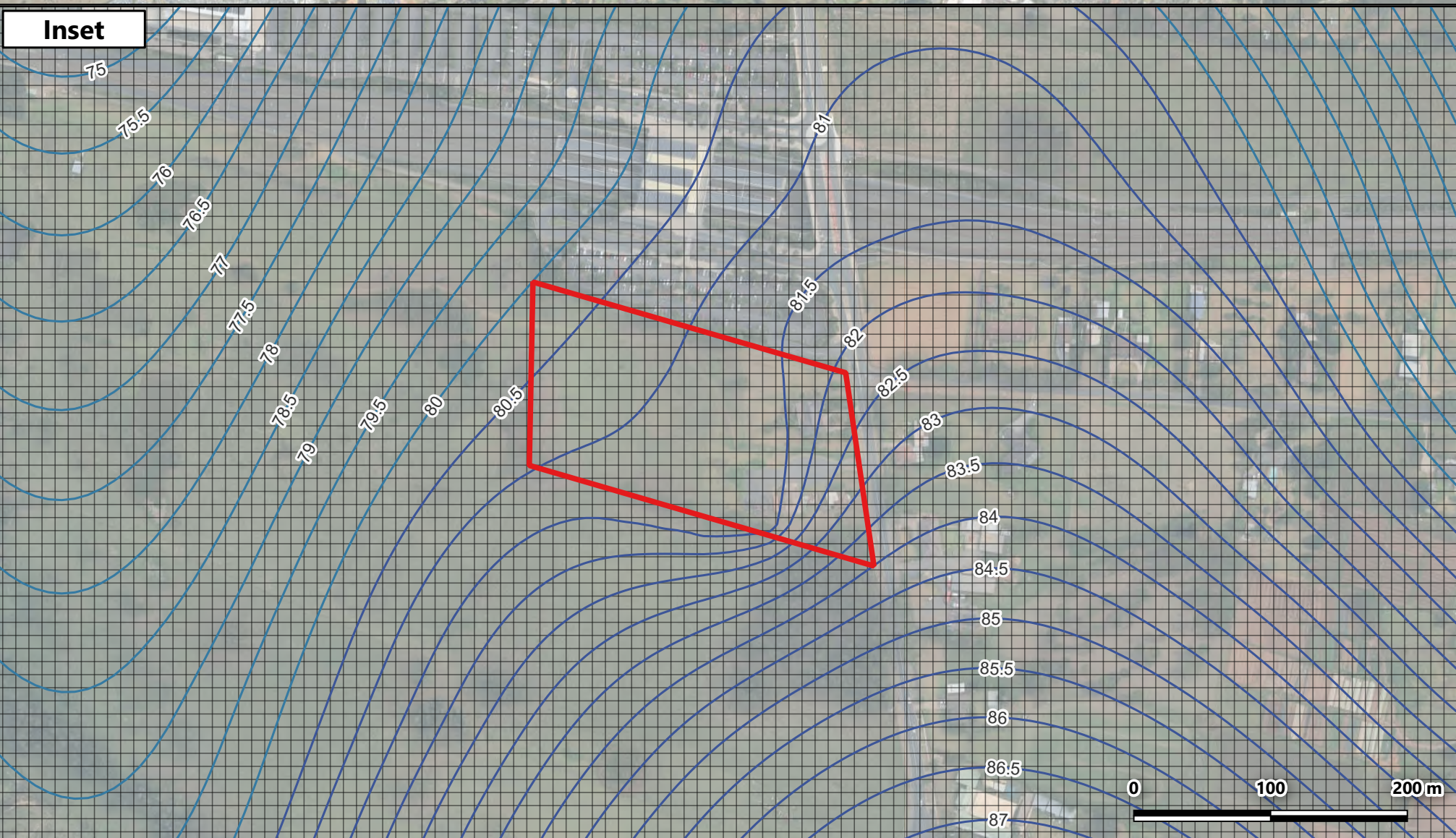


Overview

Residual Mean	-0.5856
Absolute Residual Mean	0.5856
Residual Std. Deviation	1.1712
Sum of Squares	8.5737
RMS Error	1.3095
Min. Residual	-2.9281
Max. Residual	0.0001
Number of Observations	5.0000
Range in Observations	5.8350
Scaled Residual Std. Deviation	0.2007
Scaled Absolute Residual Mean	0.1004
Scaled RMS Error	0.2244
Scaled Residual Mean	-0.1004

Site Location

Inset



Map	
26157-rp01-f12b-postcalheads4-v01	
Date of Export	
27/08/2025	
Author	Approver
TL	LD
Data Source	
Metromap, Google Maps, Open Street Map, NSW Government	

Legend

- Model Domain
- Site Boundary
- Model Grid

Post-Calibration Head Contours_Layer4 (mAHD)

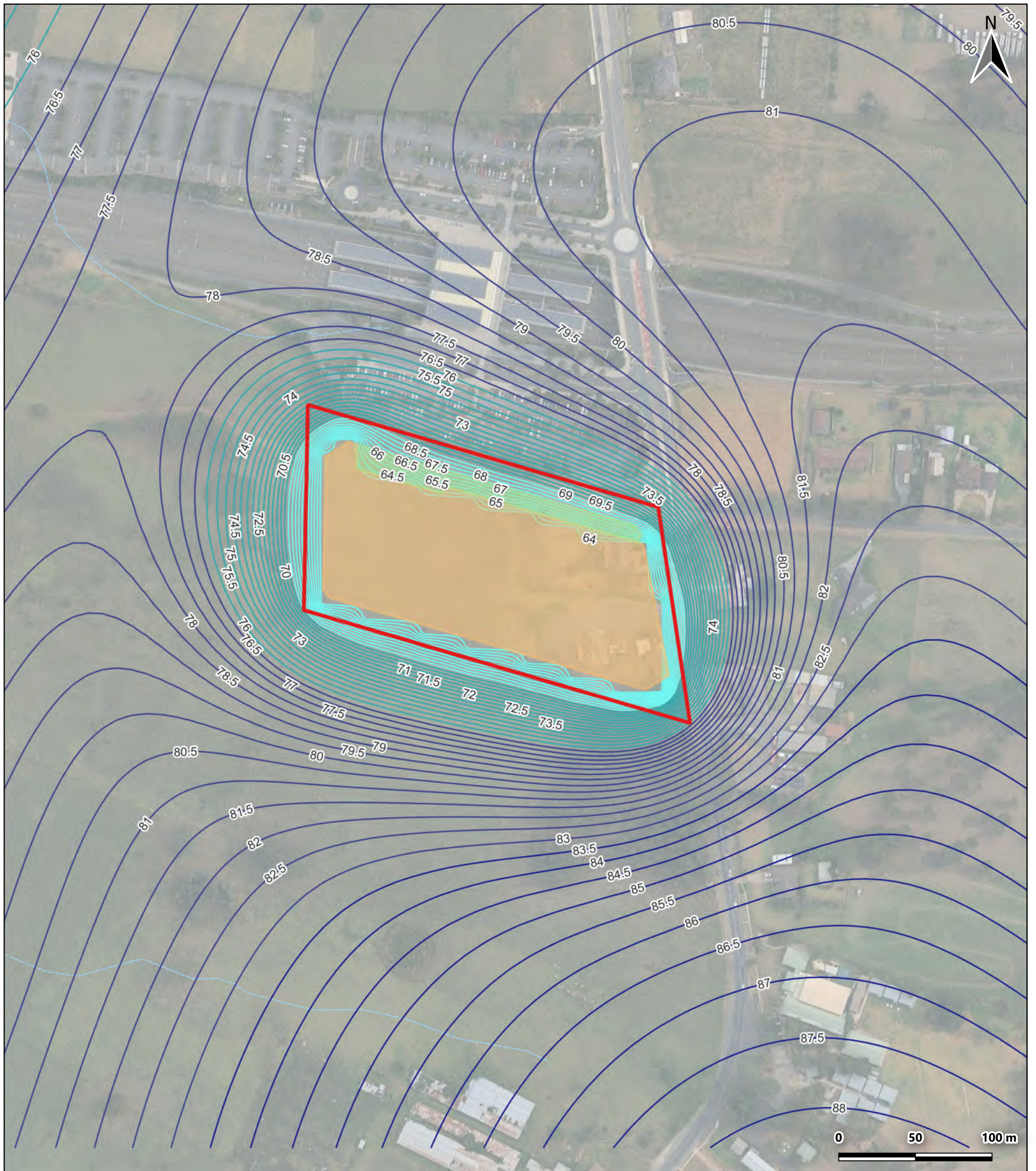
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110
- 110 - 115

Figure 12b - Post-Calibrated Heads - Layer 4 (Bringelly Shale)

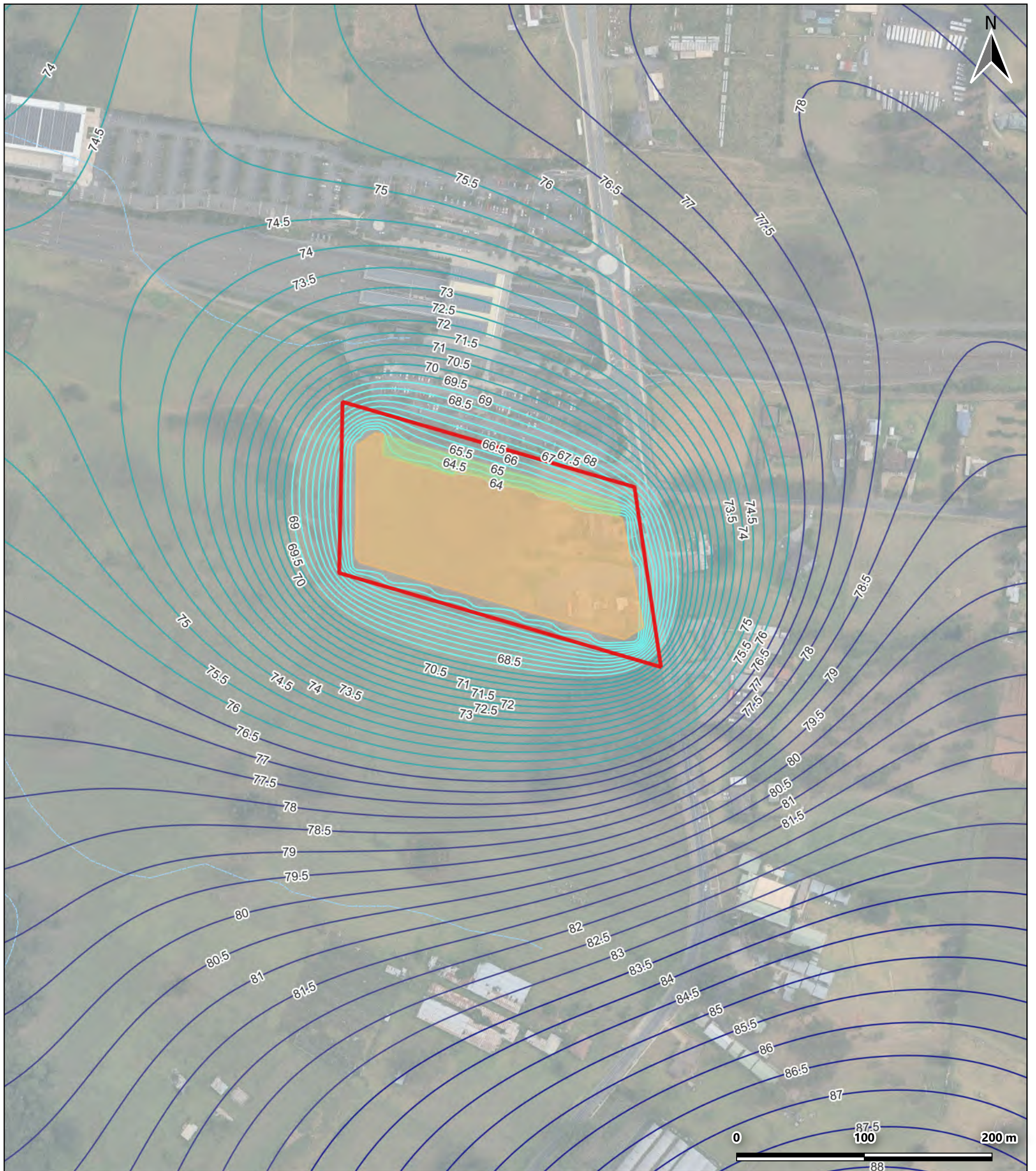
173 & 183 Rickard Road, Leppington

26157 - Groundwater Impact Assessment

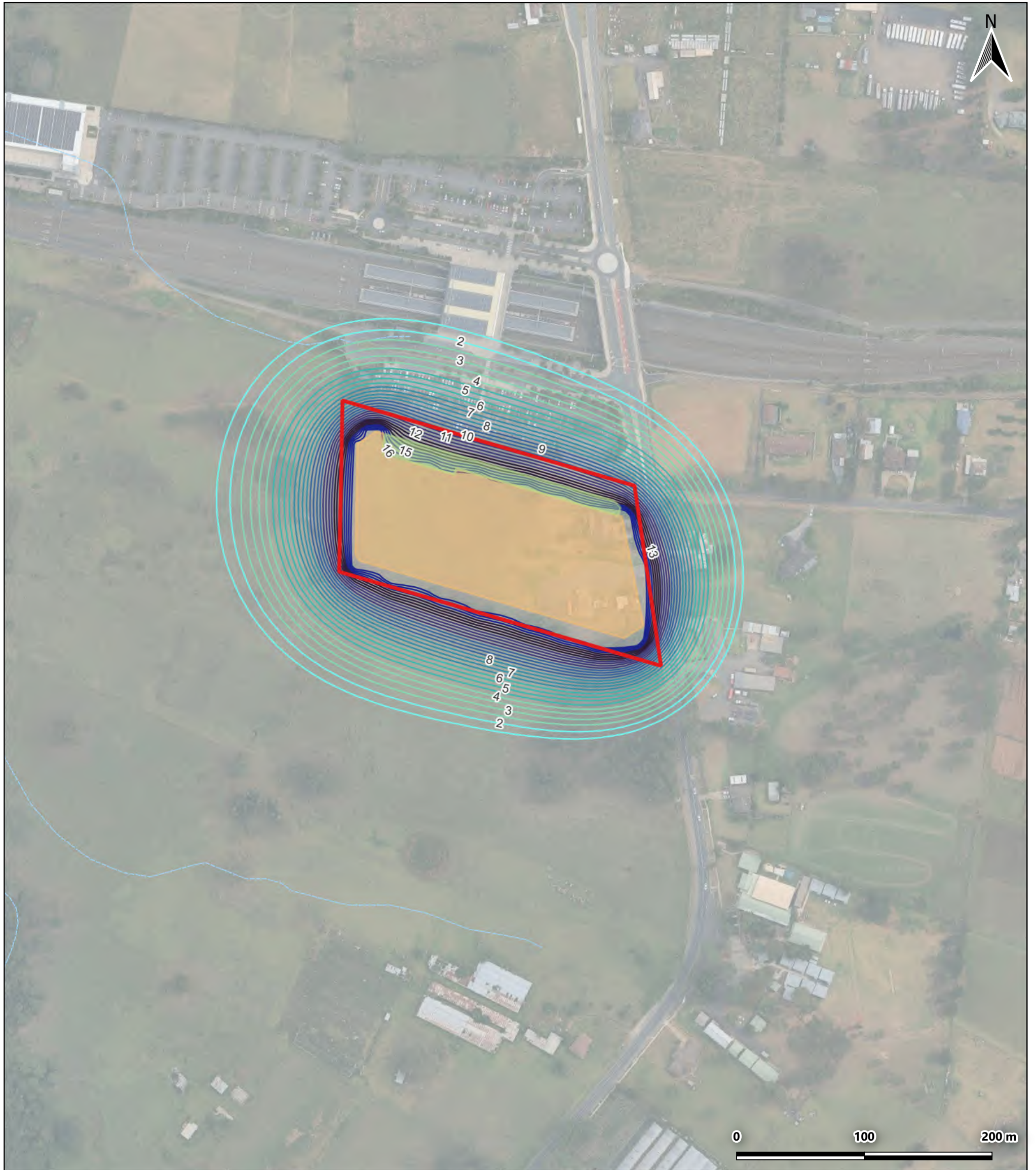
Leppington (1) 88 Development Pty Ltd



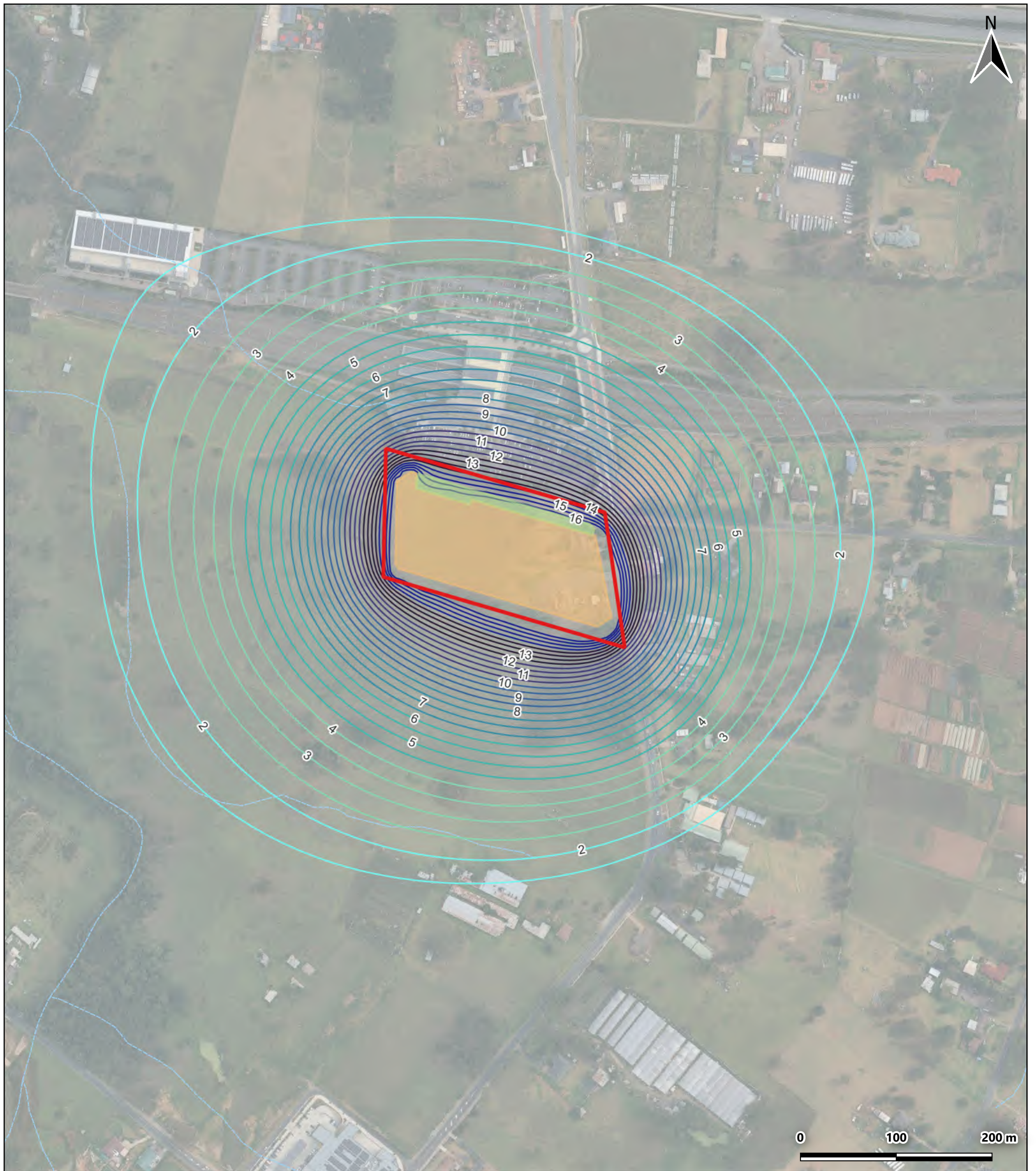
Map 26157_rp01_f13a_Heads365_v01		Legend Site Boundary Basement Excavation Deep Soil Areas Head Contours - Layer 4 (mAHD) 62 - 69 69 - 76 76 - 83 83 - 90	Figure 13a - Simulated Groundwater Head Contours Upon Cessation of Dewatering (Day 365) 173 & 183 Rickard Road, Leppington 26157 Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd
Date of Export 29/05/2026	Map Scale (approx. at A3) 1:2,500		
Author TL	Approver		
Data Source Metromap, Google Maps, Open Street Map, Geoscience Australia			



