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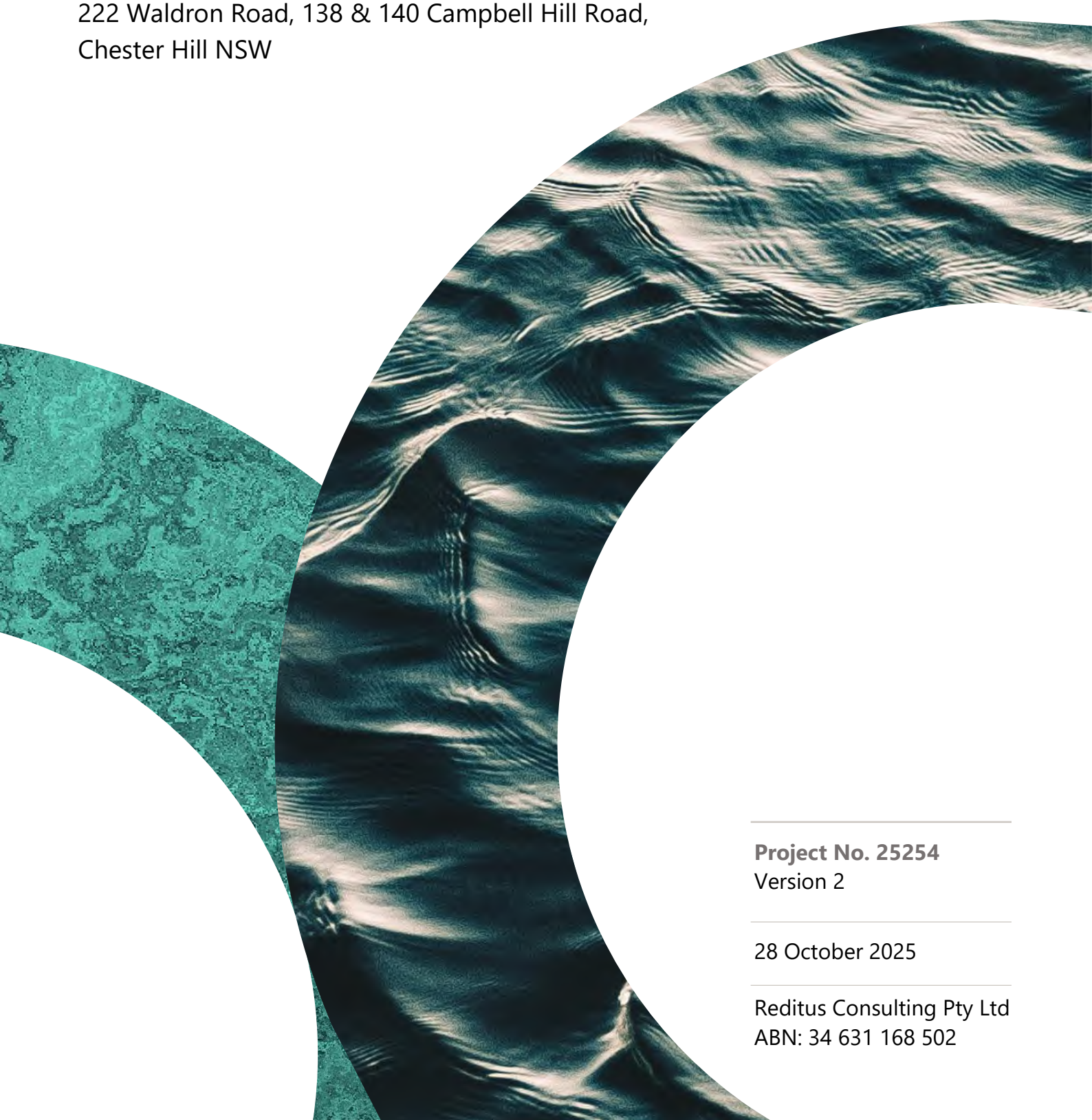
Dewatering Management Plan

222 Waldron Road, 138 & 140 Campbell Hill Road,
Chester Hill NSW



Project No. 25254
Version 2

28 October 2025

Reditus Consulting Pty Ltd
ABN: 34 631 168 502

Dewatering Management Plan

222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW

Prepared for: The Abel Tasman Village Association

c/- Centurion Project Management Pty Ltd

DOCUMENT CONTROL

Prepared by	**Robert Cameron** Senior Hydrogeologist robertcameron@reditus.com.au +61 487 250 844	
Reviewed & Approved by	**Sebastien McCulloch** Senior Hydrogeologist sebmcculloch@reditus.com.au +61 402 823 691	

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Executive Summary

Reditus Consulting Pty Ltd (Reditus) was engaged by The Abel Tasman Village Association care of Centurion Project Management Pty Ltd ('the client') to update the Dewatering Management Plan (DMP) for the proposed development at 222 Waldron Road and 138 & 140 Campbell Hill Road, Chester Hill NSW ('the site'). The site is legally identified as Lot 11 DP827703 and Lots 5, 6 & 7 DP30305, and covers a total area of approximately 1.27 ha. The site location is presented in **Figure 1, Appendix A**.

A DMP was previously prepared for the site by Reditus in January 2024, however, it is understood the proposed development is now considered a State Significant Development (SSD), and an updated DMP with contemporary site hydrogeological data is required to support the SSD application.

The proposed development is understood to include the construction of three apartment buildings (Building A, B & E) for residential aged care, with a one-level basement beneath and between the buildings (herein referred to as the 'primary basement'), including a smaller second level basement beneath building A (herein referred to as the 'lower basement'). A fourth apartment building (Building C) is earmarked for future development but is understood to not be included in the current development works proposed for the site. The preliminary basement development plans are provided as **Appendix B**.

The lowest reduced level (mAHD) of the primary basement's finished floor level (FFL) is 30.46 mAHD. The bulk excavation level (BEL) is assumed to be approximately 0.5 m below the basement FFL. Therefore, the lowest BEL of the primary basement is assumed to be 29.96 mAHD, which will require excavation depths of up to approximately 5 m below the existing ground levels at the site. The reduced level of the lower basement is understood to be 28.24 mAHD (not currently marked in the preliminary development plans), therefore with a BEL of 27.74 mAHD. The lower basement will require excavation depths of up to approximately 6 m below the existing ground levels at the site.