Map 26157_rp01_f13b_Heads_SS_v01		Legend Site Boundary Deep Soil Areas Excavation Extent Basement Excavation Extent Head Contours - Layer 4 (mAHD) 62 - 69 69 - 76 76 - 83 83 - 90		Figure 13b - Simulated Groundwater Head Contours (Steady State) 173 & 183 Rickard Road, Leppington 26157 Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd	
Date of Export 29/05/2026	Map Scale (approx. at A3) 1:3,000				
Author TL	Approver NP				
Data Source Metromap, Google Maps, Open Street Map, Geoscience Australia					



Map 26157_rp01_f14a_dd365_v01		Legend Site Boundary Basement Excavation Deep Soil Areas Drawdown Contours - Layer 4 (m) 1.2 - 2 2 - 4 4 - 6 6 - 8 8 - 10 10 - 12 12 - 14 14 - 16 <td colspan="2">Figure 14a - Simulated Drawdown Contours Upon Cessation of Construction Operations (Day 365) 173 & 183 Rickard Road, Leppington 26157 Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd</td>	Figure 14a - Simulated Drawdown Contours Upon Cessation of Construction Operations (Day 365) 173 & 183 Rickard Road, Leppington 26157 Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd	
Date of Export 29/05/2026	Map Scale (approx. at A3) 1:3,000			
Author TL	Approver			
Data Source Metromap, Google Maps, Open Street Map, Geoscience Australia				

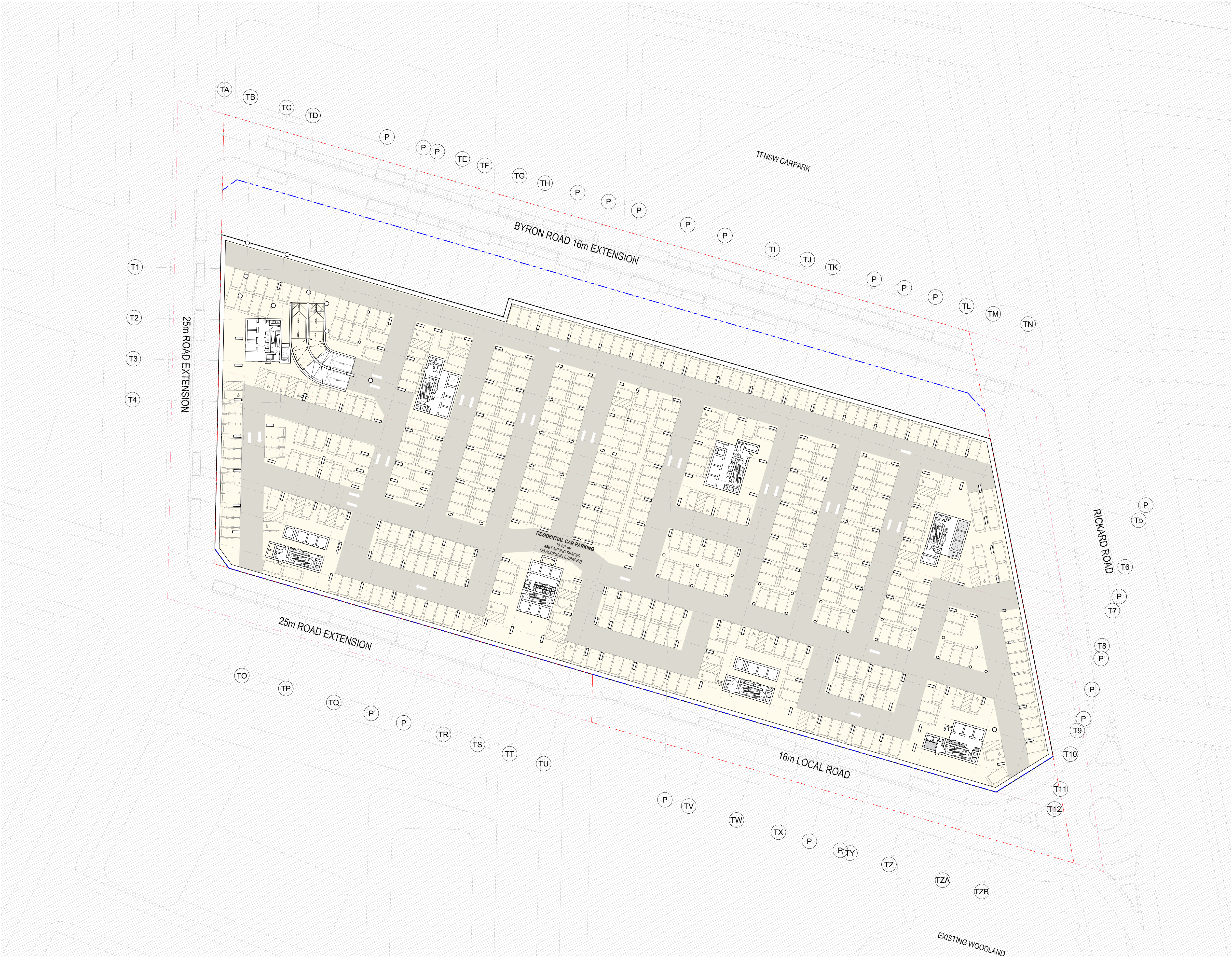


Map 26157_rp01_f14b_dd_ss_v01		Legend Site Boundary Basement Excavation Deep Soil Areas Drawdown Contours - Layer 4 (m) 1.2 - 2 2 - 4 4 - 6 6 - 8 8 - 10 10 - 12 12 - 14 14 - 16	Figure 14b - Simulated Drawdown Contours (Steady State) 173 & 183 Rickard Road, Leppington 26157 Groundwater Impact Assessment Leppington (1) 88 Development Pty Ltd
Date of Export 29/05/2026	Map Scale (approx. at A3) 1:4,000		
Author TL	Approver		
Data Source Metromap, Google Maps, Open Street Map, Geoscience Australia			

B

Design
Drawings

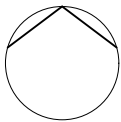




- All works to be in accordance with authority & statutory approvals.
- Refer to site survey for all information relating to existing site conditions.
- All Boundary information to be confirmed by registered surveyor before commencing works on site.
- Refer to Adjacent Report and Landscape Documentation for all information relating to trees and their retention/removal, and all landscape works.
- Drawings to be read in conjunction with all Specifications and Schedules, all specialist consultant documentation: BASIX, NatHERS, Section J Certificates.
- Minor changes to building form & configuration may be required after Development Consent.
- Do not scale from drawing; figured dimensions only to be used.
- Building Contractor to verify all dimensions before commencing work.

Rev	Date	By	Chk	Description
P1	1/05/2026			Coordination Pack
P2	16/05/2026			Updated Coordination Pack
P3	22/05/2026			Updated Coordination Pack

0 2 4 8 20.00m
Scale 1:500 @ A1



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Project Name Leppington Site A
Project Number 13053
Project Address 173-183 Rickard Road
Leppington NSW 2179

Country Dharug

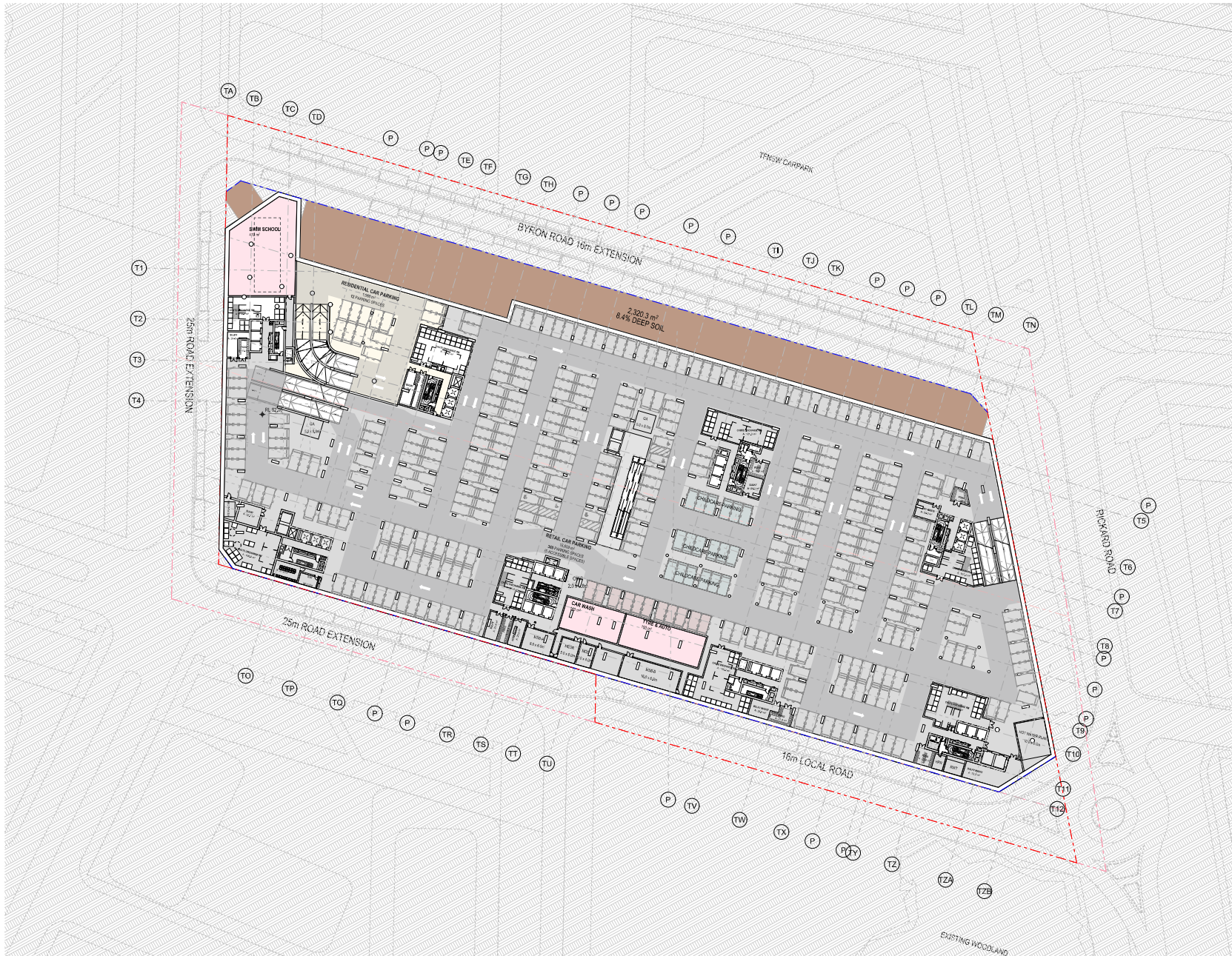
FOR COORDINATION

Drawing Name
Basement 07

Drawing No.
DA200

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Revision
P3

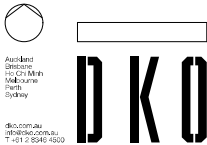
-7-
1:500
BASEMENT 07



1. All works to be in accordance with relevant standards and specifications.
2. All works to be in accordance with relevant standards and specifications.
3. All works to be in accordance with relevant standards and specifications.
4. All works to be in accordance with relevant standards and specifications.
5. All works to be in accordance with relevant standards and specifications.
6. All works to be in accordance with relevant standards and specifications.
7. All works to be in accordance with relevant standards and specifications.
8. All works to be in accordance with relevant standards and specifications.
9. All works to be in accordance with relevant standards and specifications.
10. All works to be in accordance with relevant standards and specifications.

Rev	Date	By	CHK	Description
01	1/10/2020			Coordinate
02	1/10/2020			Update Coordinate
03	1/10/2020			Update Coordinate

0 2 4 8 20,000mm
Scale 1:500 @ A1



Project Name: Leppington Site A
Project Number: 13001
Project Address: 172-183 Rickard Road
Leppington NSW 2179

County: Dhung

FOR COORDINATION

Drawing Name: Basement 01

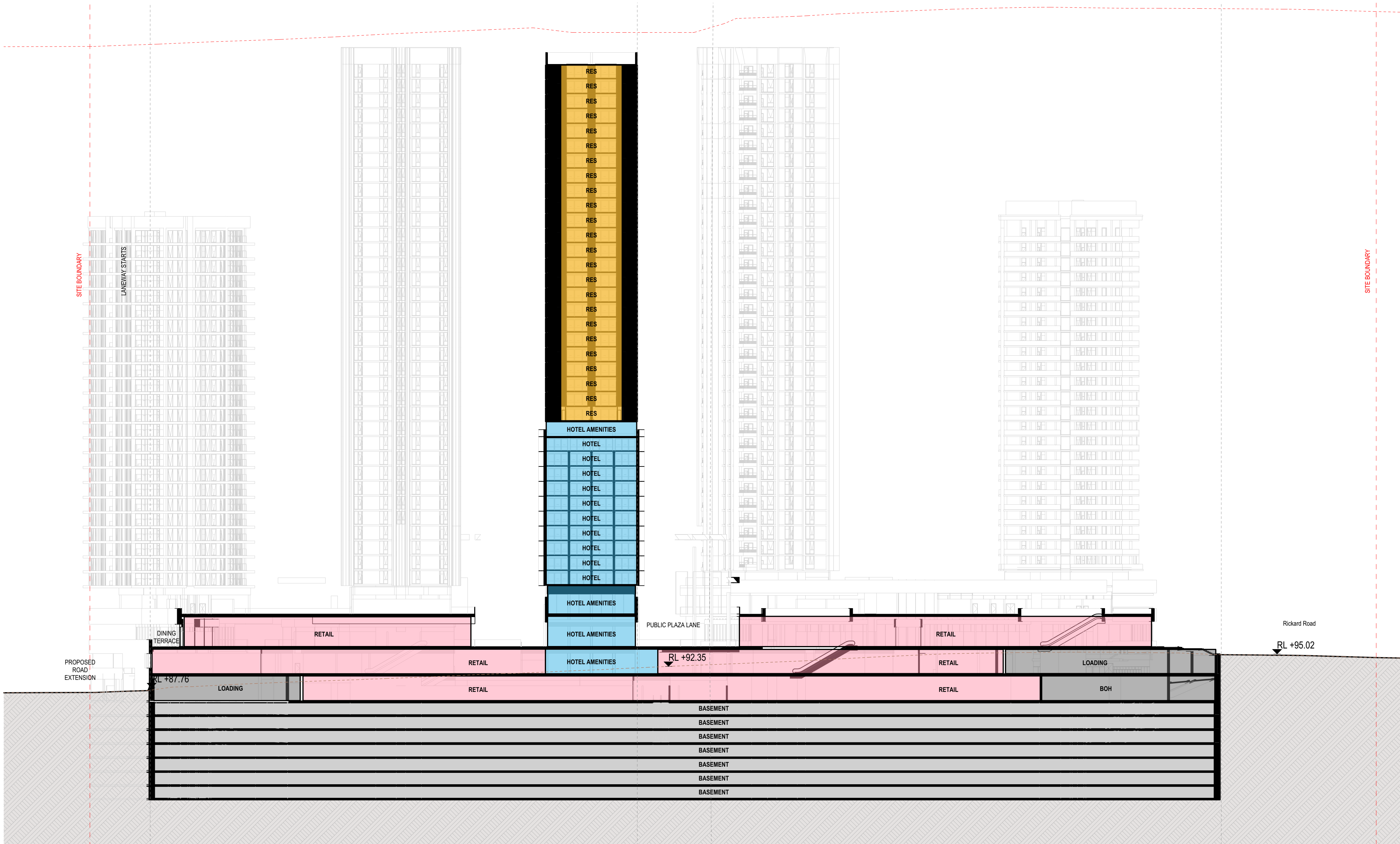
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Revision: P3

BASEMENT 01
1:500

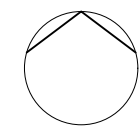
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Rev	Date	By	Chk	Description
P1	1/05/2026			Coordination Pack
P2	16/05/2026			Updated Coordination Pack
P3	22/05/2026			Updated Coordination Pack

+229.70
41 LEVEL 39
+225.70
40 LEVEL 38
+221.70
39 LEVEL 37
+218.50
38 LEVEL 36
+215.30
37 LEVEL 35
+212.10
36 LEVEL 34
+208.90
35 LEVEL 33
+205.70
34 LEVEL 32
+202.50
33 LEVEL 31
+199.30
32 LEVEL 30
+196.10
31 LEVEL 29
+192.90
30 LEVEL 28
+189.70
29 LEVEL 27
+186.50
28 LEVEL 26
+183.30
27 LEVEL 25
+180.10
26 LEVEL 24
+176.90
25 LEVEL 23
+173.70
24 LEVEL 22
+170.50
23 LEVEL 21
+167.30
22 LEVEL 20
+164.10
21 LEVEL 19
+160.90
20 LEVEL 18
+157.70
19 LEVEL 17
+154.50
18 LEVEL 16
+151.30
17 LEVEL 15
+148.10
16 LEVEL 14
+144.90
15 LEVEL 13
+141.70
14 LEVEL 12
+138.50
13 LEVEL 11
+135.30
12 LEVEL 10
+132.10
11 LEVEL 09
+128.90
10 LEVEL 08
+125.70
9 LEVEL 07
+122.50
8 LEVEL 06
+119.30
7 LEVEL 05
+116.10
6 LEVEL 04
+112.90
5 LEVEL 03
+109.70
4 LEVEL 02
+103.80
3 LEVEL 01
+96.60
2 UPPER GROUND
+90.80
1 GROUND LEVEL
+85.00
0 LOWER GROUND
+82.00
-1 BASEMENT 01
+79.00
-2 BASEMENT 02
+76.00
-3 BASEMENT 03
+73.00
-4 BASEMENT 04
+64.00
-5 BASEMENT 07



S-01
Laneway Section
1:500



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Project Name Leppington Site A
Project Number 13053
Project Address 173-183 Rickard Road
Leppington NSW 2179

Country Dharug

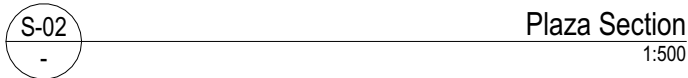
FOR COORDINATION

Drawing Name
Section 01

Drawing Scale
Drawing No.
DA312

1:500 @ A1
Revision
P3

Rev	Date	By	Chk	Description
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P2	16/05/2026			Updated Coordination Pack
P3	22/05/2026			Updated Coordination Pack



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Melbourne
Perth
Sydney

DKO

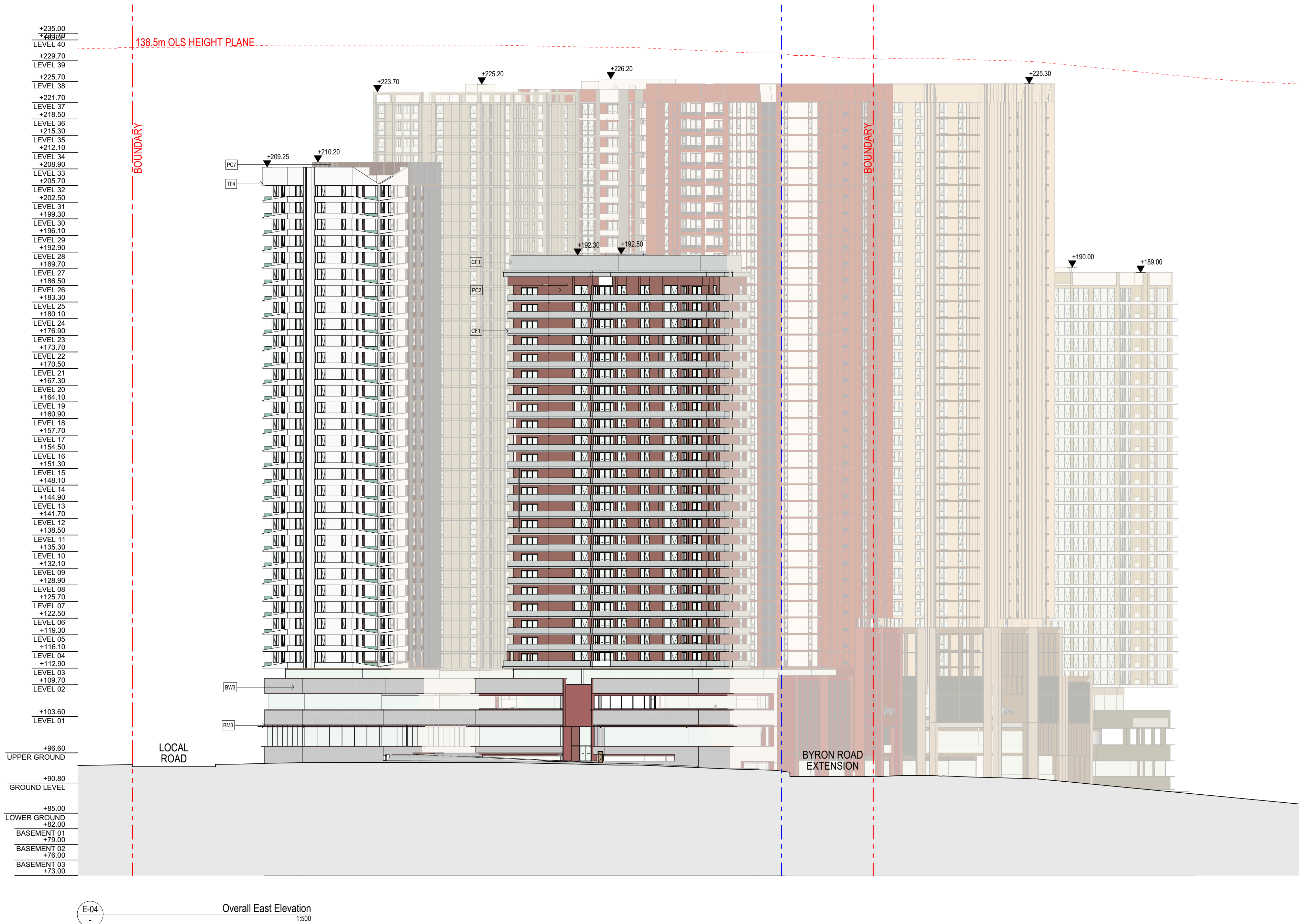
dko.com.au
info@dko.com.au
T +61 2 8346 4500

Country Dharug

FOR COORDINATION

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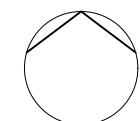
P3



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Rev	Date	By	Chk	Description
P1	1/05/2028			Coordination Pack
P2	16/05/2028			Updated Coordination Pack
P3	22/05/2028			Updated Coordination Pack

	BW1 Red Brick
	BW2 Silver Brick
	VC1 Expressed Joint Panel
	BM1 Silver Pre Finished Metal
	BM2 Light Bronze Finish Metal
	BM3 Red Finish Metal
	BM4 Bronze Finish Metal
	BM5 Grey Finish Metal
	TF1 Red Toned Concrete Look
	TF2 Textured Finish Vertical White
	TF3 Textured Finish Vertical Sand
	TF4 Textured Finish White
	CF1 Grey Concrete Finish
	CF1 Sand Concrete Finish
	PC1 Red Finish
	PC2 Light Red Finish
	PC3 Terracotta Coloured Finish
	PC4 Sand Finish
	PC5 Grey Finish
	PC6 Dark Grey Finish
	PC7 Brown Finish
	PC8 Black Finish



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info@dco.com.au
T +61 2 8346 4500

Project Name Leppington Site A
Project Number 13053
Project Address 173-183 Rickard Road
Leppington NSW 2179

Country Dharug

FOR COORDINATION

Drawing Name
Overall East Elevations

Drawing Scale
Drawing No. DA303

1:500 @ A1
Revision
P3

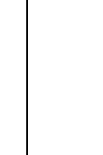
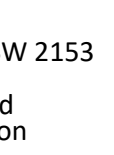
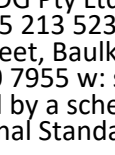
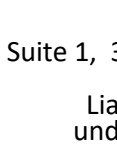
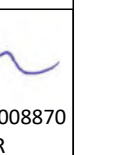
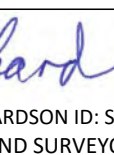
C

Site Survey Plan





ISSUE	DATE	AMENDMENT	SURV	CHK
A	26/11/21	ORIGINAL ISSUE	PS	AR





GENERAL NOTES

ONLY TREES GREATER THAN 3.5 METRES IN HEIGHT ARE SHOWN ON THIS PLAN AND THEIR POSITIONS ARE DIAGRAMMATIC ONLY AND MAY REQUIRE ADDITIONAL SURVEY WHERE CRITICAL TO DESIGN.

CONTOURS ARE INDICATIVE AT GROUND FORM ONLY. SPOT LEVELS ONLY SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.

LEVELS ARE ON AUSTRALIAN HEIGHT DATUM (AHD).

ALL SETOUT LEVELS MUST BE REFERRED TO THE BENCH MARK SHOWN ON THIS PLAN.

BOUNDARY NOTES

THE BOUNDARIES OF THE LAND HAVE BEEN SURVEYED. UNLESS SHOWN BY OFFSETS, THE POSITION OF THE FEATURES SHOWN IS DIAGRAMMATIC ONLY.

BOUNDARIES HAVE NOT BEEN MARKED.

SURVEY INFORMATION NOTES

THE ORIGIN OF COORDINATES COMES FROM PM44121 E297591.896 N6240513.137 CLASS B POSITIONAL UNCERTAINTY (PU) 0.02 (MGA2020) ADOPTED FROM SCIMS DATED 26/11/2021.

THE ORIGIN OF LEVELS COMES FROM SSM44121 RL94.997 CLASS LC POSITIONAL UNCERTAINTY (PU) 0.02 ADOPTED FROM SCIMS DATED 26/11/2021.

THE ORIENTATION OF THIS PLAN IS MGA NORTH WHICH HAS BEEN DETERMINED BY A COORDINATE JOIN BETWEEN PM44121 AND PM44281.

CERTIFICATE OF TITLE NOTES

THE FOLLOWING INFORMATION RELATES TO THE RESPECTIVE CERTIFICATE OF TITLE OF EACH LOT:

- LOT 1 IN DP812366 (CT EDITION 6 DATED 15/10/2021 SEARCH DATE 27/10/2021)
 - AFFECTED BY:
 - CAVEAT (AR479783, AR510180, AR526849)
 - COVENANT (B84868)
- LOT 2 IN DP812366 (CT EDITION 7 DATED 15/10/2021 SEARCH DATE 27/10/2021)
 - AFFECTED BY:
 - CAVEAT (AR479784, AR510176, AR527147)
 - COVENANT (B84868)
- LOT 37 IN DP8979 (CT EDITION 4 DATED 02/09/2018 SEARCH DATE 27/10/2021)
 - AFFECTED BY:
 - CAVEAT (AR88442)
 - COVENANT (B994481)
- LOT 38A IN DP8979 (CT EDITION 1 DATED 18/10/2021 SEARCH DATE 27/10/2021)
 - AFFECTED BY:
 - CAVEAT (AR527019)
 - COVENANT (A628946)

COVENANTS AND RESTRICTIONS NOTED ON THE TITLE HAVE NOT BEEN INVESTIGATED. THESE SHOULD BE INVESTIGATED PRIOR TO DESIGN TO ENSURE ANY FUTURE DEVELOPMENT COMPLIES.

SERVICES NOTES

NO UNDERGROUND SURVEY SEARCH HAS BEEN UNDERTAKEN. THERE MAY BE ADDITIONAL SERVICES WITHIN THE SURVEY AREA.

ONLY THOSE SERVICES VISIBLE AT THE TIME OF SURVEY HAVE BEEN LOCATED AND ARE QUALITY LEVEL A AS DEFINED BY AS 5488.1:2019.

ALL RELEVANT AUTHORITIES MUST BE CONTACTED TO DETERMINE THE FULL EXTENT OF SERVICES PRIOR TO ANY PLANNING OR WORKS NEAR THE SITE.

LEGEND

CL CENTRELINE	PP POWER POLE
COM COMMUNICATIONS PIT	SMH SEWER MANHOLE
FL FLOOR LEVEL	SS STREET SIGN
GAS GAS MARKER/LID	SV STOP VALVE
HYD HYDRANT	SWP STORMWATER PIT
LIP LIP LINE	TB TOP OF BANK
LP LIGHT POLE	TK TOP OF KERB
PC PEDESTRIAN CROSSING	VC VEHICLE CROSSING

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PROJECT:

DETAIL AND LEVEL SURVEY OF
LOTS 1 & 2 IN DP812366

173 & 183 RICKARD ROAD
LEPPINGTON

CLIENT: ALAND DEVELOPMENTS PTY LTD

FILE: 8581_156 166 173 183 Rickard Road Leppington_Rev A

LGA: CAMDEN

REF: 8581	CONTOURS: 0.5m
ISSUE: A	DATUM: AHD
SURVEY DATE: 28/10/2021	AZIMUTH: MGA2020
SCALE: 1:400	SHEET 2 OF 3 SHEETS

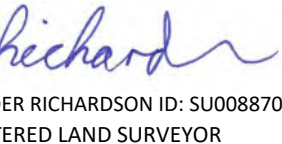
SDG

SDG Pty Ltd
abn 85 213 523 621
Suite 1, 3 Railway Street, Baulkham Hills NSW 2153
t: (02) 9630 7955 w: sdg.net.au
Liability limited by a scheme approved under Professional Standards Legislation

ALEXANDER RICHARDSON ID: SU008870
REGISTERED LAND SURVEYOR

SEE SHEET 1 FOR NOTES, LEGEND, DBYD & TREE TABLE

ISSUE	DATE	AMENDMENT	SURV	CHK
A	26/11/21	ORIGINAL ISSUE	PS	AR





GENERAL NOTES

ONLY TREES GREATER THAN 3.5 METRES IN HEIGHT ARE SHOWN ON THIS PLAN AND THEIR POSITIONS ARE DIAGRAMMATIC ONLY AND MAY REQUIRE ADDITIONAL SURVEY WHERE CRITICAL TO DESIGN.

CONTOURS ARE INDICATIVE AT GROUND FORM ONLY. SPOT LEVELS ONLY SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.

LEVELS ARE ON AUSTRALIAN HEIGHT DATUM (AHD).

ALL SETOUT LEVELS MUST BE REFERRED TO THE BENCH MARK SHOWN ON THIS PLAN.

BOUNDARY NOTES

THE BOUNDARIES OF THE LAND HAVE BEEN SURVEYED. UNLESS SHOWN BY OFFSETS, THE POSITION OF THE FEATURES SHOWN IS DIAGRAMMATIC ONLY.

BOUNDARIES HAVE NOT BEEN MARKED.

SURVEY INFORMATION NOTES

THE ORIGIN OF COORDINATES COMES FROM PM44121 E297591.896 N6240513.137 CLASS B POSITIONAL UNCERTAINTY (PU) 0.02 (MGA2020) ADOPTED FROM SCIMS DATED 26/11/2021.

THE ORIGIN OF LEVELS COMES FROM SSM44121 RL94.997 CLASS LC POSITIONAL UNCERTAINTY (PU) 0.02 ADOPTED FROM SCIMS DATED 26/11/2021.

THE ORIENTATION OF THIS PLAN IS MGA NORTH WHICH HAS BEEN DETERMINED BY A COORDINATE JOIN BETWEEN PM44121 AND PM44281.

CERTIFICATE OF TITLE NOTES

THE FOLLOWING INFORMATION RELATES TO THE RESPECTIVE CERTIFICATE OF TITLE OF EACH LOT:

- LOT 1 IN DP812366 (CT EDITION 6 DATED 15/10/2021 SEARCH DATE 27/10/2021)
 - AFFECTED BY:
 - CAVEAT (AR479783, AR510180, AR526849)
 - COVENANT (B84868)
- LOT 2 IN DP812366 (CT EDITION 7 DATED 15/10/2021 SEARCH DATE 27/10/2021)
 - AFFECTED BY:
 - CAVEAT (AR479784, AR510176, AR527147)
 - COVENANT (B84868)
- LOT 37 IN DP8979 (CT EDITION 4 DATED 02/09/2018 SEARCH DATE 27/10/2021)
 - AFFECTED BY:
 - CAVEAT (AR88442)
 - COVENANT (B994481)
- LOT 38A IN DP8979 (CT EDITION 1 DATED 18/10/2021 SEARCH DATE 27/10/2021)
 - AFFECTED BY:
 - CAVEAT (AR527019)
 - COVENANT (A628946)

COVENANTS AND RESTRICTIONS NOTED ON THE TITLE HAVE NOT BEEN INVESTIGATED. THESE SHOULD BE INVESTIGATED PRIOR TO DESIGN TO ENSURE ANY FUTURE DEVELOPMENT COMPLIES.

SERVICES NOTES

NO UNDERGROUND SURVEY SEARCH HAS BEEN UNDERTAKEN. THERE MAY BE ADDITIONAL SERVICES WITHIN THE SURVEY AREA.

ONLY THOSE SERVICES VISIBLE AT THE TIME OF SURVEY HAVE BEEN LOCATED AND ARE QUALITY LEVEL A AS DEFINED BY AS 5488.1:2019.

ALL RELEVANT AUTHORITIES MUST BE CONTACTED TO DETERMINE THE FULL EXTENT OF SERVICES PRIOR TO ANY PLANNING OR WORKS NEAR THE SITE.