The maximum groundwater elevation recorded at the site was 32.01 mAHD in MW7 during the recent long-term monitoring from 11 August 2025 to 10 October 2025. Groundwater levels have also been shown to fluctuate by up to 0.64 m during the long-term monitoring conducted at the site. Based on the maximum recorded groundwater level the basement excavations will intercept up to approximately 2.1 m (primary basement) and 4.3 m (lower basement) of groundwater. Given that groundwater will be intercepted and require dewatering during construction of the basements, the proposed development is considered to be an aquifer inference activity requiring assessment and authorisation under the Water Management Act 2000 (WM Act).

This report provides details on the hydrogeological setting, construction design, predictions of groundwater extraction volumes, and assessment of potential dewatering impacts. This document also provides management strategies to minimise adverse environmental impacts including proposed water treatment system, environmental control procedures, monitoring program, performance criteria and compliance reporting requirements.

Groundwater take estimates were predicted, incorporating both groundwater inflows and matrix removal through excavation of the basements. The groundwater inflows were predicted using a steady-state analytical method developed by Marinelli and Niccoli (2000). The following 'Most Likely' groundwater take estimates were predicted for the initial 12-months of dewatering (i.e., maximum potential annual take during construction) as well as the annual long-term groundwater inflow (i.e., steady-state groundwater inflows from permanent/ongoing drained basement).

DEWATERING AREA	PREDICTED MATRIX TAKE (ML)	PREDICTED ANNUAL GROUNDWATER INFLOW TAKE (ML/YR)	TOTAL GROUNDWATER TAKE DURING FIRST 12-MONTHS OF DEWATERING (ML)
Primary Basement	0.13	0.22	0.35
Lower Basement	0.01	0.10	0.10
Totals	**0.13**	**0.32**	**0.45**

PERIOD	PREDICTED GROUNDWATER TAKE
Maximum Potential Annual Take During Construction (includes groundwater inflows and matrix removals for the primary and lower basements over a 12-month period)	**0.45 ML**
Post Construction – Long Term Groundwater Inflow (Steady-state groundwater inflows from permanent/ongoing Drained Basement Design for both basements)	**0.32 ML/year**

Given the expected minimal groundwater inflows from the low permeability fractured and weathered shale/siltstone water bearing zones of the Bringelly Shale geology it is understood the basements are proposed to be constructed as 'Drained Basements' with traditional sub-slab drainage systems and vertical strip drains behind the basement walls.

Groundwater quality sampling conducted by Reditus on 7 June 2023 from four (4) of the onsite monitoring wells (MW4, MW5, MW6, MW7) reported all results below the laboratory limit of reporting (LOR) and/or below the adopted discharge water quality guidelines with the exception of copper and zinc, which reported results marginally above the ANZG (2018) 95% Freshwater and Marine Water Quality Guideline values. Subject to approval from Council, dewatered and treated groundwater is proposed to be discharged to the stormwater network.

The groundwater impact assessment didn't identify any receptors with 500 m of the site. A notified site which is currently regulated under the CLM Act is located approximately 100 m south of the site (site boundary to site boundary). However, given that the notified site is located topographically and hydraulically down-gradient from the development site and the maximum predicted drawdown radius of influence resulting from the proposed basement excavation under the 'upper-case' scenario is 16 m, the identified contaminated site is not considered to be a risk to the proposed basement excavations and dewatering.

Based on the groundwater inflow and impact assessment, the dewatering activities are considered to be of **minimal impact** under the *NSW Aquifer Interference Policy*, WM ACT and the NSW DPE (2023) *Groundwater impact assessment criteria*.

Based on the predicted groundwater extraction volumes, groundwater quality underlying the site, and the impact assessment completed, it is the opinion of Reditus that the proposed basement could be effectively constructed and managed under a drained based design with minimal impact.

1 Introduction

Reditus Consulting Pty Ltd (Reditus) was engaged by The Abel Tasman Village Association care of Centurion Project Management Pty Ltd ('the client') to update the Dewatering Management Plan (DMP) for the proposed development at 222 Waldron Road and 138 & 140 Campbell Hill Road, Chester Hill NSW ('the site'). The site is legally identified as Lot 11 DP827703 and Lots 5, 6 & 7 DP30305, and covers a total area of approximately 1.27 ha. The site location is presented in **Figure 1, Appendix A** and a summary of the site identification details are provided in **Table 1** below.

A DMP was previously prepared for the site by Reditus in January 2024, however, it is understood the proposed development is now considered a State Significant Development (SSD), and an updated DMP with contemporary site hydrogeological data is required to support the SSD application.

The proposed development is understood to include the construction of three apartment buildings (Building A, B & E) for residential aged care, with a one-level basement beneath and between the buildings (herein referred to as the 'primary basement'), including a smaller second level basement beneath building A (herein referred to as the 'lower basement'). A fourth apartment building (Building C) is earmarked for future development but is understood to not be included in the current development works proposed for the site. The preliminary basement development plans are provided as **Appendix B**.

At the time of reporting, the building construction dewatering schedule and the broader construction schedule is still to be determined.

Table 1. Site Identification Details

ITEM	DETAIL
Street Address	Existing Aged Care Facility: 222 Waldron Road, Chester Hill NSW Former Service Station and Vacant Lot: 138-140 Campbell Hill Road, Chester Hill NSW
Lot and Deposited Plan	Existing Aged Care Facility: Lot 11 DP827703 Former Service Station and Vacant Lot: Lots 5, 6 & 7 DP30305
Local Government Area	Canterbury-Bankstown Council
Site Coordinates of the approximate centre of the site (GDA2020-MGA56)	Easting: 314738 Northing: 6249128
Site Area	Approximately 1.27 ha
Basement Excavation Areas	Primary Basement[1]: Approximately 6,100 m^2 Lower Basement: Approximately 210 m^2
Site Location	**Figure 1, Appendix A**
Site Layout	**Figure 2, Appendix A**
Water Sharing Plan	Greater Metropolitan Region Groundwater Sources 2023
Groundwater Source	Sydney Basin Central Groundwater Source

[1] Determined from the outline of the entire primary basement (i.e., conservatively includes the non-basement area between Building B and Building E).