LEGEND

CL	CENTRELINE	PP	POWER POLE
COM	COMMUNICATIONS PIT	SMH	SEWER MANHOLE
FL	FLOOR LEVEL	SS	STREET SIGN
GAS	GAS MARKER/LID	SV	STOP VALVE
HYD	HYDRANT	SWP	STORMWATER PIT
LIP	LIP LINE	TK	TOP OF KERB
LP	LIGHT POLE	TP	TOP OF BANK
PC	PEDESTRIAN CROSSING	VC	VEHICLE CROSSING

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PROJECT:

DETAIL AND LEVEL SURVEY OF
LOTS 37 & 38A IN DP8979

156 & 166 RICKARD ROAD
LEPPINGTON

CLIENT: ALAND DEVELOPMENTS PTY LTD
FILE: 8581_156 166 173 183 Rickard Road Leppington_Rev A

LGA: CAMDEN	
REF: 8581	CONTOURS: 0.5m
ISSUE: A	DATUM: AHD
SURVEY DATE: 28/10/2021	AZIMUTH: MGA2020
SCALE: 1:400	SHEET 3 OF 3 SHEETS



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ALEXANDER RICHARDSON ID: SU008870
REGISTERED LAND SURVEYOR

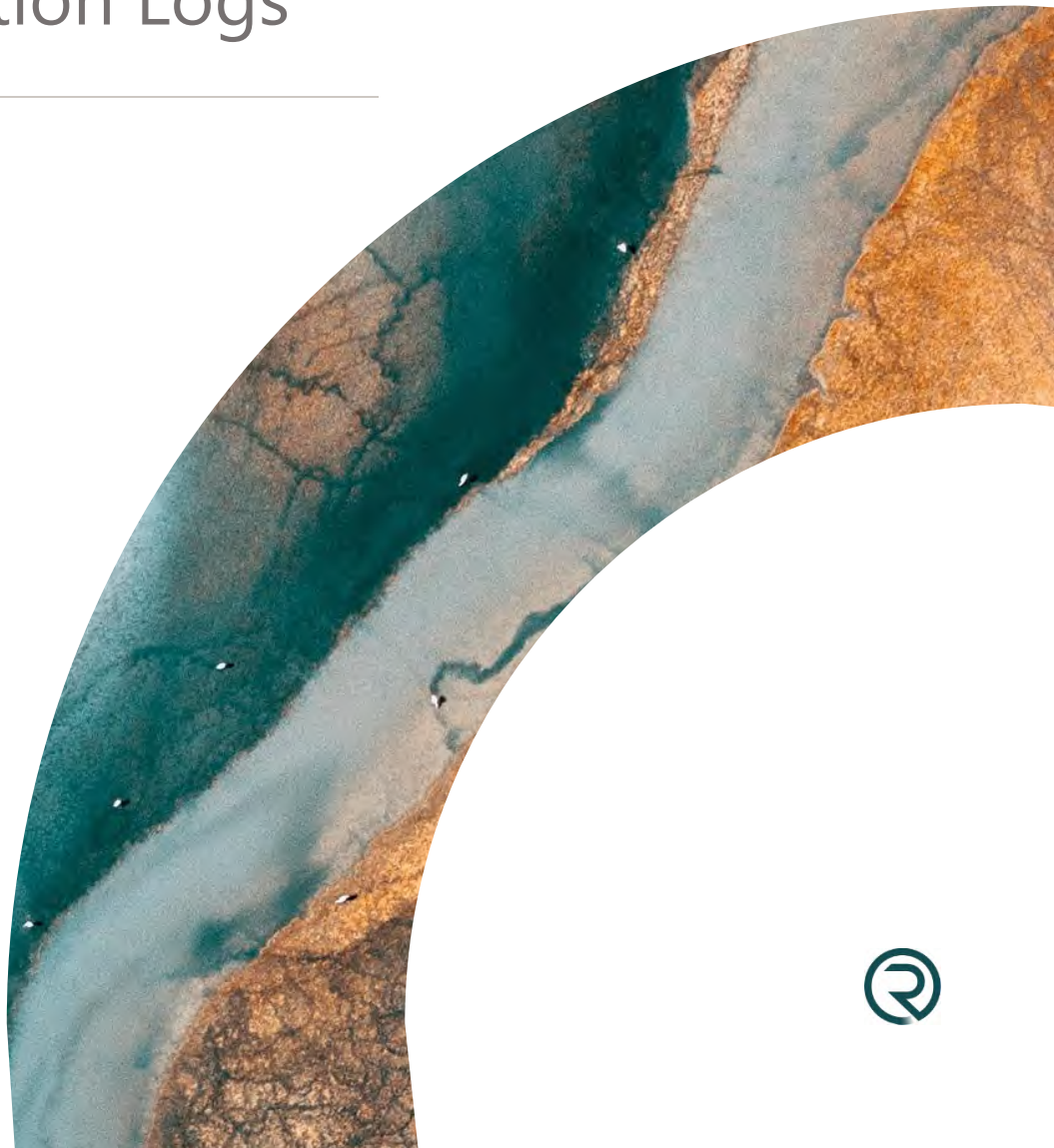
SEE SHEET 1 FOR NOTES, LEGEND, DBYD & TREE TABLE

ISSUE	DATE	AMENDMENT	SURV	CHK
A	26/11/21	ORIGINAL ISSUE	PS	AR

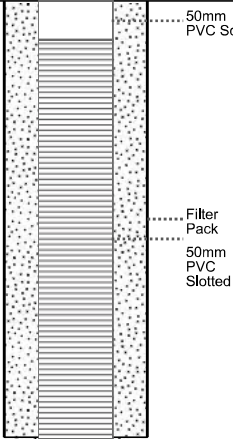


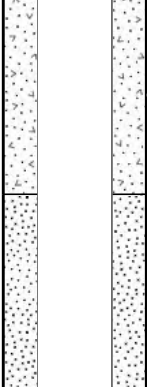
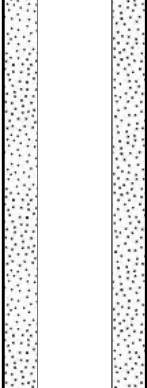
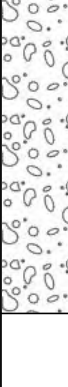
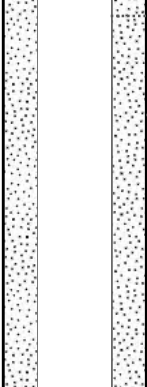
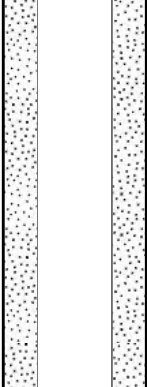
D

Borelogs /
Monitoring Well
Construction Logs



 REDITUS Reditus Consulting Pty Ltd Lvl 1, Suite 1/29-33 Waratah St, Kirrawee NSW 2232, Australia Phone: (02) 9521 6567 Boring No.: RED_BH4									
Easting : 297496.59		Drill Supplier : BG Drilling Pty Ltd		Job Number : 25122		Sheet : 1 OF 2			
Northing : 6240593.64		Driller Company : BG Drilling Pty Ltd		Client : ALand					
Elevation : 91.5(m)		Logged By : Thomas Lancaster		Project : 173 & 183 Rickard Road, Leppington					
Total Depth : 12 m		Date : 26/05/2025		Location : 173 Rickard Road, Leppington NSW, Australia					
Drilling Method	Depth (m)	Elevation (m)	Soil Origin	Graphic Log	Moisture	Material Description	Comments	Well Diagram	Water
SFA		91	TOPSOIL			TOPSOIL Sandy CLAY, mottled grey / red / brown, medium plasticity, trace rootlets, dry			
	1								
		90							
	2								
		89	Natural		D				
	3								
		88							
	4								
		87							
	5								
		86							
	6		Natural		D				
		85							
	7								
		84							

 REDITUS Reditus Consulting Pty Ltd Lvl 1, Suite 1/29-33 Waratah St, Kirrawee NSW 2232, Australia Phone: (02) 9521 6567 Boring No.: RED_BH4									
Easting : 297496.59		Drill Supplier : BG Drilling Pty Ltd		Job Number : 25122		Sheet : 2 OF 2			
Northing : 6240593.64		Driller Company : BG Drilling Pty Ltd		Client : ALand					
Elevation : 91.5(m)		Logged By : Thomas Lancaster		Project : 173 & 183 Rickard Road, Leppington					
Total Depth : 12 m		Date : 26/05/2025		Location : 173 Rickard Road, Leppington NSW, Australia					
Drilling Method	Depth (m)	Elevation (m)	Soil Origin	Graphic Log	Moisture	Material Description	Comments	Well Diagram	Water
SFA			Natural		D	Sandy SILT, grey, low plasticity, dry			
	83 9 82 10 81 11 80		Natural		D	Silty SAND, poorly graded, rounded, with SHALE, grey - black, sub-angular - angular, dry			
						RED_BH4 Terminated at 12m (Target depth was reached at 12 m. Groundwater well installed (monument))			

 Reditus Consulting Pty Ltd Lvl 1, Suite 1/29-33 Waratah St, Kirrawee NSW 2232, Australia Phone: (02) 9521 6567 Boring No.: RED_BH5											
Easting : 297592,35			Drill Supplier : BG Drilling Pty Ltd			Job Number : 25122			Sheet : 1 OF 2		
Northing : 6240489,38			Driller Company : BG Drilling Pty Ltd			Client : ALand					
Elevation : 95.2(m)			Logged By : Thomas Lancaster			Project : 173 & 183 Rickard Road, Leppington					
Total Depth : 14.6 m			Date : 26/05/2025			Location : 173 Rickard Road, Leppington NSW, Australia					
Drilling Method	Depth (m)	Elevation (m)	Soil Origin	Graphic Log	Moisture	Material Description	Comments	Well Diagram		Water	
SFA		95	Natural		D	Silty CLAY, red/brown/grey, medium plasticity, trace GRAVEL, fg, grey, dry			Concrete Cement		
	1										
		94									
	2										
		93	Natural		D	Silty SAND, grey, poorly graded, rounded, dry			50mm PVC Solid		
	3		Natural			SHALE: XW, recovered as GRAVEL: fg, grey, sub-angular - angular			Filter Pack		
		92									
	4										
	5										
		91	Rock			Rock. SHALE: highly weathered, grey - black.					
		90									
	6										
		89									
		7									
			88								

Page 2 of 2

ECS Group

ENVIRONMENTAL CONSULTING SERVICES



Location No.: BH1

Date: 29/04/2025

Project: 173-183 Rickard Rd, Leppington

Logged by: Tom Caples

Location: Middle

Reviewed by: Simon Caples

Depth (m)	Method	Water	Description: Soil type, colour, characteristics	Sample Interval	Piezometer Details	Graphic Log
0	Solid Auger		Silty clay, disturbed, brown & red			
			Silty clay, red brown/yellow-brown, trace sand			
1					Bentonite	
2			Silty clay, pale brown & grey grading to red & grey, trace sand			
3						
4			Shale, highly weathered, grey & light brown grading to grey			
5			Shale, highly weathered, grey	5.0m		
6					Sand screen	
7				7.0m		
8						
9				9.0m		
			Well to 9.5m, 6m screen, sand to 2.4m, bentonite to 0.5m			
			End of Hole (EOH) @ 9.8m – Refusal on shale	9.8m (10)		



Location No.: BH2

Date: 29/04/2025

Project: 173-183 Rickard Rd, Leppington

Logged by: Tom Caples

Location: West

Reviewed by: Simon Caples

Depth (m)	Method	Water	Description: Soil type, colour, characteristics	Sample Interval	Piezometer Details	Graphic Log
0	Solid Auger		Silty clay, disturbed, red & brown			
			Silty clay, red & light brown, trace sand			
1						
			Silty clay, light brown grading to grey, trace sand			
2						
3			Silty clay with shale, highly weathered, pale brown & grey			
4						
5			Shale, weathered, grey/brown	5.0m		
6			Shale, light brown grading to light grey			
7				7.0m		
8						
9			Shale, light grey	9.0m		
			Well to 9.8m, 6m screen, sand to 3.5m, bentonite to 0.5m			
			End of Hole (EOH) @ 10.5m	10.5m		

ECS Group

ENVIRONMENTAL CONSULTING SERVICES



Location No.: BH3	Date: 29/04/2025
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Project: 173-183 Rickard Rd, Leppington	Logged by: Tom Caples
---	-----------------------

Location: East				Reviewed by: Simon Caples			

Depth (m)	Method	Water	Description: Soil type, colour, characteristics	Sample Interval	Piezometer Details			Graphic Log	
0	Solid Auger		Sandy clay, topsoil, brown/dark brown		Bentonite				
			Sandy clay, disturbed, brown & red						
1				Silty clay, trace sand & shale (highly weathered), red/brown with some grey					
2									
3				Silty clay with shale (highly weathered), light brown		Sand screen			
4			Shale, highly weathered, pale brown & grey/brown						
5				5.0m					
6			Shale, highly weathered, pale brown grading to grey						
7				7.0m					
8									
9				9.0m					
			Well to 9.7m, 6m screen, sand to 3.0m, bentonite to 0.5m						
			End of Hole (EOH) @ 10.5m	10.5m					



BOREHOLE LOG

BH ID: BH1M

Location 173-183 Rickard Road, Leppington NSW
Client Aland
Job No. E27124.G03
Sheets 1 of 4

Started 12 May 2026
Completed 12 May 2026
Logged By JF
Review By Date

Drilling Contractor Sytech Drilling
Plant Hanjin D&B 8-D

Surface RL -
Inclination 90°

Northing 6240470.1 (MGA 2020 Zone 56)
Easting 297543.7 (MGA 2020 Zone 56)

METHOD	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	SAMPLE RECOVERY	DEPTH (m)	GRAPHIC LOG	RL (mAHD)	MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / REL. DENSITY	MATERIAL ORIGIN & OBSERVATIONS
AD/T	GWNE	BH1M_0.50-0.90 SPT 0.50-0.95 12, 16, 17 N=33 BH1M_0.90-0.95		0.00			FILL: Silty CLAY: low to medium plasticity, dark grey, trace of root fibres and fine to medium igneous gravel	M < PL	-	FILL
		BH1M_1.50-1.70 SPT 1.50-1.78 12, 21/130 mm HB N=R BH1M_1.70-1.78		0.90			Silty CLAY: high plasticity, light grey and red brown	M ≈ PL	H	RESIDUAL SOIL
				1.70			SILTSTONE: grey and red brown, inferred very low strength			WEATHERED ROCK
		BH1M_3.00-3.05 SPT 3.00-3.05 7/50 mm HB N=R		2.80			SILTSTONE: dark grey and red brown, inferred low strength			WEATHERED ROCK
				3.05			Log continued on next page.			
				4						
				5						
				6						
				7						
				8						
				9						
				10						

This log should be read in conjunction with EI Australia's accompanying explanatory notes.

BOREHOLE CORE LOG

BH ID: BH1M

Location 173-183 Rickard Road, Leppington NSW
Client Aland
Job No. E27124.G03
Sheets 2 of 4

Started 12 May 2026
Completed 12 May 2026
Logged By JF **Date**
Review By **Date**

Drilling Contractor Sytech Drilling **Surface RL** - **Northing** 6240470.1 (MGA 2020 Zone 56)
Plant Hanjin D&B 8-D **Inclination** 90° **Easting** 297543.7 (MGA 2020 Zone 56)

METHOD	Flush Return	TCR %	RQD %	DEPTH (m)	GRAPHIC LOG	RL (mAHD)	MATERIAL DESCRIPTION	WEATHERING	ESTIMATED STRENGTH Is(50)						DISCONTINUITIES & ADDITIONAL DATA	FRACTURE SPACING			
									VL	L	M	H	VH	EH		30	100	300	1000
				0			Log continued from previous page.												
				1															
				2															
				3															
				4			SILTSTONE: grey with red brown bands and laminae, indistinctly laminated at 0°-10°	HW							3.08: BP 0° PR SM Clay VN 3.17: BP 0° PR SM Fe SN 3.24: BP 0° PR SM Clay VN 3.27-3.29: XWS 3.42: BP 0° PR SM Fe SN 3.58: BP 0° PR SM Fe SN 3.60: BP 10° PR SM Fe SN 3.79: BP 10° PR SM Fe SN 3.81: BP 10° PR SM Fe SN 3.88-4.00: XWZ 4.10-4.12: XWS 4.19-4.23: XWS 4.44: JT 25° PR SM Fe SN 4.68: BP 10° PR SM Fe SN 4.79: BP 5° PR SM Fe SN 4.91: JT 90° PR SM Fe SN 4.93: BP 5° PR SM Fe SN 5.08-5.10: FS 5.23: BP 10° IR RO Fe SN 5.26-5.28: XWS 5.27: JT 65° PR SM Fe SN 5.33: BP 10° IR RO Clay VN 5.50: JT 70° PR SM Fe SN 5.81: BP 5° UN SM Fe SN 5.92: BP 5° PR SM Fe SN 6.06: JT 45° PR SM CN 6.44: JT 80° PR SM Fe SN 6.45-6.48: CS 6.56-6.57: XWS 6.59: BP 0° PR SM Clay Infilled 6.61: BP 0° PR SM Fe SN 7.13: BP 0° PR SM Clay VN 7.15: JT 40° ST SM Clay VN 7.50-7.51: XWS				
		100	71	4.32			SILTSTONE: dark grey with red brown bands, indistinctly laminated at 0°-10°												
				5				MW											
				6															
				7				HW											
				8															
				8.12			NO CORE: 40mm thick								8.18-8.22: XWS				
				8.16			SILTSTONE: dark grey with grey laminae, indistinctly laminated at 0°-5°	MW							8.52: BP 5° PR SM Clay Infilled				
				9											8.79-8.81: CS 8.84: BP 0° PR RO Clay Infilled 8.95: BP 5° PR SM Clay Infilled				
				9.07			NO CORE: 120mm thick								9.19-9.29: FZ				
				9.19			SILTSTONE: dark grey, with grey and light grey laminae, distinctly laminated at 0°-5°	SW							9.36: BP 0° PR SM Clay VN 9.65: BP 0° PR SM Clay VN				
				10															

This log should be read in conjunction with EI Australia's accompanying explanatory notes.