The site is noted to be located within the Bringelly Shale geological unit. Given the expected low permeability of the Bringelly Shale, groundwater inflows are expected to be negligible (<3 ML/year) and likely to be to be effectively managed under a drained basement design with implementation of an appropriate Dewatering Management Plan (DMP).

As groundwater will be intercepted and require dewatering during construction of the basement, and ongoing post construction (provided a drained basement design is approved), the proposed development is considered to be an aquifer inference activity requiring assessment and authorisation under the Water Management Act 2000 (WM Act), relevant watering sharing plan and the *NSW Aquifer Interference Policy* requirements.

These requirements include groundwater investigations and reporting in accordance with the NSW DPE (2022) *Minimum Requirements for Building Site Groundwater Investigations and Reporting* guidelines and that a Water Supply Works Approval for construction dewatering (and any occupation phase dewatering) is obtained prior to carrying out dewatering at the site.

This report has been prepared in general accordance with the NSW DPE (2022) *Minimum requirements for building site groundwater investigations and reporting* to address the mandatory requirements and support the State Significant Development Application (SSDA) submission for the proposed development at the site.

1.1 Objectives

Dewatering activities have the potential to impact the surrounding environment, primarily associated with:

- Potential settlement issues as a result of groundwater drawdown outside the site.
- Potential groundwater drawdown impacts on surrounding water supply works (e.g., domestic bores) or groundwater dependant ecosystems (GDEs).
- Potential issues with groundwater drawdown in acid sulfate soil environments.
- Potential mobilisation and migration of contamination from offsite sources.

The primary objectives of this dewatering management plan are to:

- Provide details on the hydrogeological setting of the site and a summary of key environmental factors relevant to dewatering with specific focus on water quality and aquifer properties at the site.
- Provide details of the proposed development layout, construction design and dewatering methods.
- Predict dewatering extraction volumes required for the development works during construction and ongoing post construction.
- Determine the potential impacts of the dewatering activity to any nearby water supply works, GDEs and potential for subsidence impacts on nearby structures or infrastructure through assessment against the Minimal Impact thresholds detailed under the *NSW Aquifer Interference Policy*, Water Management Act 2000 (WM ACT) and the NSW DPE (2023) *Groundwater impact assessment criteria*.
- Provide details of the proposed dewatering pumping method and proposed water treatment system to ensure compliance with relevant guidelines and regulations.
- Provide management strategies to minimise adverse environmental impacts.
- Establish environmental control procedures, monitoring program, performance criteria and compliance reporting to assess the potential impacts of extracted groundwater on the receiving environment and the effectiveness of implemented controls.

1.2 Scope of Works

To meet the above objectives, the following scope of work was undertaken:

- A desktop site assessment, including review of previous reports where available.
- A review of relevant groundwater policy, legislation, regulations, and guidelines, including:
  - NSW DPI (2012) Aquifer Interference Policy.
  - Water Management Act 2000 and Part 5 of the Water Act 1912.
  - NSW DPE (2022) *Minimum requirements for building site groundwater investigations and reporting*.
  - NSW DPE (2023) *Groundwater Impact Assessment Criteria*.
- Review of construction proposal details relevant to dewatering and proposed dewatering methodology.

- Data analysis and interpretation of additional groundwater level data and rising head (slug test) data collected from the site.
- Development of a conceptual flow model to replicate the proposed excavation activity. This was completed using a steady-state analytical groundwater flow model for 'best-case', 'most likely', and 'upper-case' scenarios, allowing prediction of groundwater inflow volumes and groundwater drawdown extent resulting from the proposed basement excavation and construction design:
  - Completion of analytical equations to derive groundwater extraction volumes using a range of representative aquifer parameters from published literature values and site-specific data.
  - Estimate volume of groundwater required to be removed during the dewatering process and assess the likely impacts of the dewatering activities on other groundwater users/receptors against the NSW DPE (2023) *Groundwater impact assessment criteria*.
- Specify the discharge water quality criteria, anticipated treatment requirements and proposed water treatment system, sampling frequency and compliance reporting requirements.
- Preparation of an updated Dewatering Management Plan (this document).

1.3 Limitations

A detailed statement of limitations for this report is provided in **Section 15**.

This report is based on the Scope of Work outlined above in **Section 1.2**. Reditus prepared this report in a manner consistent with the normal level of care and expertise exercised by members of the environmental and hydrogeological assessment profession.

This report relates only to the objectives stated and does not relate to any other work undertaken for the Client (The Abel Tasman Village Association c/- Centurion Project Management). It is a report based on the information reported in previous environmental and geotechnical assessments by others, and data made available to Reditus. These conditions stated in this report may change with time and space.

All conclusions regarding the property area are the professional opinions of Reditus, subject to the qualifications in the report. Whilst 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. The client acknowledges that this report is for the exclusive use of the client.

All groundwater models include some degree of uncertainty in their predictions as they are, by necessity, simplifications of complex real world systems. Whilst every effort is made to ensure that the primary model reflects the 'best case', 'most likely' case and 'upper case' understanding of site conditions, this cannot be guaranteed and any model result presented as a single number should be viewed with a degree of caution.

Factors which significantly affect the groundwater model and impact assessment results include dewatering rate, dewatering design, dewatering period, aquifer characteristics and degree of aquifer variability (including hydraulic conductivity, specific yield/ storativity, porosity, recharge, heterogeneity).

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.

2 Document and Data Review

The following documents specific to the site were utilised for preparation of this report:

- Boffa Robertson Group (September 2023) Preliminary Architectural Drawings (ref: 2108/A1DA05).
- Environmental Strategies (March 2014) Environmental Site Assessment, 138-140 Campbell Hill Road, Chester Hill NSW.
- Asset Geotechnical Engineering Pty Ltd (20 May 2022) Proposed Redevelopment, Abel Tasman Village, Chester Hill NSW (ref: 6851-G1).
- Reditus Consulting (17 June 2022) Detailed Site Investigation, 222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW (ref: 22065RP01_v1).
- Reditus Consulting (18 May 2023) Remedial Action Plan, Abel Tasman Village, 138 & 140 Campbell Hill Road, Chester Hill NSW (ref: 22065RP02_v2)
- Reditus Consulting (31 October 2023) UPSS Decommissioning & Validation Report, 140 Campbell Hill Road, Chester Hill NSW (ref: 22137RP02_v3)
- Reditus Consulting (13 November 2023) Site Hydrogeology Report, 222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW (ref: 22137RP03_v1).
- Reditus Consulting (24 January 2024) Dewatering Management Plan, 222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW (ref: 22137RP04_v1).

3 Geological Setting

The Penrith 1:100,000 Series Geological Map Sheet indicates the site is underlain by Bringelly Shale of the Wianamatta Group, which is described as shale, carbonaceous claystone, laminate, lithic sandstone, and rare coal.

3.1 Topography

The site slopes from northeast to southwest, with a fall from approximately 38 mAHD in the northeast corner of the site to approximately 30 mAHD in the southwest corner of the site over a distance of approximately 130 m. The site layout, including 2 m elevation contours is presented in **Figure 2**, **Appendix A**.

3.2 Site Specific Geology

The site-specific geology has been determined through intrusive investigation works completed at the site by Environmental Strategies (2014), Asset Geotechnical (2022) and Reditus (2022 & 2023).

A total of seven (7) boreholes and 21 hand augers have been completed across the portion of the site at 222 Waldron Road, while 11 boreholes locations have been drilled across the former service station and vacant lot located at 138 & 140 Campbell Hill Road. The borehole locations are presented in **Figure 2**, **Appendix A** and the borehole logs are provided in **Appendix C**.

Intrusive investigation works completed at the site are summarised as follows:

- Environmental Strategies completed 10 boreholes (BH1 to BH10) across the former service station and vacant lot located at 138 & 140 Campbell Hill Road on the 14 and 15 January 2014. The bores were augured to depths between 4.0 to 7.5 mbgl. Groundwater monitoring wells were installed at three (3) borehole locations (BH4/MW3, BH5/MW2, BH6A/MW1).
- Reditus completed 21 hand augers (HA01 to HA21) across 222 Waldron Road on the 3 and 4 May 2022. The hand augers were completed to depths between 0.4 to 1.1 mbgl.
- Asset Geotechnical completed five (5) boreholes (BH101 to BH105) across the site on 4 and 5 May 2022. The bores were augured to depths between 1.30 to 2.55 mbgl and then cored to depths between 7.50 to 8.19 mbgl. A groundwater monitoring well was installed at borehole location BH105/MW4.
- On the 25 May 2023 Reditus installed three additional monitoring wells (MW5, MW6, MW7) at the site for hydrogeological assessment purposes. The bores were drilled to depths between 5.25 to 5.60 mbgl.

The generalised site stratigraphy established from the intrusive works completed is presented in **Table 2** and the generalised site geotechnical model as reported by Asset Geotechnical (2022) is presented in **Table 3** below.

Table 2. Generalised Site Stratigraphy Summary

LAYER	DEPTH (mbgl)	THICKNESS (m)	DESCRIPTION
Fill / Topsoil	0.15 - 1.20 mbgl	0.15 - 1.20 m	Clay with silt and trace sand, sand with clay and gravels, gravelly clay, brown to dark brown
Residual Clay	0.15 - 1.25 mbgl	0.25 - 1.45 m	Medium to high plasticity, red brown, orange-brown, yellow brown, grey and blue grey, stiff to very stiff
Bedrock (Shale/Siltstone)	From 1.0 to 1.6 mbgl	Unknown	Interbedded shale and siltstone, generally thinly to very thinly laminated, sub horizontal lamination, slightly fractured. Extremely weathered to highly weathered at the top of the unit, becoming less weathered with depth and increasing strength.

mbgl – metres below ground level

Table 3. Generalised Site Geotechnical Model (Asset Geotechnical, 2022)

Unit	Origin	Description	Depth to Top of Unit [1] (m)	Unit Thickness [1] (m)
1	Fill	Fill, Gravelly, cemented SAND/ Clayey SAND with some silt/ Sandy CLAY, fine to medium grained, low to medium plasticity, subangular gravels, dark brown/ brown/ dark grey. Appeared to be moderately to well compacted.	0.04 to 0.125	0.075 to 1.125
2	Residual	CLAY, medium to high plasticity, yellow brown/ brown/ orange brown, generally very stiff, becoming hard with depth.	0.15 to 1.2	0.25 to 1.45
3a	Bedrock[2]	SILTSTONE/ SHALE (remoulded as CLAY with some silt/ Shaley CLAY), extremely weathered, blocky, clayey matrix, remnant rock structure, very low strength, assessed as Class 5 Shale.	1 to 1.6	0.1 to 1.55
3b	Bedrock[2]	SHALE/ SILTSTONE, pale grey/ brown with dark grey lamination, ironstone staining, sub horizontal lamination, generally thinly to very thinly laminated, slightly to moderately fractured, very low to low strength, defect spacing <60mm, assessed as Class 4 Shale.	1.4 to 2.55	1.54 to 3.75
3c	Bedrock[2]	SHALE interbedded with SILTSTONE, dark brown/ brown/ pale grey with dark grey lamination, generally thinly laminated, horizontal lamination, slightly fractured, poorly to well-developed layering, defect spacing 60mm to 200mm, assessed as Class 3 Shale (only in BH101 & BH102).	1.3 to 2.0	3 to 4.93
3d	Bedrock[2]	SILTSTONE interbedded with SHALE, light grey with dark grey lamination, generally very thinly laminated, sub horizontal lamination, high strength, defect spacing >200mm, assessed as Class 2 Shale.	2.94 to 6.3	>1.2 to >5.1

Notes:

1. The depths and unit thicknesses are based on the information from the test locations only and do not necessarily represent the maximum and minimum values across the Site.
2. Rock classification to Pells, P.J.N., Mostyn, G. & Walker, B.F., Foundations on Sandstone and Shale in the Sydney Region, Australian Geomechanics Journal, December 1998.