BOREHOLE CORE LOG

BH ID: BH1M

Location 173-183 Rickard Road, Leppington NSW
Client Aland
Job No. E27124.G03
Sheets 3 of 4

Started 12 May 2026
Completed 12 May 2026
Logged By JF
Review By JF
Date

Drilling Contractor Sytech Drilling
Plant Hanjin D&B 8-D
Surface RL -
Inclination 90°
Northing 6240470.1 (MGA 2020 Zone 56)
Easting 297543.7 (MGA 2020 Zone 56)

METHOD	FLUSH RETURN	TCR %	RQD %	DEPTH (m)	GRAPHIC LOG	RL (mAHD)	MATERIAL DESCRIPTION	WEATHERING	ESTIMATED STRENGTH Is(50) ▼ - Axial ▽ - Diametral	DISCONTINUITIES & ADDITIONAL DATA	FRACTURE SPACING
NMLC	95%								VL 0-1 L 0-3 M 1 H 3 VH 10 EH		30 100 300 1000 3000
		96	89	11			SILTSTONE: dark grey, with grey and light grey laminae, distinctly laminated at 0°-5°	SW		10.42: BP 0° PR SM Clay VN	
				12						11.32-11.34: CS 11.52: BP 0° PR SM Clay VN	
		100	100	12.33			LAMINITE: 70% Siltstone, dark grey, and 30% Sandstone, fine to medium grained, grey and light grey, distinctly laminated at 0°-5°			12.17: JT 90° PR SM Clay VN 12.49: JT 80° PR RO CN	
				13							
				14							
				14.25			SILTSTONE: dark grey and grey, with light grey laminae, with sandstone bands and breccia, indistinctly laminated at 0°-10°			14.37: BP 5° PR RO Clay VN	
				15							
		100	94	16				FR		15.25: BP 8° PR SM Clay VN 15.27: BP 8° PR SM Clay VN 15.43: BP 0° PR SM Clay VN 15.66-15.71: CS 15.73: BP 0° PR SM Clay VN 15.94: JT 85° PR SM CN 16.10: BP 0° PR SM Clay VN	
				16.68			SANDSTONE: fine grained, grey, indistinctly cross bedded at 0°-10°			16.59: BP 0° IR SM Clay VN 16.66-16.68: CS	
				17						17.04-17.05: XWS	
				17.32			LAMINITE: 60% Siltstone, dark grey, and 40% Sandstone, fine grained, grey and light grey, indistinctly laminated at 0°-5°				
		100	96	18						18.06-18.04: CS 18.09: BP 0° PR SM Clay Infilled 18.23: BP 0° PR SM Clay Infilled	
				19							
				20							

This log should be read in conjunction with EI Australia's accompanying explanatory notes.



BOREHOLE CORE LOG

BH ID: BH1M

Location 173-183 Rickard Road, Leppington NSW
Client Aland
Job No. E27124.G03
Sheets 4 of 4

Started 12 May 2026
Completed 12 May 2026
Logged By JF
Review By JF
Date

Drilling Contractor Sytech Drilling
Plant Hanjin D&B 8-D
Surface RL -
Inclination 90°
Northing 6240470.1 (MGA 2020 Zone 56)
Easting 297543.7 (MGA 2020 Zone 56)

METHOD	Flush Return	TCR %	RQD %	DEPTH (m)	GRAPHIC LOG	RL (mAHD)	MATERIAL DESCRIPTION	WEATHERING	ESTIMATED STRENGTH Is(50)							DISCONTINUITIES & ADDITIONAL DATA	FRACTURE SPACING				
									VL	L	M	H	VH	EH	30		100	300	1000	3000	
NMLC	95%	100	88	21			LAMINITE: 60% Siltstone, dark grey, and 40% Sandstone, fine grained, grey and light grey, indistinctly laminated at 0°-5°	FR							20.01: JT 80° UN SM CN 20.13: JT 70° PR SM CN 20.49-20.52: CS 20.64-20.66: CS 20.69: BP 0° PR SM Clay Infilled 20.82: BP 0° PR SM Clay VN 20.98-21.02: CS 21.11-21.13: CS 21.19: BP 0° PR SM Clay VN 22.41: JT 80-90° PR SM CN 23.27: JT 90° PR SM CN 23.53-23.55: CS 23.55: JT 90° PR SM Clay VN 23.62: JT 35° PR SM Clay Infilled 23.84: JT 45-75° IR SM CN 24.38-24.40: CS 24.41: JT 70° PR SM Clay VN 24.52: JT 60° PR SM Clay VN 24.57-24.58: CS 25.18-25.20: CS 25.20: JT 90° PR SM CN 25.24: JT 90° PR SM CN 25.93: JT 65° PR SM CN 26.60: BP 0° IR SM Clay VN 26.69: BP 0° PR SM Clay VN 26.83: BP 0° PR SM Clay VN 26.95: BP 5° IR SM Clay VN 27.03-27.10: XWS 27.14-27.18: XWS 27.30-27.35: CS 27.43-27.48: CS 29.30: JT 70-90° IR SM CN						
				26.00			NO CORE: 160mm thick		-												
				26.16			LAMINITE: 60% Siltstone, dark grey, and 40% Sandstone, fine grained, grey and light grey, indistinctly laminated at 0°-5°														
				27																	
				28				FR													
				29																	
				30			Terminated at 29.63m. Target Depth Reached.														

This log should be read in conjunction with EL Australisk core sampling exploration notes.

This log should be read in conjunction with EI Australia's accompanying explanatory notes.



BOREHOLE LOG

BH ID: BH2M

Location 173-183 Rickard Road, Leppington NSW
Client Aland
Job No. E27124.G03
Sheets 1 of 5

Started 13 May 2026
Completed 13 May 2026
Logged By JF
Review By **Date**

Drilling Contractor Sytech Drilling
Plant Hanjin D&B 8-D

Surface RL -
Inclination 90°

Latitude -
Longitude -

METHOD	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	SAMPLE RECOVERY	DEPTH (m)	GRAPHIC LOG	RL (mAHD)	MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / REL. DENSITY	MATERIAL ORIGIN & OBSERVATIONS
AD/T	GWNE	BH2M_0.50-0.95 SPT 0.50-0.95 6,10,15 N=25		0.00			FILL: Silty CLAY: low plasticity, dark grey, with rootlets and ash	M > PL	-	FILL
		BH2M_1.50-1.95 SPT 1.50-1.95 10,13,15 N=28		0.40			Silty CLAY: high plasticity, red brown mottled light grey, with rootlets and fine to medium ironstone gravel	M ≈ PL	VSt	RESIDUAL SOIL
		BH2M_3.00-3.05 SPT 3.00-3.05 6/50 mm HB N=R		1.30			Silty CLAY: medium to high plasticity, light grey mottled orange brown and dark grey, with extremely weathered fabric	M < PL	H	
				2.70			SILTSTONE: dark grey and orange brown, inferred low strength	-	-	WEATHERED ROCK
				3.09			Log continued on next page.			
				4						
				5						
				6						
				7						
				8						
				9						
				10						

This log should be read in conjunction with EI Australia's accompanying explanatory notes.



BOREHOLE CORE LOG

BH ID: BH2M

Location 173-183 Rickard Road, Leppington NSW
Client Aland
Job No. E27124.G03
Sheets 2 of 5

Started 13 May 2026
Completed 13 May 2026
Logged By JF
Review By JF
Date

Drilling Contractor Sytech Drilling
Plant Hanjin D&B 8-D

Surface RL -
Inclination 90°

Latitude -
Longitude -

METHOD	FLUSH RETURN	TCR %	RQD %	DEPTH (m)	GRAPHIC LOG	RL (mAHD)	MATERIAL DESCRIPTION	WEATHERING	ESTIMATED STRENGTH Is(50) ▼ - Axial ▽ - Diametral	DISCONTINUITIES & ADDITIONAL DATA	FRACTURE SPACING
				0			Log continued from previous page.		VL ₀₋₁ L ₀₋₃ M ₁ H ₃ VH ₁₀ EH		30 100 300 1000 3000
				1							
				2							
				3							
				4			SILTSTONE: dRk grey and red brown, with some sandstone bands, indistinctly laminated at 0°-10°	MW		3.16: BP 10° PR SM Clay VN 3.29: BP 10° PR SM Fe SN 3.32: BP 0° PR SM Fe SN 3.35: BP 0° PR SM Fe SN 3.46: BP 0° PR SM Clay VN 3.62: BP 0° PR SM CN 3.68: BP 0° PR SM Fe SN 3.72: BP 0° PR SM Fe SN 4.02: JT 80° PR SM Fe SN 4.12: BP 0° PR RO Fe Infilled 4.21-4.26: XWS 4.43: BP 0° PR SM Clay VN 4.52-4.55: XWS	
		100	88	4.64			SANDSTONE: fine grained, light brown, indistinctly cross bedded at 0°-20°	HW		4.81: JT 25° PR SM Fe SN 4.92: BP 0° PR SM Fe SN	
				5							
				5.25			LAMINITE: 60% Sandstone, fine grained, grey and 40% Siltstone, dark grey, with red brown bands, indistinctly laminated at 0°-5°			5.44: BP 0° PR SM Fe SN 5.45: BP 0° PR SM Fe SN 5.49-5.52: CS 5.58: JT 90° PR SM Fe SN 5.60: BP 0° PR SM Fe SN 5.64-5.66: XWS 5.74: BP 0° PR SM Fe SN 5.77: BP 0° PR SM Clay VN 5.87-5.88: CS 5.90: BP 0° PR SM Fe SN 5.95-6.00: XWS 6.04-6.05: XWS 6.19-6.28: XWS 6.37-6.41: XWS 6.46-6.47: XWS 6.67: BP 5° PR SM Fe SN 6.70: BP 0° PR SM Fe SN 6.74: JT 75° PR SM healed joint Fe SN 6.86: BP 0° PR SM Fe SN 6.91: BP 0° PR SM Fe SN 6.97: JT 85° PR SM healed joint Fe SN 7.31-7.32: XWS 7.40: BP 0° PR SM Clay Infilled 7.68: BP 0° PR SM Fe SN 7.69: BP 0° PR SM Fe SN 8.07-8.09: XWS 8.14: BP 0° PR SM Fe SN 8.20: BP 0° PR SM Fe SN 8.27: JT 70° PR SM healed joint Fe SN 8.80-8.83: CS 8.85-8.88: CS 8.96: JT 30° PR SM healed joint Fe SN 9.03: BP 0° PR SM Fe SN 9.05: BP 0° PR SM Clay VN 9.07: BP 0° PR SM Fe SN 9.74: JT 80-90° PR SM healed joint Fe SN 9.86: JT 90° PR SM CN	
				6							
				6.27			SILTSTONE: dark grey with red brown and grey and light grey laminae, with some sandstone bands, indistinctly laminated at 0°-5°	MW			
				7							
		100	66	8							
				9							
		94	81	10				SW			

This log should be read in conjunction with EI Australia's accompanying explanatory notes.

Review By _____ Date _____

Longitude -

This log should be read in conjunction with El Australia's accompanying explanatory notes.



BOREHOLE CORE LOG

BH ID: BH2M

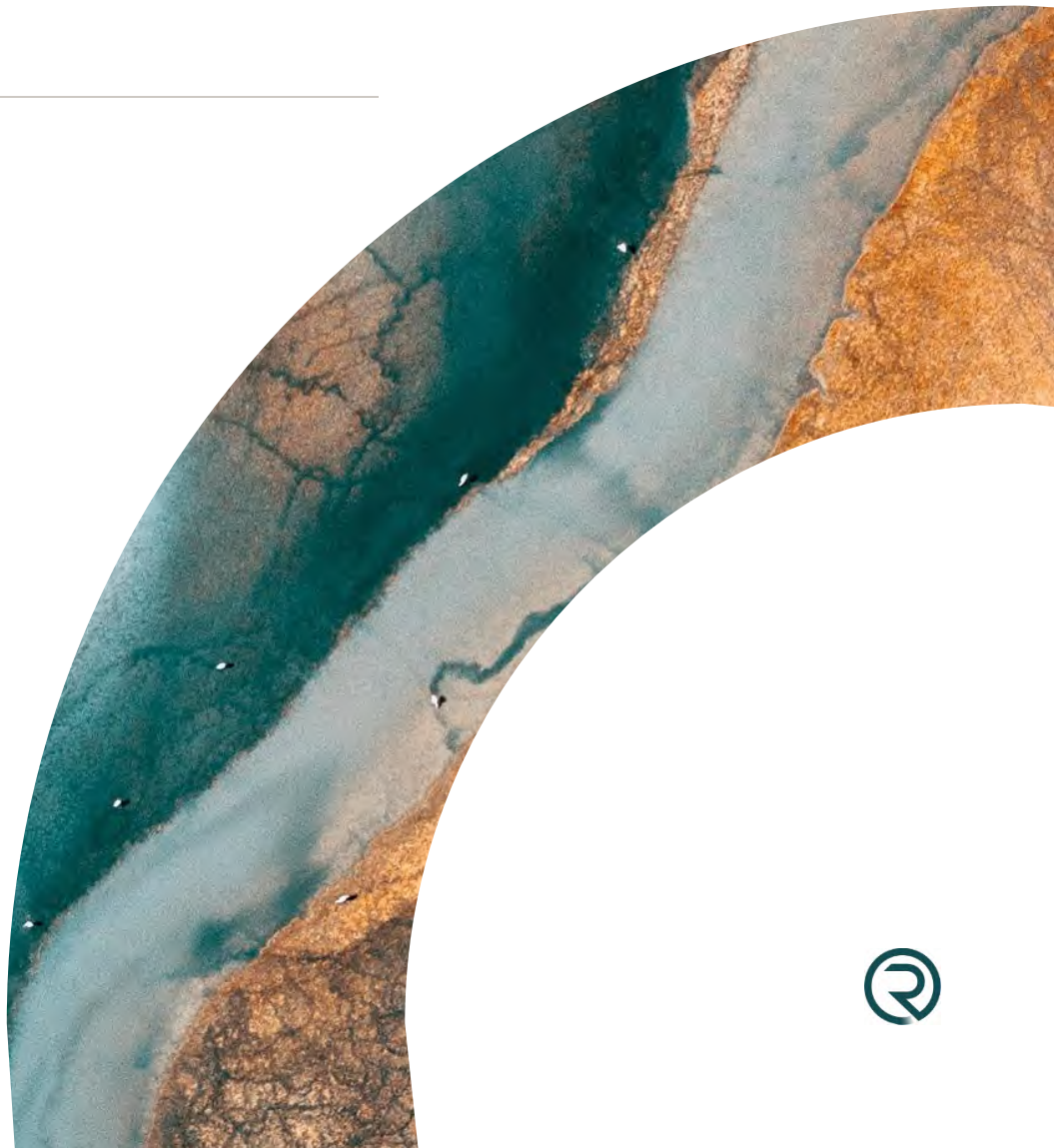
Location	173-183 Rickard Road, Leppington NSW	Started	13 May 2026
Client	Aland	Completed	13 May 2026
Job No.	E27124.G03	Logged By	JF
Sheets	5 of 5	Review By	Date
Drilling Contractor	Sytech Drilling	Surface RL	-
Plant	Hanjin D&B 8-D	Inclination	90°
		Latitude	-
		Longitude	-

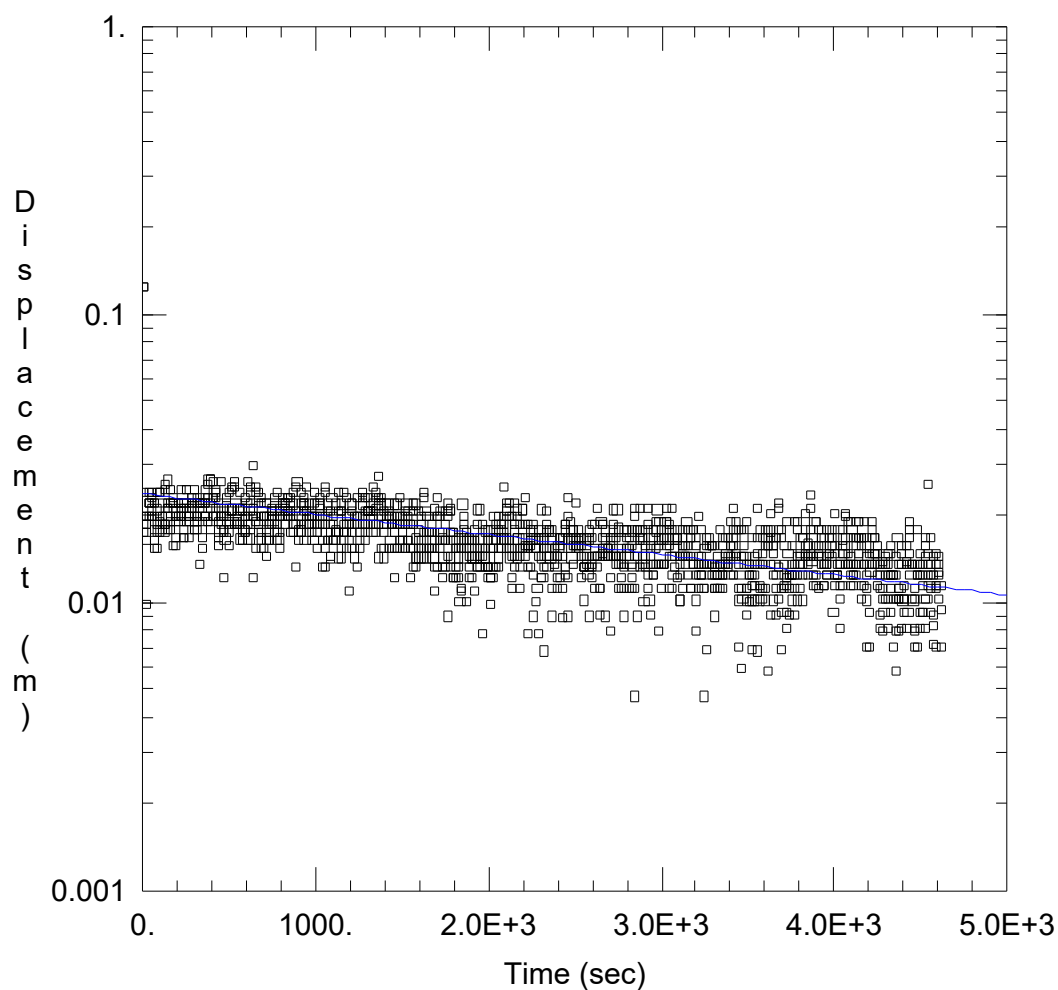
METHOD	FLUSH RETURN	TCR %	RQD %	DEPTH (m)	GRAPHIC LOG	RL (mAHD)	MATERIAL DESCRIPTION	WEATHERING	ESTIMATED STRENGTH Is(50)	DISCONTINUITIES & ADDITIONAL DATA	FRACTURE SPACING
NMLC	90%	100	100				LAMINITE: 60% Siltstone, dark grey, and 40% Sandstone, fine grained, grey and light grey, distinctly laminated at 0°-5°	FR	VL 0-1 L 0-3 M 1 H 3 VH 10 EH		30 100 300 1000 3000
				31			Terminated at 31.14m. Target Depth Reached.				
				32							
				33							
				34							
				35							
				36							
				37							
				38							
				39							
				40							

This log should be read in conjunction with EI Australia's accompanying explanatory notes.