3.3 Acid Sulphate Soils

Acid sulfate soils (ASS) occur predominantly on coastal land with elevations generally below 5 m Australian Height Datum (AHD). 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.

Review of the Liverpool Acid Sulfate Soil Risk Map (Murphy, 1997) shows the site is located in area of "No known occurrence of acid sulfate soil materials", where acid sulfate soils are not known or expected to occur in these environments.

The Canterbury-Bankstown Local Environmental Plan 2023 also indicates that the site is not located in an area of known acid sulfate soil risk.

Based on a review of the publicly available information and reported site conditions, ASS is not considered to be a risk at the site.

4 Hydrogeological Setting

The groundwater system within the development extent on the site is described as a **semi-confined/confined groundwater system within weathered and fractured shale/siltstone** of middle Triassic Bringelly Shale.

The site is located within the administrative boundary of the **Sydney Basin Central Groundwater Source**, which is managed under the WM Act through the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023.

A review of Hydrogeology map of Australia (Geoscience Australia) indicates that site aquifers are porous aquifers of low to moderate yield.

4.1 Groundwater Monitoring Wells

Seven (7) groundwater monitoring wells (MW1 to MW7) have been installed and monitored at the site. The groundwater monitoring well locations are provided in **Figure 2**, **Appendix A**, and the borehole logs are provided in **Appendix C**.

The groundwater monitoring wells installed at the site are summarised as follows:

- MW1 to MW3 were installed by Environmental Strategies (ES) in 2014 during their environmental assessment of the former service station and the vacant lot located at 138 & 140 Campbell Hill Road (Lots 6 & 7 DP30305). It is noted that the monitoring wells were destroyed during demolition works at the site in July 2023, but monitoring data from the wells was obtained in 2014 and 2022.
- MW4 was installed by Asset Geotechnical (Asset) in May 2022 during their geotechnical investigation at the site and utilised by Reditus for their Detailed Site Investigation (DSI) completed in June 2022.
- MW5 to MW7 were installed by Reditus in May 2023 for hydrogeological assessment purposes to facilitate site-wide hydrogeological conceptualisation and characterisation. It is noted that due to the majority of the site still operating as an aged care facility, there are site access restrictions, particularly to the northern portion of the site.

A summary of the groundwater monitoring well construction details are provided in **Table 4** below.

Table 4. Groundwater Monitoring Well Construction Details

WELL ID	DATE INSTALLED	EASTING	NORTHING	TOP OF CASING (mAHD)	DEPTH OF WELL		SCREEN INTERVAL (mbgl)
					(mbgl)	(mAHD)	
MW1	14/01/2014	314784	6249068	32.97	6.8	26.17	3.8 – 6.8
MW2	15/01/2014	314796	6249064	32.97	7.5	25.47	4.5 – 7.5
MW3	15/01/2014	314804	6249065	33.22	7.0	26.22	4.0 – 7.0
MW4	6/05/2022	314772	6249074	33.00	7.5	25.50	4.5 – 7.5
MW5	25/05/2023	314697	6249105	31.89	5.25	26.64	1.25 – 5.25
MW6	25/05/2023	314716	6249136	33.18	5.6	27.58	1.1 – 5.1
MW7	25/05/2023	314722	6249129	32.65	5.5	27.15	1.1 – 5.1

mAHD – metres Australian Height Datum

mbgl – metres below ground level

4.2 Groundwater Elevations and Inferred Flow Direction

Groundwater elevations have been confirmed at the site by both manual discrete measurements and long-term monitoring using programable data loggers, detailed as follows:

- **Manual Measurements**: Manual groundwater elevation measurements have been recorded on the following dates:
  - 24 January 2014 (MW1 to MW3)
  - 17 May 2022 (MW1 to MW4)
  - 7 June 2023 (MW4 to MW7)
  - 13 September 2023 (MW4 to MW7)
  - 12 January 2024 (MW4 to MW7)
  - 10 October 2025 (MW4 to MW7)
- **Long-term Monitoring**: Long-term groundwater level monitoring was conducted over two periods, as follows:
  - A four-month period (121 days) from 13 September 2023 to 12 January 2024. This covered significant rainfall events including 28 September 2023 where 35.2 mm of rainfall occurred.
  - A further two-month period (60 days) from 11 August 2025 to 10 October 2025. This covered significant rainfall events including 21 August 2025 where 44.4 mm of rainfall occurred and 11 September 2025 where 51.6 mm of rainfall occurred.

It is also noted at the time of reporting that the data loggers are still deployed at site to collect a full 6-months of long-term groundwater level monitoring data to inform future reporting or available upon request.

4.2.1 MANUAL MEASUREMENTS

A summary of the manual groundwater measurements recorded at the site is provided in **Table 5** below.

Table 5. Manual Groundwater Elevation Measurements

WELL ID	DATE	TOP OF CASING (mAHD)	DEPTH OF WELL (mAHD)	DEPTH TO WATER	
				(mbTOC)	(mAHD)
MW1	24 Jan 2014	32.97	26.17	1.195	31.774
	17 May 2022			1.145	31.824
MW2	24 Jan 2014	32.97	25.47	1.270	31.701
	17 May 2022			1.170	31.801
MW3	24 Jan 2014	33.22	26.22	1.450	31.772
	17 May 2022			1.345	31.877
MW4	17 May 2022	33.00	25.50	1.150	31.854
	7 Jun 2023			1.250	31.754
	13 Sep 2023			1.765	31.239
	12 Jan 2024			1.250	31.754
	10 Oct 2025			1.285	31.719
MW5	7 Jun 2023	31.89	26.64	3.470	28.416