E

Hydraulic Conductivity Testing Results





BH2_FHT

Data Set: C:\...\BH2_FHT.aqt

Date: 07/10/25

Time: 17:08:58

PROJECT INFORMATION

Company: Reditus Consulting

Client: ALand

Project: 25122

Test Well: BH2

Test Date: 03/06/25

AQUIFER DATA

Saturated Thickness: 1.555 m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH2)

Initial Displacement: 0.125 m

Static Water Column Height: 1.555 m

Total Well Penetration Depth: 6. m

Screen Length: 6. m

Casing Radius: 0.025 m

Well Radius: 0.0575 m

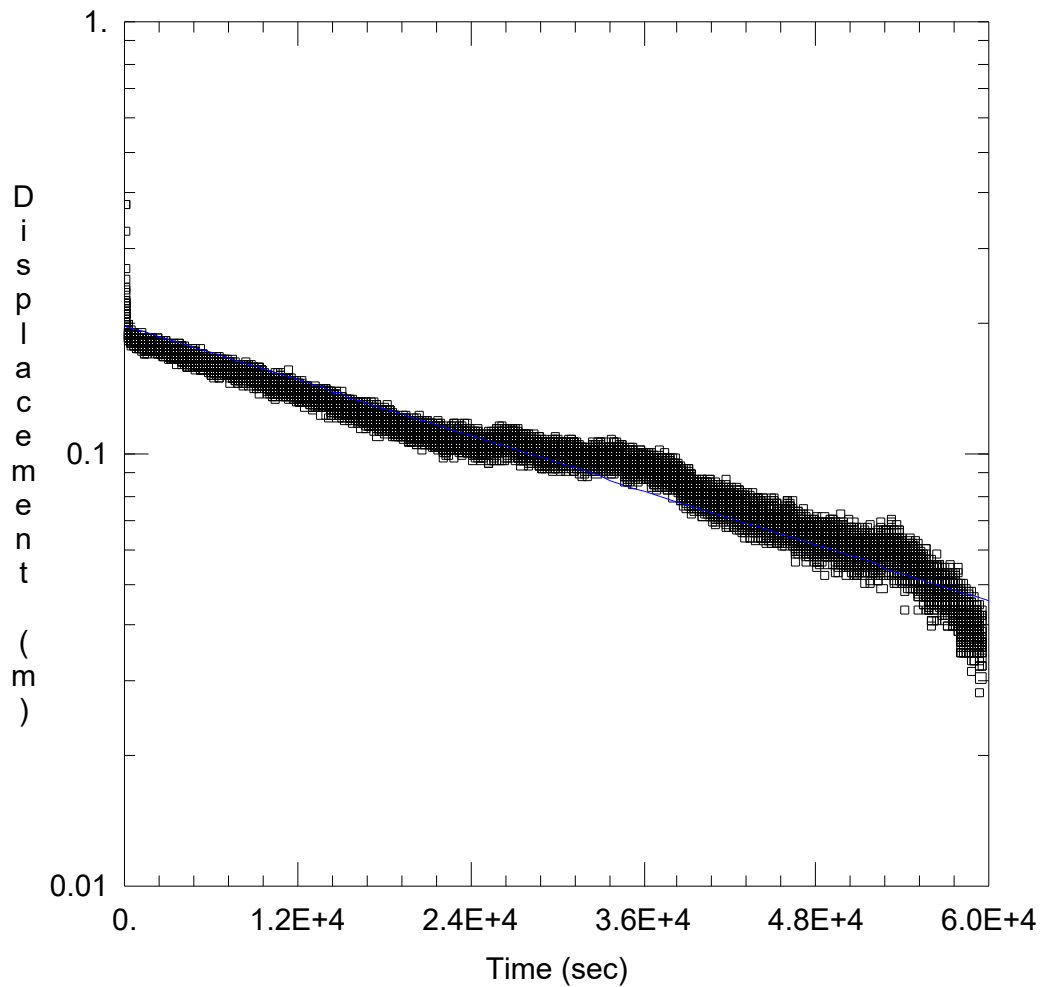
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.00916 m/day

y0 = 0.02382 m



BH2_RHT

Data Set: C:\...\BH2_RHT.aqt

Date: 07/10/25

Time: 17:09:39

PROJECT INFORMATION

Company: Reditus Consulting

Client: ALand

Project: 25122

Test Well: BH2

Test Date: 03/06/25

AQUIFER DATA

Saturated Thickness: 1.555 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH2)

Initial Displacement: 0.375 m

Total Well Penetration Depth: 6. m

Casing Radius: 0.025 m

Static Water Column Height: 1.555 m

Screen Length: 6. m

Well Radius: 0.0575 m

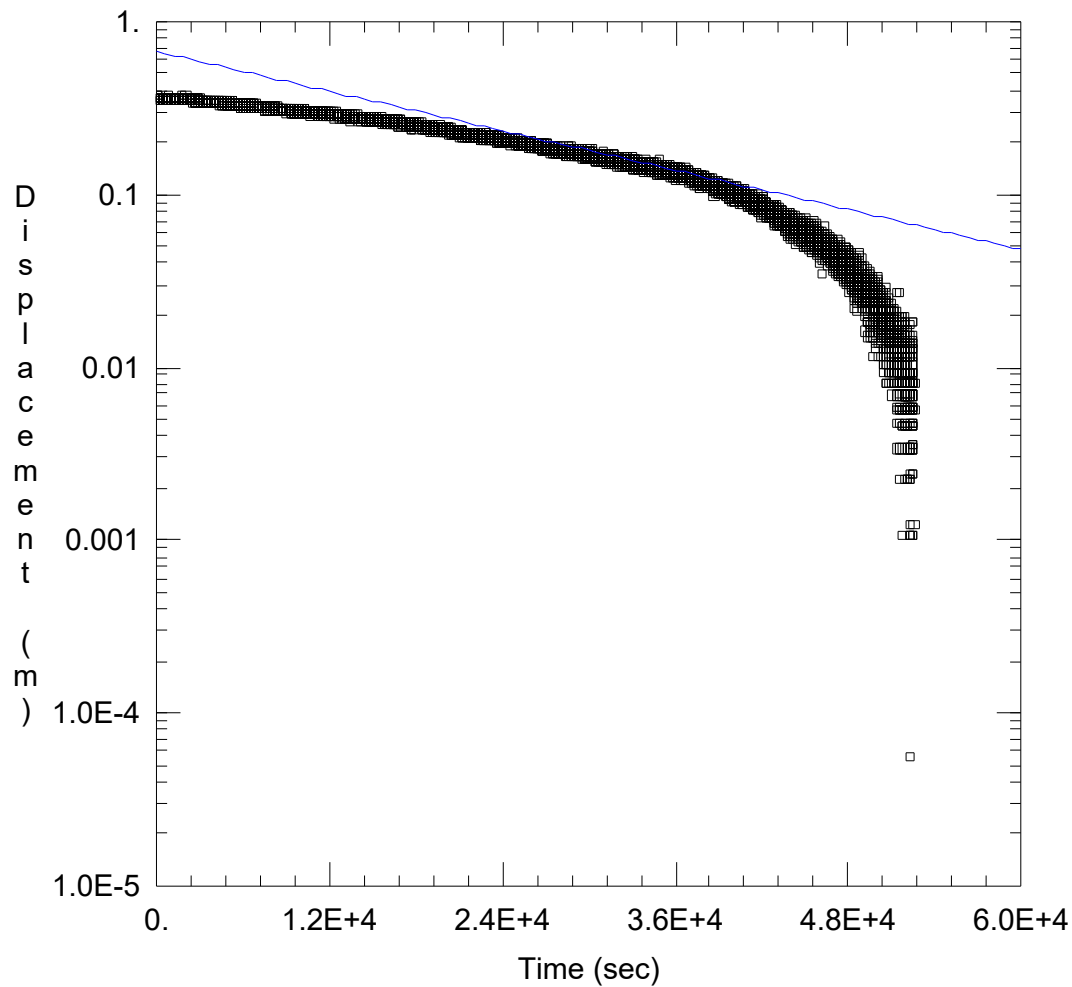
SOLUTION

Aquifer Model: Unconfined

$K = 0.001386$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.1981$ m



RHT

Data Set: C:\...\RED_BH4_RHT.aqt

Date: 07/10/25

Time: 17:12:02

PROJECT INFORMATION

Company: Reditus Consulting

Client: Leppington Main 88 Pty Ltd

Project: 25122

Test Well: RED_BH4

Test Date: 03/06/25

AQUIFER DATA

Saturated Thickness: 1.69 m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (RED_BH4)

Initial Displacement: 0.3734 m

Static Water Column Height: 1.69 m

Total Well Penetration Depth: 2. m

Screen Length: 2. m

Casing Radius: 0.025 m

Well Radius: 0.0575 m

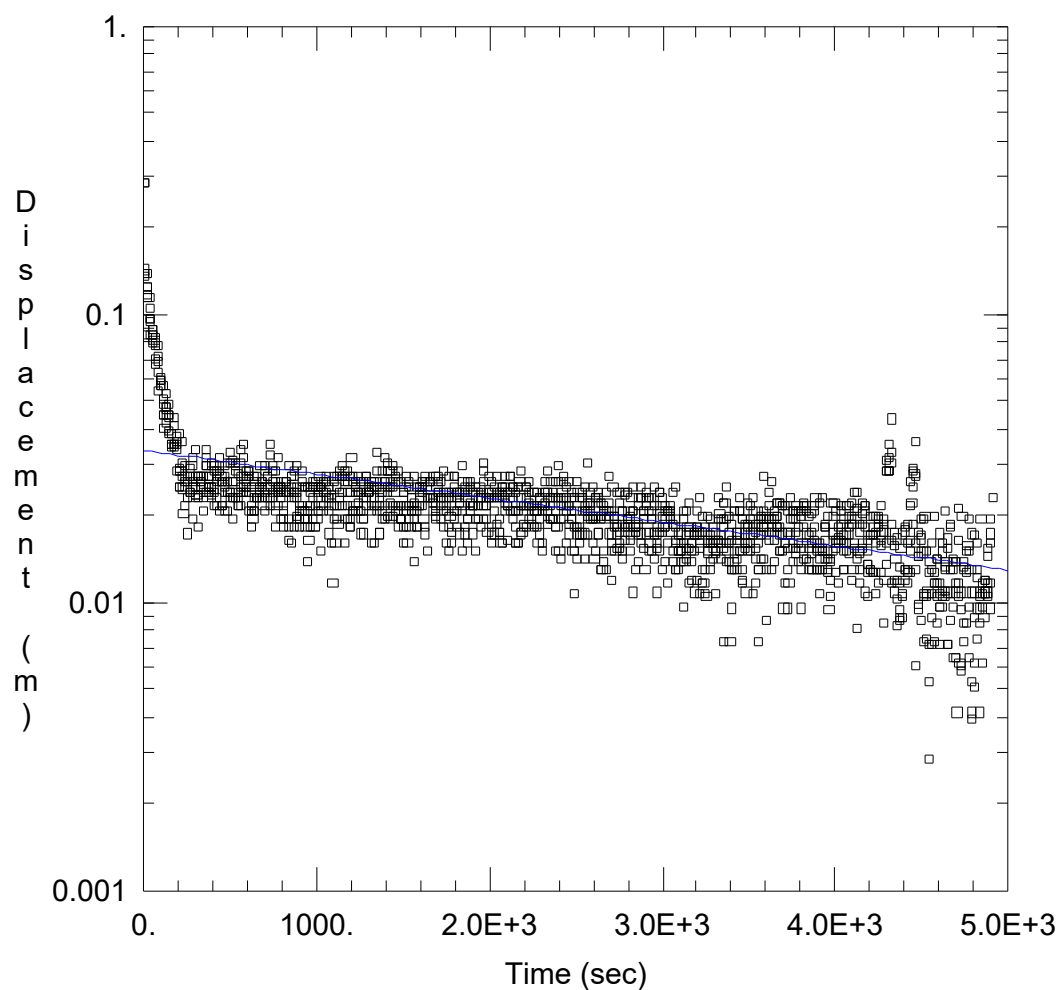
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.001863 m/day

y0 = 0.6686 m



FHT1

Data Set: C:\...\RED_BH5_FHT1.aqt

Date: 07/10/25

Time: 17:14:28

PROJECT INFORMATION

Company: Reditus Consulting

Client: Leppington Main 88 Pty Ltd

Project: 25122

Test Well: RED_BH5

Test Date: 03/06/25

AQUIFER DATA

Saturated Thickness: 4.1 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (RED_BH5)

Initial Displacement: 0.287 m

Static Water Column Height: 4.56 m

Total Well Penetration Depth: 4.56 m

Screen Length: 2. m

Casing Radius: 0.025 m

Well Radius: 0.0575 m

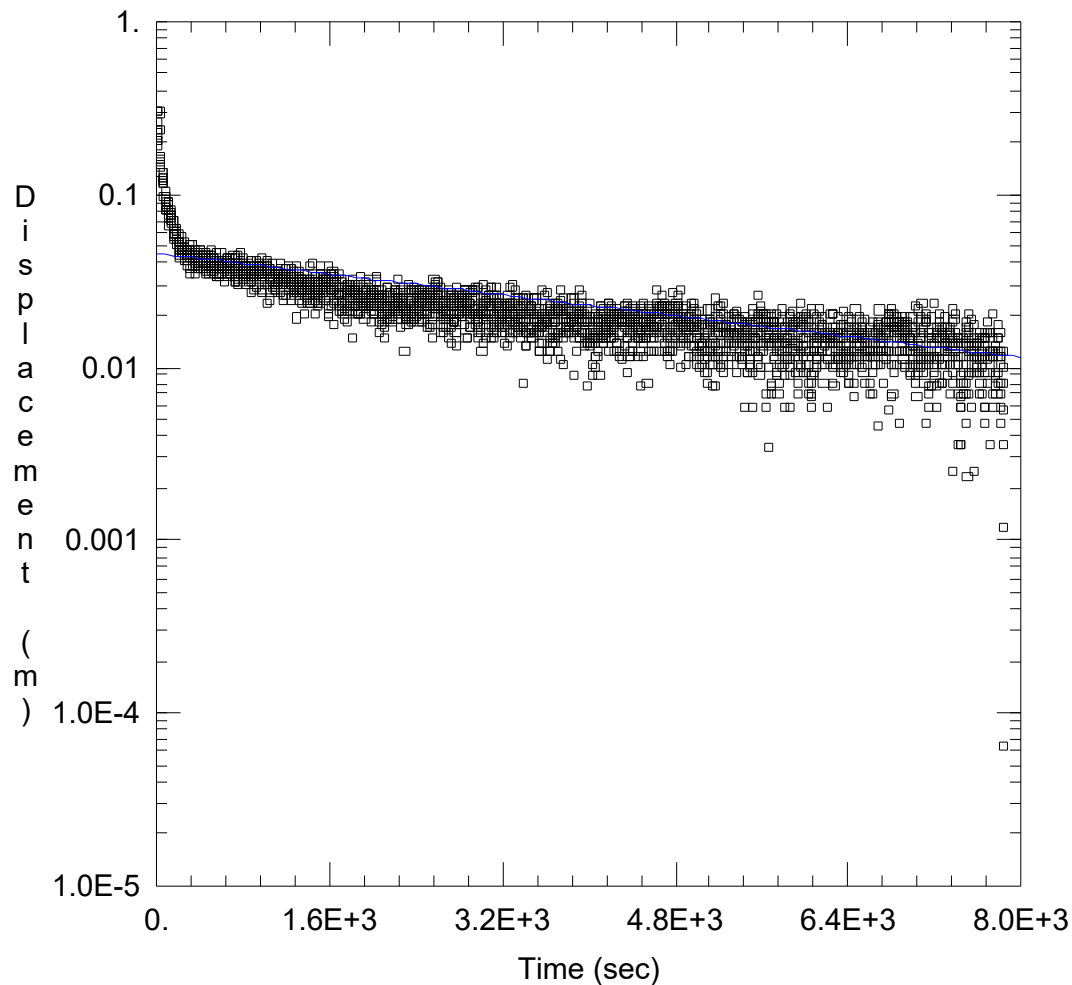
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.008245$ m/day

$y_0 = 0.03379$ m



RHT1

Data Set: C:\...\RED_BH5_RHT1.aqt

Date: 07/10/25

Time: 17:20:00

PROJECT INFORMATION

Company: Reditus Consulting

Client: Leppington Main 88 Pty Ltd

Project: 25122

Test Well: RED_BH5

Test Date: 03/06/25

AQUIFER DATA

Saturated Thickness: 4.1 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (RED_BH5)

Initial Displacement: 0.3012 m

Static Water Column Height: 4.56 m

Total Well Penetration Depth: 4.56 m

Screen Length: 2. m

Casing Radius: 0.025 m

Well Radius: 0.0575 m

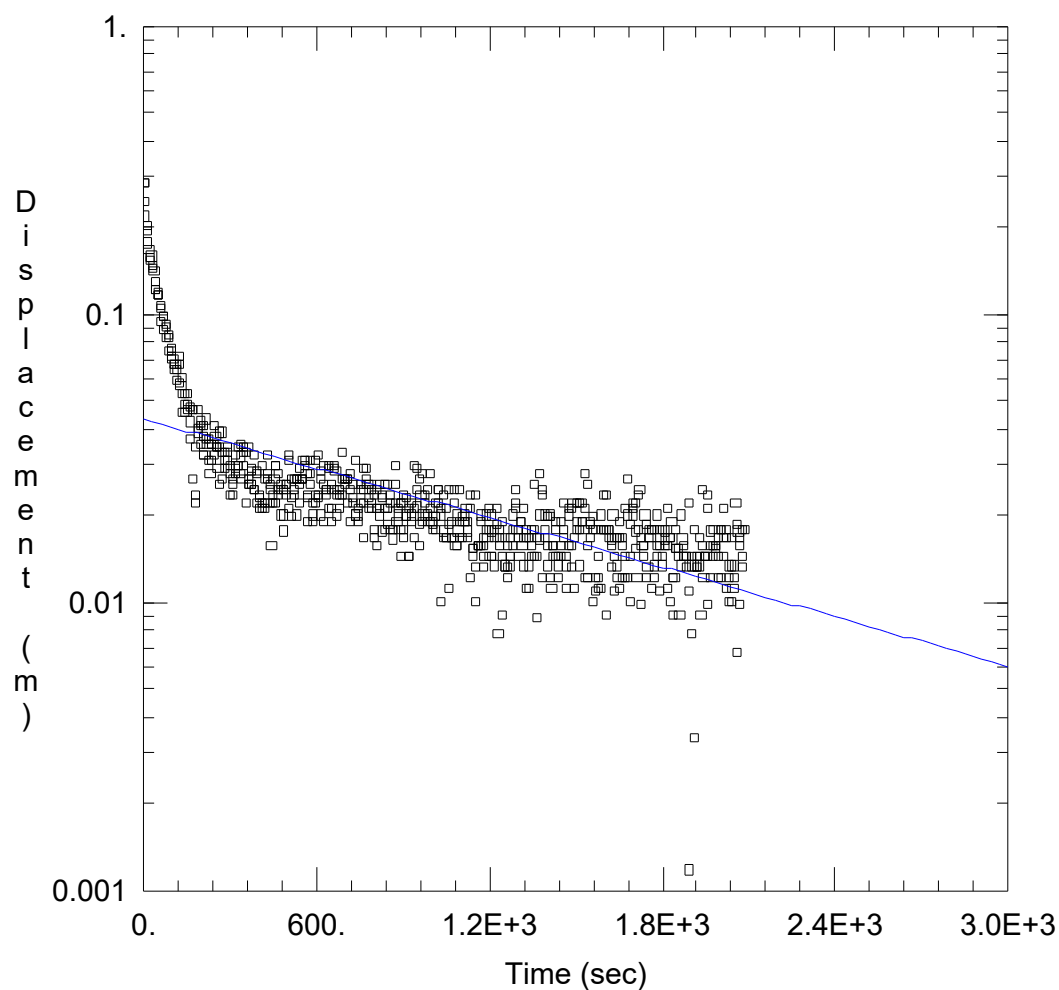
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.007511$ m/day

$y_0 = 0.04565$ m



RHT2

Data Set: C:\...\RED_BH5_RHT2.aqt

Date: 07/10/25

Time: 17:20:55

PROJECT INFORMATION

Company: Reditus Consulting

Client: Leppington Main 88 Pty Ltd

Project: 25122

Test Well: RED_BH5

Test Date: 03/06/25

AQUIFER DATA

Saturated Thickness: 4.1 m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (RED_BH5)

Initial Displacement: 0.2843 m

Static Water Column Height: 4.56 m

Total Well Penetration Depth: 4.56 m

Screen Length: 2. m

Casing Radius: 0.025 m

Well Radius: 0.0575 m

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.02847 m/day

y0 = 0.04349 m

F

Analytical Results Tables



BTEX							Polycyclic Aromatic Hydrocarbons (PAH)																		
Benzene	Ethylbenzene	Toluene	meta- & para-Xylene	ortho-Xylene	Total Xylenes	Sum of BTEX	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)pyrene	Benzo(a)anthracene	Benzo(a)pyrene TEQ (zero)	Benzo(b+g)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene (Ex SVOC)	Naphthalene	Phenanthrene	Pyrene	Sum of polycyclic aromatic hydrocarb
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
1	2	2	2	2	2	1	1	1	1	0.5	1	0.5	1	1	1	1	1	1	1	1	1	5	1	1	0.5
ANZECC 2000 DGVs for physical and checmical stressors - south-east Australia - lowland rivers																									
ANZ Guidelines for Fresh & Marinewater Quality - toxicant DGVs Freshwater - 95% Species Protection							-	-	0.4	0.2	-	-	-	-	-	-	-	1.4	-	-	16	16	2	-	-

Field ID	Sampled Date	Matrix	<1	<2	<2	<2	<2	<2	<1	<1	<1	<1	<0.5	<1	<0.5	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.5
BH2	04-06-2025	Water	<1	<2	<2	<2	<2	<2	<1	<1	<1	<1	<0.5	<1	<0.5	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.5
DUP01	04-06-2025	Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RED_BH4	04-06-2025	Water	<1	<2	<2	<2	<2	<2	<1	<1	<1	<1	<0.5	<1	<0.5	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.5
RED_BH5	04-06-2025	Water	<1	<2	<2	<2	<2	<2	<1	<1	<1	<1	<0.5	<1	<0.5	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.5



	Nutrients								Total Recoverable Hydrocarbons (TRH)					TRH - NEPM Fractions												
	Ammonia as N	Total Kjeldahl Nitrogen as N	Total Nitrogen as N	Nitrate as N	Nitrite as N	Nitrite + Nitrate as N	Reactive Phosphorus as P	Total Phosphorus as P	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	C6 - C10 Fraction	C6 - C10 Fraction minus BTEX (F1)	>C10 - C16 Fraction	>C10 - C16 Fraction minus Naphthalene	>C16 - C34 Fraction	>C34 - C40 Fraction	>C10 - C40 Fraction (sum)	Aluminium	Antimony	Arsenic	Barium		
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		
10	100	100	10	10	10	10	10	10	20	50	100	50	50	20	20	100	100	100	100	100	10	1	1	1		
ANZECC 2000 DGVs for physical and chemical stressors - south-east Australia - lowland rivers			500			40	50	20																		
ANZ Guidelines for Fresh & Marine water Quality - toxicant DGVs Freshwater - 95% Species Protection	910	-	-	-	-	-	-	-	-	-	-	-	600	-	-	-	-	-	-	-	55	-	-	-		
Field ID	Sampled Date	Matrix																								
BH2	04-06-2025	Water	860	7,500	7,500	< 10	10	10	< 10	4,260	< 20	< 50	< 100	< 50	< 50	< 20	< 20	< 100	< 100	< 100	< 100	< 100	650	3	4	82
DUP01	04-06-2025	Water	890	1,300	1,500	60	100	160	< 10	120	-	-	-	-	-	-	-	-	-	-	10	3	6	380		
RED_BH4	04-06-2025	Water	230	11,200	11,200	40	10	50	< 10	4,750	< 20	< 50	170	50	220	< 20	< 20	160	160	< 100	< 100	160	150	2	3	601
RED_BH5	04-06-2025	Water	890	1,300	1,500	80	100	180	< 10	110	< 20	< 50	< 100	< 50	< 50	< 20	< 20	< 100	< 100	< 100	< 100	< 100	20	4	7	400

Table 1
Water Analytical Results Summary



Metals																				Ionic Balance																		
Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Mercury	Molybdenum	Nickel	Selenium	Silicon as SiO2	Silver	Strontium	Uranium	Vanadium	Zinc	Ionic Balance	Chloride	Sulfate as SO4 - Turbidimetric	Total Hardness as CaCO3																
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%	µg/L	µg/L	µg/L																
1	50	0.1	1	1	1	50	1	1	0.1	1	1	10	100	1	1	1	10	5	0.01	1,000	1,000	1,000																
ANZECC 2000 DGVs for physical and checmical stressors - south-east Australia - lowland rivers																																						
ANZ Guidelines for Fresh & Marinewater Quality - toxicant DGVs Freshwater - 95% Species Protection																				-	940	0.2	-	-	1.4	-	3.4	-	0.6	-	11	11	-	0.05	-	-	-	-
Field ID	Sampled Date	Matrix																																				
BH2	04-06-2025	Water	< 1	60	< 0.1	< 1	12	1	720	< 1	198	< 0.1	28	18	< 10	16,700	< 1	5,440	4	< 10	22	5.01	3,730,000	450,000	1,700,000													
DUP01	04-06-2025	Water	< 1	50	< 0.1	< 1	2	3	< 50	< 1	56	< 0.1	18	18	< 10	-	< 1	2,510	3	< 10	1,560	3.22	1,700,000	305,000	-													
RED_BH4	04-06-2025	Water	< 1	< 50	< 0.1	< 1	6	4	130	< 1	124	< 0.1	13	15	< 10	11,600	< 1	10,500	12	< 10	13	2.91	7,100,000	1,220,000	3,480,000													
RED_BH5	04-06-2025	Water	< 1	60	< 0.1	2	2	3	< 50	< 1	59	< 0.1	14	21	< 10	11,900	< 1	2,630	3	< 10	1,650	0.68	1,640,000	306,000	712,000													

Table 1
Water Analytical Results Summary



	Major Anions					Major Cations						Other				
	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Total Anions	Calcium	Magnesium	Manganese	Potassium	Sodium	Total Cations	Thermotolerant Coliforms	Escherichia coli	Faecal Streptococci		
	µg/L	µg/L	µg/L	µg/L	meq/l	µg/L	µg/L	µg/L	µg/L	µg/L	meq/l	cfu/100ml	cfu/100ml	cfu/100ml		
	1,000	1,000	1,000	1,000	0.01	1,000	1,000	1	1,000	1,000	0.01	1	1	1		
ANZECC 2000 DGVs for physical and checmical stressors - south-east Australia - lowland rivers																
ANZ Guidelines for Fresh & Marinewater Quality - toxicant DGVs Freshwater - 95% Species Protection					-	-	-	-	1,900	-	-	-	-	-	-	
Field ID	Sampled Date	Matrix														
BH2	04-06-2025	Water	< 1,000	< 1,000	1,500,000	1,500,000	144	135,000	332,000	508	39,000	2,200,000	131	30	10	930
DUP01	04-06-2025	Water	< 1,000	< 1,000	851,000	851,000	71.3	63,000	126,000	96	28,000	1,210,000	66.9	-	-	-
RED_BH4	04-06-2025	Water	< 1,000	< 1,000	1,020,000	1,020,000	246	310,000	656,000	636	34,000	3,720,000	232	23,000	220	10,000
RED_BH5	04-06-2025	Water	< 1,000	< 1,000	854,000	854,000	69.7	66,000	133,000	99	29,000	1,280,000	70.6	93	1	160



			Physical/Chemical Parameters	Heavy Metals																				
			Total Alkalinity as CaCO3																					
				Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Lithium	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Uranium	Vanadium	Zinc	
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
1,000	1	1	1	1	50	0.1	1	1	1	1	1	0.1	1	1	10	1	1	1	10	5				
RPD Limits			30%	100%	75%	30%	100%	100%	100%	100%	100%	100%	30%	100%	30%	30%	100%	100%	30%	100%	100%	30%		

Field ID	Sampled Date	Matrix	854,000	4	7	400	< 1	60	< 0.1	2	2	3	< 1	59	< 0.1	14	21	< 10	< 1	2,630	3	< 10	1,650
RED_BH5	04-06-2025	Water	851,000	3	6	380	< 1	50	< 0.1	< 1	2	3	< 1	56	< 0.1	18	18	< 10	< 1	2,510	3	< 10	1,560
DUP01	04-06-2025	Water	0.35%	28.57%	15.38%	5.13%	-	18.18%	-	-	0%	0%	-	5.22%	-	25%	15.38%	-	-	4.67%	0%	-	5.61%
RPD																							



			Inorganics	Major Anions					Major Cations							Nutrients			
			Ionic Balance	Chloride	Nitrate as N	Nitrite as N	Nitrite + Nitrate as N	Sulfate as SO4 - Turbidimetric	Aluminium	Calcium	Iron	Magnesium	Manganese	Potassium	Sodium	Ammonia as N	Total Kjeldahl Nitrogen as N	Total Nitrogen as N	Reactive Phosphorus as P
			%	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
			0.01	1,000	10	10	10	1,000	10	1,000	50	1,000	1	1,000	1,000	10	100	100	10
RPD Limits			30%	30%	75%	30%	30%	30%	100%	30%	100%	30%	30%	30%	30%	30%	30%	30%	100%

Field ID	Sampled Date	Matrix																	
RED_BH5	04-06-2025	Water	0.68	1,640,000	80	100	180	306,000	20	66,000	< 50	133,000	99	29,000	1,280,000	890	1,300	1,500	< 10
DUP01	04-06-2025	Water	3.22	1,700,000	60	100	160	305,000	10	63,000	< 50	126,000	96	28,000	1,210,000	890	1,300	1,500	< 10
RPD			130.26%	3.59%	28.57%	0%	11.76%	0.33%	66.67%	4.65%	-	5.41%	3.08%	3.51%	5.62%	0%	0%	0%	-

G

Laboratory Reports



SAMPLES RECEIVED WITHOUT COC

CLIENT:	CARRIER:
PROJECT / QUOTE: 25122	CONNOTE #:
CONTACT NAME:	AWB #:
CONTACT NUMBER:	# OF ESKIES: 1
SAMPLER NAME: MS	SECURITY SEAL: Y N <u>N/A</u>
SAMPLER NUMBER:	TYPE OF ESKIES: small hard
SAMPLES RECEIVED BY: C.C	ESKY NUMBERS: 1
DATE/TIME RECEIVED: 4/6 15:00	# OF SAMPLES: 4
CLIENT SERVICES NOTIFIED BY:	TEMPERATURE: 16.8°C, 16.3°C, 14.8°C

Environmental Division
Sydney
Work Order Reference
ES2516705



Telephone : +61-2-8784 8555

LAB ID	SAMPLE DETAILS			NUMBER OF CONTAINERS	ADDITIONAL INFORMATION / COMMENTS:
	SAMPLE ID	DATE	MATRIX		OTHER INFORMATION:
1	Red - B414	4/6/25	W	9	☒ MICRO ☐ BIOSECURITY ☐ BROKEN CONTAINERS ☐ COC EMAILED ☐ ALS COMPASS URGENT HT
2					
3					
4					
5					
TOTAL					

CORRESPONDENCE (DATE, INITIALS - DETAILS OF CORRESPONDENCE):

WED 588



CERTIFICATE OF ANALYSIS

Work Order : **ES2516705**
Client : **REDITUS CONSULTING PTY LTD.**
Contact : **THOMAS LANCASTER**
Address : **1A/29-33 Waratah Street**
KIRRAWEE
Telephone : **----**
Project : **25122**
Order number : **----**
C-O-C number : **----**
Sampler : **MIA SCHAEPER**
Site :
Quote number : **EN/333**
No. of samples received : **4**
No. of samples analysed : **4**

Page : 1 of 8
Laboratory : Environmental Division Sydney
Contact : Andrew Wotherspoon
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 04-Jun-2025 15:00
Date Analysis Commenced : 04-Jun-2025
Issue Date : 11-Jun-2025 12:37



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Lauren Waters	Microbiology Laboratory Technician	Sydney Microbiology, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- MF = membrane filtration
- CFU = colony forming unit
- EP075 (SIM): Where reported, Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenzo(a,h)anthracene (1.0), Benzo(g,h,i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- MW006 is ALS's internal code and is equivalent to AS4276.5.
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- Membrane filtration (MF) results for ES2516705-03 MW006 are reported as an estimate (~) due to the growth of bacteria on the filter membrane being <10cfu and/or >100cfu and due to the membrane filter having a dark background from the sample.
- Membrane filtration results for ES2516705-01 and 02 MW006 are reported as an estimate (~) due to the presence of many non-target organism colonies that may have inhibited the growth of the target organisms on the filter membrane. It may be informative to record this fact.
- MW013 is ALS's internal code and is equivalent to AS4276.9.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				RED_BH4	RED_BH5	BH2	DUP01	----
Sampling date / time				04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	----
Compound	CAS Number	LOR	Unit	ES2516705-001	ES2516705-002	ES2516705-003	ES2516705-004	-----
				Result	Result	Result	Result	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	3480	712	1700	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1020	854	1500	851	----
Total Alkalinity as CaCO3	----	1	mg/L	1020	854	1500	851	----
ED040F: Dissolved Major Anions								
Silicon as SiO2	14464-46-1	0.1	mg/L	11.6	11.9	16.7	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1220	306	450	305	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	7100	1640	3730	1700	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	310	66	135	63	----
Magnesium	7439-95-4	1	mg/L	656	133	332	126	----
Sodium	7440-23-5	1	mg/L	3720	1280	2200	1210	----
Potassium	7440-09-7	1	mg/L	34	29	39	28	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.15	0.02	0.65	0.01	----
Antimony	7440-36-0	0.001	mg/L	0.002	0.004	0.003	0.003	----
Arsenic	7440-38-2	0.001	mg/L	0.003	0.007	0.004	0.006	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Barium	7440-39-3	0.001	mg/L	0.601	0.400	0.082	0.380	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	0.002	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	0.006	0.002	0.012	0.002	----
Copper	7440-50-8	0.001	mg/L	0.004	0.003	0.001	0.003	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				RED_BH4	RED_BH5	BH2	DUP01	----
Sampling date / time				04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	----
Compound	CAS Number	LOR	Unit	ES2516705-001	ES2516705-002	ES2516705-003	ES2516705-004	-----
				Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lithium	7439-93-2	0.001	mg/L	0.124	0.059	0.198	0.056	----
Manganese	7439-96-5	0.001	mg/L	0.636	0.099	0.508	0.096	----
Molybdenum	7439-98-7	0.001	mg/L	0.013	0.014	0.028	0.018	----
Nickel	7440-02-0	0.001	mg/L	0.015	0.021	0.018	0.018	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Strontium	7440-24-6	0.001	mg/L	10.5	2.63	5.44	2.51	----
Uranium	7440-61-1	0.001	mg/L	0.012	0.003	0.004	0.003	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	0.013	1.65	0.022	1.56	----
Boron	7440-42-8	0.05	mg/L	<0.05	0.06	0.06	0.05	----
Iron	7439-89-6	0.05	mg/L	0.13	<0.05	0.72	<0.05	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.23	0.89	0.86	0.89	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	0.01	0.10	0.01	0.10	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.04	0.08	<0.01	0.06	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.05	0.18	0.01	0.16	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	11.2	1.3	7.5	1.3	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	11.2	1.5	7.5	1.5	----

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	RED_BH4	RED_BH5	BH2	DUP01	----
Sampling date / time				04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	----
Compound	CAS Number	LOR	Unit	ES2516705-001	ES2516705-002	ES2516705-003	ES2516705-004	-----	
				Result	Result	Result	Result	----	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L	4.75	0.11	4.26	0.12	----	
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----	
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L	246	69.7	144	71.3	----	
∅ Total Cations	----	0.01	meq/L	232	70.6	131	66.9	----	
∅ Ionic Balance	----	0.01	%	2.91	0.68	5.01	3.22	----	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----	
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----	
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----	
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----	
EP080/071: Total Petroleum Hydrocarbons									