WELL ID	DATE	TOP OF CASING (mAHD)	DEPTH OF WELL (mAHD)	DEPTH TO WATER	
				(mbTOC)	(mAHD)
	13 Sep 2023			3.964	27.922
	12 Jan 2024			3.428	28.458
	10 Oct 2025			3.465	28.421
MW6	7 Jun 2023	33.18	27.58	2.110	31.073
	13 Sep 2023			1.987	31.196
	12 Jan 2024			1.565	31.618
	10 Oct 2025			1.320	31.863
MW7	7 Jun 2023	32.65	27.15	1.580	31.068
	13 Sep 2023			1.427	31.221
	12 Jan 2024			0.960	31.688
	10 Oct 2025			0.790	31.858
			Minimum:	0.790	27.922
			Maximum:	3.964	31.877
			Geometric Mean:	1.584	31.010
			Median:	1.345	31.701

mAHD – metres Australian Height Datum

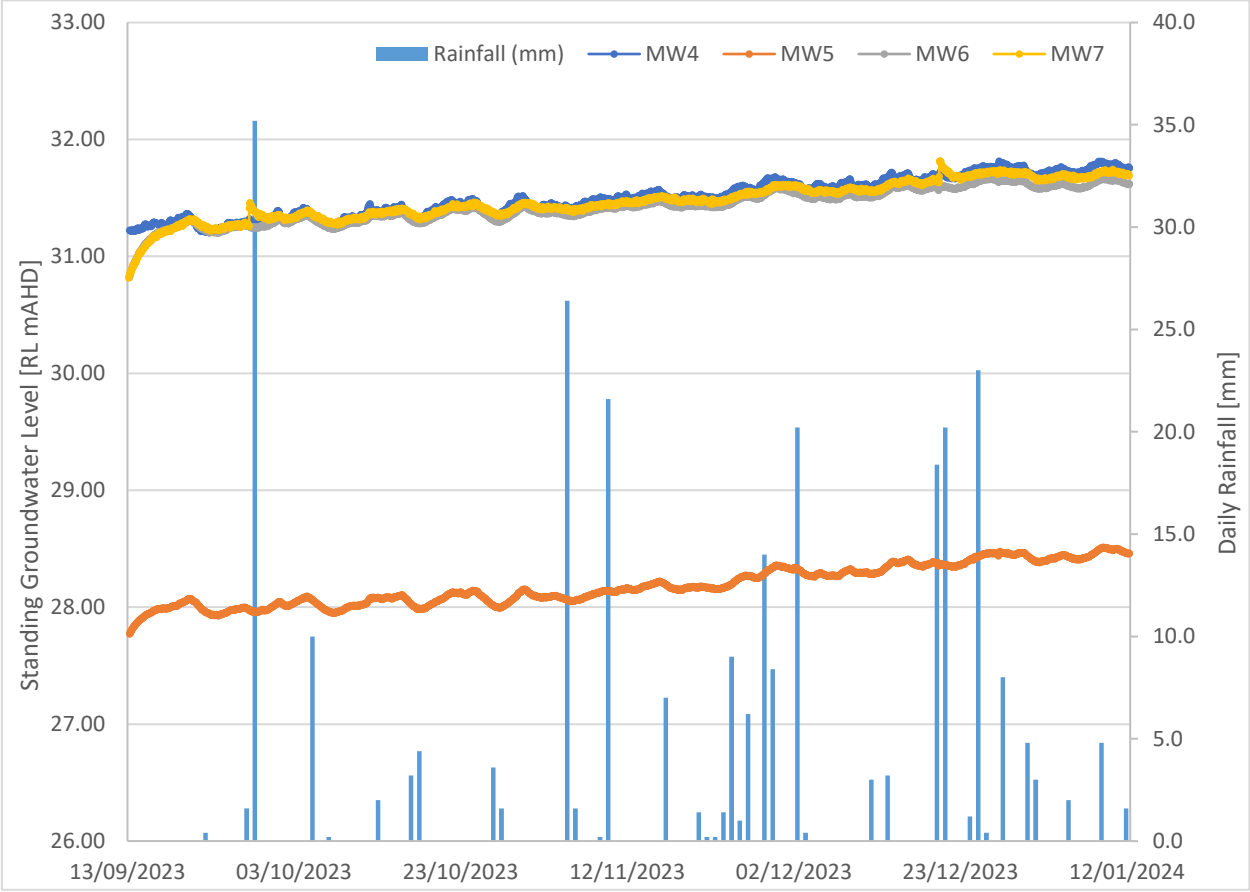
mbTOC – metres below top of casing

4.2.2 LONG-TERM MONITORING

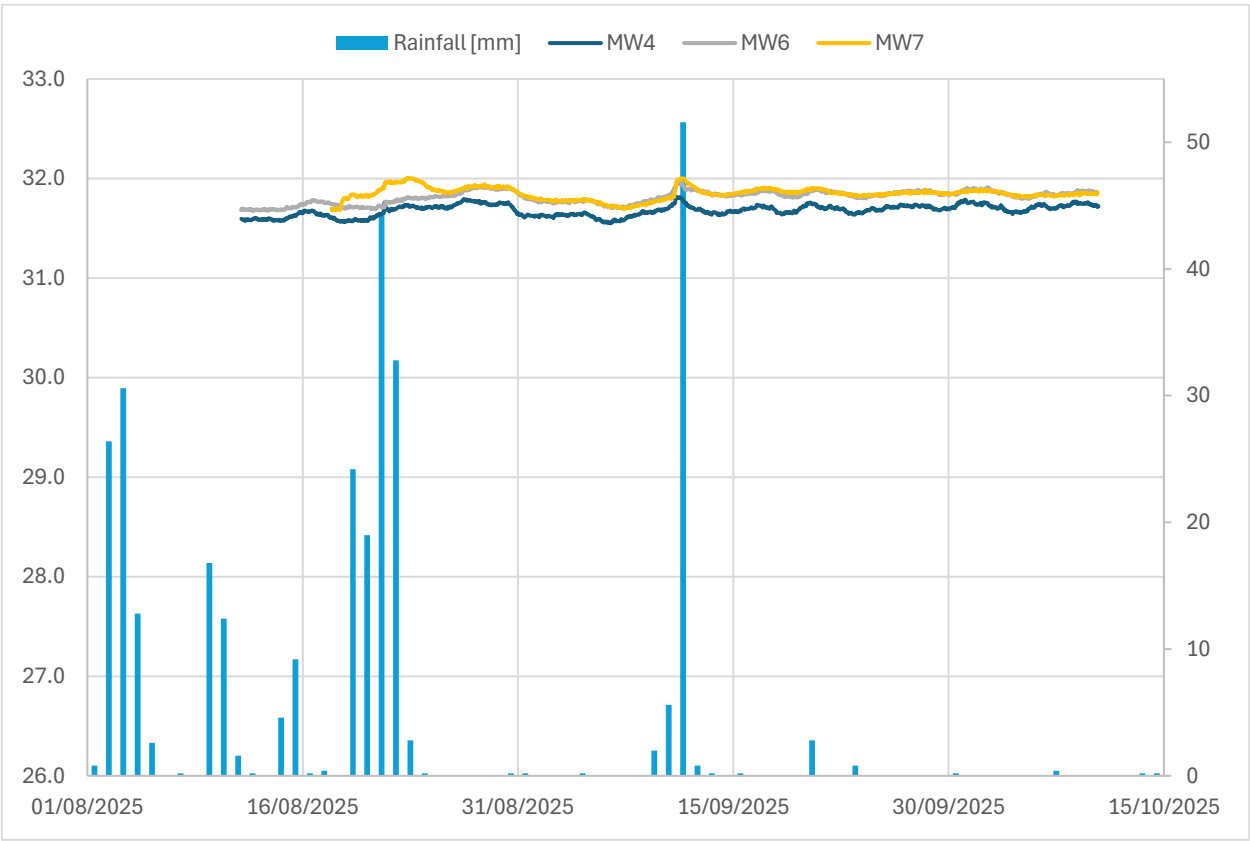
Standing groundwater levels (RL mAHD) overlain with the recorded rainfall (Bankstown Airport AWS, 066137) during the monitoring period from 13 September 2023 to 12 January 2024 are provided in **Graph 1** below and in **Graph 2** below for the more recent monitoring period from 11 August 2025 to 10 October 2025.

It is noted for the recent monitoring period due to issues with the data collected from the logger deployed in MW5, the long-term data from this location was not available for inclusion in this report.

Additionally, MW7 was noted to have surface water ingress when the loggers were installed on 11 August 2025. To remove the excess surface water and not comprise the groundwater level data been recorded, the well was bailed dry on 14 August 2025. Due to this the groundwater level data from MW7 for the first week of monitoring has not been included in **Graph 2** below while the groundwater level was stabilising.



Graph 1. Long-term Groundwater Elevation and Rainfall Data from 13 September 2023 to 12 January 2024.



Graph 2. Long-term Groundwater Elevation and Rainfall Data from 11 August 2025 to 10 October 2025.

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

- Standing groundwater levels at the site fluctuated between 0.47 m (MW6) to 0.64 m (MW7) across the four monitoring wells during the 4-month monitoring period at the site from 13 September 2023 to 12 January 2024.
  - It is noted that the first 3 days of monitoring were excluded from this range as the groundwater levels within the wells were still stabilising following the rising head tests completed on 13 September 2023.
- Standing groundwater levels at the site fluctuated between 0.28 m (MW6) to 0.33 m (MW7) across the three wells monitoring during the further recent two-month monitoring period at the site.