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	RED_BH4	RED_BH5	BH2	DUP01	----
Sampling date / time				04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	----
Compound	CAS Number	LOR	Unit	ES2516705-001	ES2516705-002	ES2516705-003	ES2516705-004	-----	
				Result	Result	Result	Result	----	
EP080/071: Total Petroleum Hydrocarbons - Continued									
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----	
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----	
C15 - C28 Fraction	----	100	µg/L	170	<100	<100	----	----	
C29 - C36 Fraction	----	50	µg/L	50	<50	<50	----	----	
^ C10 - C36 Fraction (sum)	----	50	µg/L	220	<50	<50	----	----	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----	
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----	
>C10 - C16 Fraction	----	100	µg/L	160	<100	<100	----	----	
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	----	----	
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----	
^ >C10 - C40 Fraction (sum)	----	100	µg/L	160	<100	<100	----	----	
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	160	<100	<100	----	----	
EP080: BTEXN									
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----	
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----	
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----	
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----	
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----	
^ Total Xylenes	----	2	µg/L	<2	<2	<2	----	----	
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	----	----	
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----	
MW006: Faecal Coliforms & E.coli by MF									
Thermotolerant Coliforms	----	1	CFU/100mL	~23000	~93	~30	----	----	
Escherichia coli	----	1	CFU/100mL	~220	~<1	~10	----	----	
MW013: Faecal Streptococci by MF									



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				RED_BH4	RED_BH5	BH2	DUP01	----
Sampling date / time				04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	04-Jun-2025 00:00	----
Compound	CAS Number	LOR	Unit	ES2516705-001	ES2516705-002	ES2516705-003	ES2516705-004	-----
				Result	Result	Result	Result	----
MW013: Faecal Streptococci by MF - Continued								
<i>Faecal Streptococci</i>	----	1	CFU/100mL	10000	160	~930	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	27.9	16.0	29.2	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	64.4	38.6	56.0	----	----
2,4,6-Tribromophenol	118-79-6	1.0	%	62.0	31.0	54.7	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	73.4	68.1	70.0	----	----
Anthracene-d10	1719-06-8	1.0	%	79.1	68.2	72.7	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	80.5	70.8	73.3	----	----
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	2	%	132	121	129	----	----
Toluene-D8	2037-26-5	2	%	112	96.9	108	----	----
4-Bromofluorobenzene	460-00-4	2	%	120	104	117	----	----



Surrogate Control Limits

Sub-Matrix: **WATER**

		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2,4,6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	72	143
Toluene-D8	2037-26-5	75	131
4-Bromofluorobenzene	460-00-4	73	137



QUALITY CONTROL REPORT

Work Order	: ES2516705	Page	: 1 of 10
Client	: REDITUS CONSULTING PTY LTD.	Laboratory	: Environmental Division Sydney
Contact	: THOMAS LANCASTER	Contact	: Andrew Wotherspoon
Address	: 1A/29-33 Waratah Street KIRRAWEE	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 25122	Date Samples Received	: 04-Jun-2025
Order number	: ----	Date Analysis Commenced	: 04-Jun-2025
C-O-C number	: ----	Issue Date	: 11-Jun-2025
Sampler	: MIA SCHAEPER		
Site	:		
Quote number	: EN/333		
No. of samples received	: 4		
No. of samples analysed	: 4		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Lauren Waters	Microbiology Laboratory Technician	Sydney Microbiology, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 6626735)									
ES2516706-002	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	280	277	0.8	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	280	277	0.8	0% - 20%
ES2516723-005	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	530	532	0.4	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	530	532	0.4	0% - 20%
ED040F: Dissolved Major Anions (QC Lot: 6631903)									
ES2516922-006	Anonymous	ED040F: Silicon as SiO2	14464-46-1	0.1	mg/L	6.4	6.3	1.6	0% - 20%
ES2516705-001	RED_BH4	ED040F: Silicon as SiO2	14464-46-1	0.1	mg/L	11.6	11.2	3.2	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6631899)									
ES2516617-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.0	No Limit
ES2516705-001	RED_BH4	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1220	1380	12.5	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 6631902)									
ES2516617-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	46	46	0.0	0% - 20%
ES2516705-001	RED_BH4	ED045G: Chloride	16887-00-6	1	mg/L	7100	6990	1.5	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 6633522)									
ES2516738-005	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	10	10	0.0	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED093F: Dissolved Major Cations (QC Lot: 6633522) - continued									
ES2516681-008	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	4	4	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	3	3	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	20	20	0.0	0% - 50%
		ED093F: Potassium	7440-09-7	1	mg/L	2	2	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 6633518)									
ED2500832-001	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.420	0.419	0.0	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 6633521)									
ES2516632-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.083	0.086	3.2	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.009	0.009	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.001	0.002	0.0	No Limit
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.057	0.056	1.9	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.082	0.081	1.9	0% - 50%
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.27	0.25	6.0	0% - 20%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.07	0.07	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	1.35	1.38	2.1	0% - 20%
ES2516681-008	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.011	0.010	0.0	0% - 50%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 6633521) - continued									
ES2516681-008	Anonymous	EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.059	0.059	0.0	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.015	0.016	7.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.11	0.11	0.0	0% - 50%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.58	0.57	0.0	0% - 50%
EG035F: Dissolved Mercury by FIMS (QC Lot: 6633520)									
ES2516681-004	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
ES2516681-009	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 6633101)									
ES2516392-016	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.28	0.26	6.9	0% - 20%
ES2517118-003	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	20.3	19.8	2.6	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 6631901)									
ES2516617-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
ES2516705-001	RED_BH4	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.01	0.01	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 6633100)									
ES2516392-016	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.38	0.38	0.0	0% - 20%
ES2517118-003	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	10.6	10.9	2.3	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 6633096)									
ES2516392-007	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.6	1.8	15.2	0% - 50%
ES2516973-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	0.7	0.0	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 6633095)									
ES2516392-007	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.90	0.93	3.5	0% - 20%
ES2516973-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.06	0.05	0.0	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 6631900)									
ES2516617-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.18	0.16	11.3	0% - 50%
ES2516705-001	RED_BH4	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 6627140)									
EN2509253-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
ES2516628-002	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 6627140)									
EN2509253-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit

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 Work Order : ES2516705
 Client : REDITUS CONSULTING PTY LTD.
 Project : 25122



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 6627140) - continued									
ES2516628-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP080: BTEXN (QC Lot: 6627140)									
EN2509253-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
			106-42-3						
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
ES2516628-002	Anonymous	EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
		EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
			106-42-3						
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit



Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result		LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 6626735)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	93.5	81.0	115
				----	50 mg/L	94.6	80.0	128
ED040F: Dissolved Major Anions (QCLot: 6631903)								
ED040F: Silicon as SiO2	14464-46-1	0.1	mg/L	<0.1	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6631899)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	94.5	82.0	122
				<1	500 mg/L	102	82.0	122
ED045G: Chloride by Discrete Analyser (QCLot: 6631902)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	50 mg/L	97.7	80.9	127
				<1	1000 mg/L	104	80.9	127
ED093F: Dissolved Major Cations (QCLot: 6633522)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	101	80.0	114
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	105	90.0	116
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	97.9	82.0	120
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	98.2	85.0	113
EG020F: Dissolved Metals by ICP-MS (QCLot: 6633518)								
EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	0.02 mg/L	95.7	70.0	130
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	97.2	81.0	113
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	98.4	85.0	115
EG020F: Dissolved Metals by ICP-MS (QCLot: 6633521)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	101	80.0	116
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.02 mg/L	71.6	70.0	130
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	98.7	85.0	114
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	90.3	85.0	115
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	97.8	82.0	110
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	96.2	84.0	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	98.3	85.0	111
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	95.0	82.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	97.0	81.0	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.8	83.0	111



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EG020F: Dissolved Metals by ICP-MS (QCLot: 6633521) - continued								
EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	0.1 mg/L	89.5	79.0	117
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	90.8	82.0	110
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	99.8	79.0	113
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	98.1	82.0	112
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	108	85.0	115
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	96.2	83.0	109
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	108	81.0	117
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	87.9	85.0	115
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	97.4	82.0	112
EG035F: Dissolved Mercury by FIMS (QCLot: 6633520)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	95.7	83.0	105
EK055G: Ammonia as N by Discrete Analyser (QCLot: 6633101)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	105	90.0	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6631901)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	104	82.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 6633100)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	103	91.0	113
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6633096)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	5 mg/L	87.3	69.0	123
				<0.1	2.5 mg/L	81.9	70.0	123
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6633095)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	2.21 mg/L	89.2	71.3	126
				<0.01	0.5 mg/L	92.1	71.3	126
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6631900)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	100	85.0	117
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 6627041)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	71.8	50.0	94.0
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	71.7	63.6	114
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	74.5	62.2	113
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	73.6	63.9	115
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	69.2	62.6	116
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	69.4	64.3	116
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	72.3	63.6	118
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	74.6	63.1	118



Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result			Low	High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 6627041) - continued								
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	71.4	64.1	117
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	75.7	62.5	116
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2	1	µg/L	<1.0	5 µg/L	79.6	61.7	119
	205-82-3							
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	70.7	63.0	115
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	75.7	63.3	117
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	67.8	59.9	118
EP075(SIM): Dibenz(a,h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	70.6	61.2	117
EP075(SIM): Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	66.6	59.1	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6627042)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	400 µg/L	63.4	53.7	97.0
EP071: C15 - C28 Fraction	----	100	µg/L	<100	600 µg/L	68.2	63.3	107
EP071: C29 - C36 Fraction	----	50	µg/L	<50	400 µg/L	71.4	58.3	120
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6627140)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	95.8	75.0	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6627042)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	500 µg/L	54.0	53.9	95.5
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	700 µg/L	66.9	57.8	110
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	300 µg/L	73.1	50.5	115
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6627140)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	96.6	75.0	127
EP080: BTEXN (QCLot: 6627140)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	97.7	68.3	119
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	104	73.5	120
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	109	73.8	122
EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	10 µg/L	117	73.0	122
	106-42-3							
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	116	76.4	123
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	114	75.5	124

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Matrix Spike (MS) Report		
Spike	Spike Recovery(%)	Acceptable Limits (%)

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6631899)							
ES2516617-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	111	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6631902)							
ES2516617-001	Anonymous	ED045G: Chloride	16887-00-6	250 mg/L	119	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 6633521)							
ES2516635-006	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	97.0	70.0	130
		EG020A-F: Beryllium	7440-41-7	1 mg/L	130	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	122	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	97.6	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	130	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	129	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	99.0	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	114	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	122	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	96.4	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	125	70.0	130
EG020A-F: Zinc	7440-66-6	1 mg/L	97.8	70.0	130		
EG035F: Dissolved Mercury by FIMS (QCLot: 6633520)							
ES2516569-001	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	80.6	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 6633101)							
ES2516392-016	Anonymous	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	114	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 6631901)							
ES2516617-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	103	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 6633100)							
ES2516392-016	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	115	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 6633096)							
ES2516392-008	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	76.9	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 6633095)							
ES2516392-008	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	99.2	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 6631900)							
ES2516617-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	97.5	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6627140)							
EN2509253-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	97.4	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6627140)							
EN2509253-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	94.9	70.0	130
EP080: BTEXN (QCLot: 6627140)							



Sub-Matrix: WATER				Matrix Spike (MS) Report			
Laboratory sample ID		Sample ID		Spike	SpikeRecovery(%)	Acceptable Limits (%)	
		Method: Compound	CAS Number	Concentration	MS	Low	High
EP080: BTEXN (QCLot: 6627140) - continued							
EN2509253-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	92.6	70.0	130
		EP080: Toluene	108-88-3	25 µg/L	95.8	70.0	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	102	70.0	130
		EP080: meta- & para-Xylene	108-38-3	25 µg/L	107	70.0	130
			106-42-3				
		EP080: ortho-Xylene	95-47-6	25 µg/L	109	70.0	130
		EP080: Naphthalene	91-20-3	25 µg/L	105	70.0	130



QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES2516705	Page	: 1 of 10
Client	: REDITUS CONSULTING PTY LTD.	Laboratory	: Environmental Division Sydney
Contact	: THOMAS LANCASTER	Telephone	: +61-2-8784 8555
Project	: 25122	Date Samples Received	: 04-Jun-2025
Site	:	Issue Date	: 11-Jun-2025
Sampler	: MIA SCHAEFER	No. of samples received	: 4
Order number	: ----	No. of samples analysed	: 4

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- **NO** Matrix Spike outliers occur.
- For all regular sample matrices, where applicable to the methodology, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers exist - please see following pages for full details.



Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser						
Clear Plastic Bottle - Natural						
RED_BH4, RED_BH5, BH2, DUP01	----	----	----	07-Jun-2025	06-Jun-2025	1
EK071G: Reactive Phosphorus as P by discrete analyser						
Clear Plastic Bottle - Natural						
RED_BH4	----	----	----	07-Jun-2025	06-Jun-2025	1

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type		Count		Rate (%)		Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)						
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	7	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	9	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)						
Major Anions - Dissolved	ED040F	0	14	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)						
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	7	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	9	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA065: Total Hardness as CaCO3								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)		04-Jun-2025	----	----	----	07-Jun-2025	02-Jul-2025	✔
RED_BH4,								
BH2								
RED_BH5,								



Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P) RED_BH4, BH2,	RED_BH5, DUP01	04-Jun-2025	----	----	----	05-Jun-2025	18-Jun-2025	✓
ED040F: Dissolved Major Anions								
Clear Plastic Bottle - Natural (ED040F) RED_BH4, BH2	RED_BH5,	04-Jun-2025	----	----	----	06-Jun-2025	02-Jul-2025	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G) RED_BH4, BH2,	RED_BH5, DUP01	04-Jun-2025	----	----	----	07-Jun-2025	02-Jul-2025	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G) RED_BH4, BH2,	RED_BH5, DUP01	04-Jun-2025	----	----	----	07-Jun-2025	02-Jul-2025	✓
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) RED_BH4, BH2,	RED_BH5, DUP01	04-Jun-2025	----	----	----	07-Jun-2025	02-Jul-2025	✓
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020B-F) RED_BH4, BH2,	RED_BH5, DUP01	04-Jun-2025	----	----	----	07-Jun-2025	01-Dec-2025	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) RED_BH4, BH2,	RED_BH5, DUP01	04-Jun-2025	----	----	----	11-Jun-2025	02-Jul-2025	✓
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G) RED_BH4, BH2,	RED_BH5, DUP01	04-Jun-2025	----	----	----	10-Jun-2025	02-Jul-2025	✓
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G) RED_BH4, BH2,	RED_BH5, DUP01	04-Jun-2025	----	----	----	07-Jun-2025	06-Jun-2025	✗
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G) RED_BH4, BH2,	RED_BH5, DUP01	04-Jun-2025	----	----	----	10-Jun-2025	02-Jul-2025	✓



Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) RED_BH4, RED_BH5, BH2, DUP01	04-Jun-2025	07-Jun-2025	02-Jul-2025	✓	10-Jun-2025	02-Jul-2025	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) RED_BH4, RED_BH5, BH2, DUP01	04-Jun-2025	07-Jun-2025	02-Jul-2025	✓	10-Jun-2025	02-Jul-2025	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) RED_BH4	04-Jun-2025	----	----	----	07-Jun-2025	06-Jun-2025	✗
Clear Plastic Bottle - Natural (EK071G) RED_BH5, BH2, DUP01	04-Jun-2025	----	----	----	06-Jun-2025	06-Jun-2025	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM)) RED_BH4, RED_BH5, BH2	04-Jun-2025	05-Jun-2025	11-Jun-2025	✓	06-Jun-2025	15-Jul-2025	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071) RED_BH4, RED_BH5, BH2	04-Jun-2025	05-Jun-2025	11-Jun-2025	✓	06-Jun-2025	15-Jul-2025	✓
Amber VOC Vial - Sulfuric Acid (EP080) RED_BH4, RED_BH5, BH2	04-Jun-2025	05-Jun-2025	18-Jun-2025	✓	05-Jun-2025	18-Jun-2025	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071) RED_BH4, RED_BH5, BH2	04-Jun-2025	05-Jun-2025	11-Jun-2025	✓	06-Jun-2025	15-Jul-2025	✓
Amber VOC Vial - Sulfuric Acid (EP080) RED_BH4, RED_BH5, BH2	04-Jun-2025	05-Jun-2025	18-Jun-2025	✓	05-Jun-2025	18-Jun-2025	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080) RED_BH4, RED_BH5, BH2	04-Jun-2025	05-Jun-2025	18-Jun-2025	✓	05-Jun-2025	18-Jun-2025	✓
MW006: Faecal Coliforms & E.coli by MF							
Sterile Plastic Bottle - Sodium Thiosulfate (MW006) RED_BH4, RED_BH5, BH2	04-Jun-2025	----	----	----	04-Jun-2025	05-Jun-2025	✓



Matrix: WATER					Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.			
Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
MW013: Faecal Streptococci by MF								
Sterile Plastic Bottle - Sodium Thiosulfate (MW013)		04-Jun-2025	----	----	----	04-Jun-2025	05-Jun-2025	✔
RED_BH4,								
BH2								

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Evaluation: ✖ = Quality Control frequency not within specification : ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)		Quality Control Specification	
Analytical Methods	Method	QC	Regular	Actual	Expected		Evaluation
Laboratory Duplicates (DUP)							
Alkalinity by Auto Titrator	ED037-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	9	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	2	14	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	12	16.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	7	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	17	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	15	13.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	9	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	9	11.11	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	0	14	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	12	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	17	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	3	15	20.00	15.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	9	11.11	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							



Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Method Blanks (MB) - Continued							
Ammonia as N by Discrete analyser	EK055G	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	9	11.11	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	12	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	9	11.11	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	7	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	9	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by Auto Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Major Anions - Dissolved	ED040F	WATER	In house: Referenced to APHA 3120. The 0.45µm filtered samples are determined by ICP/AES for Sulfur and/or Silicon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO ₄ 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO ₄ . Dissolved sulfate is determined in a 0.45µm filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO ₄ suspension is measured by a photometer and the SO ₄ -2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm.
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl ₂)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH ₃ G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO ₂ - B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)



Analytical Methods	Method	Matrix	Method Descriptions
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030E. This method is compliant with NEPM Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)
Thermotolerant Coliforms & E.coli by Membrane Filtration	MW006	WATER	AS 4276.5
Faecal Streptococci by Membrane Filtration	MW013	WATER	APHA 9230A
Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)



Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.



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