- Standing groundwater levels at the site do not appear to respond directly to local rainfall events, expect for two instances during the 2023 monitoring period at MW7 on 28 September 2023 and 20 December 2023, and more recently during the 2025 monitoring period on 11 September 2025. However, the step rise in standing groundwater levels during these dates is considered to be the result of potential surface water ingress into the vented wells rather than reflective of true increases in standing groundwater levels. All monitoring wells have been constructed with flush mounted gatics and MW4, MW5 and MW7 are in locations where potential surface water will accumulate during large rainfall events, noting during the aforementioned dates, 35.2 mm, 18.4 mm and 51.6 mm of rainfall occurred.
- The maximum groundwater elevations reported over the 2023 long-term monitoring period were as follows:
  - MW4: 31.81 mAHD (~1.194 m below ground level)
  - MW5: 28.51 mAHD (~3.376 m below ground level)
  - MW6: 31.67 mAHD (~1.513 m below ground level)
  - MW7: 31.81 mAHD (~0.838 m below ground level)
  - Average of maximums: 30.95 mAHD, median of maximums: 31.74 mAHD
- The maximum groundwater elevations reported over the 2025 long-term monitoring period were as follows:
  - MW4: 31.82 mAHD (~1.19 m below ground level)
  - MW6: 31.96 mAHD (~1.23 m below ground level)
  - MW7: 32.01 mAHD (~0.64 m below ground level)
  - Average of maximums: 31.93 mAHD, median of maximums: 31.96 mAHD

4.2.3 INFERRED FLOW DIRECTION

Based on the manual measurements recorded of standing groundwater levels at the site on 7 June 2023, 13 September 2023, 12 January 2024, and 10 October 2025 groundwater elevation contours have been prepared using kriging interpolated software. The inferred groundwater flow direction is to the west-southwest, generally conforming with the local topography. The groundwater contours established for the site are presented in **Figure 3A, 3B, 3C and 3D, Appendix A**.

4.3 Site Specific Hydraulic Conductivity

Rising head aquifer tests (slug tests) were completed on the three (3) recent groundwater monitoring wells (MW5, MW6, MW7) installed at the site by Reditus. It is noted while monitoring well MW4 is still located at the site, due to Reditus being unable to confirm the construction details and integrity of the bore, and given the bore was cored from 2.55 mbgl (i.e., change from 125 mm to 75 mm diameter bore), MW4 was not utilised to determine hydrogeological properties of the aquifer at the site.

Slug tests were conducted on 13 September 2023, 12 January 2024 and 10 October 2025. Groundwater elevation measurements were collected at nominal 0.5 second intervals using programable pressure transducers (diver data loggers) following the instantaneous removal of water from the well column (assumed to be instantaneous). Groundwater displacement measurements were processed using a computer software package AQTESOLV Pro (version 4.0) and the groundwater displacement data was analysed using the Hvorslev (1951)[1] solution for a confined

[1] Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi, pp. 1-50.

aquifer. Estimates of hydraulic conductivity were calculated and are summarised in **Table 6** below. Slug test analysis outputs are provided in **Appendix D**.

Table 6. Estimates of Hydraulic Conductivity

WELL ID	DATE	HYDRAULIC CONDUCTIVITY (m/day) Hvorslev 1951 Solution (confined aquifer)
MW5	13 Sep 2023	5.45×10^{-3}
	12 Jan 2024	1.83×10^{-3}
	10 Oct 2025	2.28×10^{-4}
MW6	13 Sep 2023	1.22×10^{-3}
	12 Jan 2024	1.13×10^{-3}
	10 Oct 2025	4.34×10^{-4}
MW7	13 Sep 2023	1.72×10^{-3}
	12 Jan 2024	3.94×10^{-4}
	10 Oct 2025	4.82×10^{-4}
Minimum:		2.28×10^{-4}
Maximum:		5.45×10^{-3}
Geometric Mean:		9.13×10^{-4}
Median:		1.13×10^{-3}

The above estimates of hydraulic conductivity are noted to be generally consistent with literature values (Fitts, 2013) for sandstone.

4.4 Groundwater Quality Sampling Results

Collection and analysis of groundwater samples from the four (4) onsite monitoring wells (MW4, MW5, MW6, MW7) was completed by Reditus on 7 June 2023. The groundwater monitoring well locations are presented in **Figure 2**, **Appendix A**, tabulated analytical results are provided as **Appendix E** and copies of the laboratory reports are provided as **Appendix F**.

The groundwater samples were submitted to the NATA accredited laboratories Envirolab (primary laboratory) and ALS Environmental (secondary laboratory) for the analysis of:

- Major Anions and Cations.
- Ionic Balance.
- Nutrients (including ammonia, nitrate, total nitrogen, oxidised nitrogen, total phosphorus and reactive phosphorus).
- Coliforms.
- Benzene, Toluene, Ethylbenzene, Xylenes, Naphthalene (BTEXN).
- Total Recoverable Hydrocarbons (TRH).
- Polycyclic Aromatic Hydrocarbons (PAHs).
- Eight Priority Heavy Metals (including arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc).

All samples collected reported concentrations of BTEXN, TRH and PAHs, below the laboratory limit of reporting (LOR).

Concentrations of heavy metals were reported below the ANZG (2018) 95% Freshwater and Marine Water Quality Guidelines (nearest ecological water receptor Prospect Creek), with the exception of copper and zinc, which reported the following concentration ranges:

- Copper: <1 to 4 µg/L (1.4 µg/L)
- Zinc: 4 to 27 µg/L (8 µg/L).

4.5 Registered Groundwater Bore Search

A search of the WaterNSW Registered Groundwater Bore Database (https://realtimedata.waternsw.com.au/water.stm) indicated there are three (3) registered groundwater bores with a 500 m radius of the site. All three bores are used for monitoring purposes and located west of the site. The registered bores identified within the vicinity of the site are presented on **Figure 4**, **Appendix A**.

The closest registered groundwater bore is GW112903, which is located approximately 470 m west of the site. The bore was drilled to 8.46 m, but no construction details or groundwater information is listed. There are no registered groundwater supply bores within a 500 m radius of the site.

4.6 Groundwater Dependant 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.

The groundwater dependence of ecosystems can range from complete to partial reliance on groundwater, such as might occur during droughts. The degree and nature of groundwater dependence will influence the extent to which they are affected by changes to the groundwater system, both in quality and quantity.

Many land and water use activities within a catchment can affect groundwater dependent ecosystem function and viability. It is important to manage these land and water use activities within a regulatory and licensing framework. 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.

WSPs have been developed for groundwater systems in NSW to preserve water resources by establishing rules for sharing water between different types of water uses. The site is located within the **Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023 – Sydney Basin Central Groundwater Source**.

No high-priority GDEs are located within a 500 m radius of the site. The nearest high-priority GDEs are all located over 8 km from the site (i.e., Badu Mangroves and Voyager Point Wetland Reserve), beyond the influence of any proposed dewatering at the site.

4.7 Contaminated Sites

A search was undertaken (October 2025) 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 subject site is not listed on the NSW EPA record of notices under Section 60 of the Contaminated Land Management Act (1997).
- There is one (1) site within a 500 m radius of the site that is listed on the NSW EPA List of Notified Sites under the Contaminated Land Management Act (1997), detailed within **Table 7** below.

Table 7. NSW EPA List of Notified Sites

NAME	ADDRESS	DISTANCE FROM SITE BOUNDARY TO SITE BOUNDARY	CONTAMINATING ACTIVITY	MANAGEMENT CLASS
149 Orchard Road Chester Hill	191 Miller Road & 149 Orchard Road	~100 m South	Chemical Industry	Contamination currently regulated under CLM Act

Given the site is currently regulated under the CLM Act it is considered a potential risk. However, given that the notified site is located topographically and hydraulically down-gradient from the development site and the maximum predicted drawdown radius of influence resulting from the proposed basement excavation under the 'upper-case' scenario is 16 m (see **Section 6.7.4**), the contaminated site is not considered to be a risk to the proposed basement excavations and dewatering activity.

5 Proposed Development

5.1 Development Details

The preliminary basement development plans, dated 4 September 2023 are provided as **Appendix B**, and include the following Architectural Drawings:

- Boffa Roberston Group (4 September 2023), Ground Floor Plan – Overall, Drawing: 2108/A1DA05
- Boffa Roberston Group (4 September 2023), Basement Floor Plan – Overall, Drawing: 2108/A1DA04
- Boffa Roberston Group (4 September 2023), Lower Basement Floor Plan – Overall, Drawing: 2108/A1DA03

The proposed development will include the construction of three apartment buildings (Building A, B and E) for residential aged care, with a one-level basement beneath and between the buildings (the 'primary basement'), and a smaller second level basement beneath building A (the 'lower basement'). A fourth apartment building (Building C) is earmarked for future development but is not included in the current development works proposed for the site.

The proposed basement footprints at the site are presented in **Figure 2, Appendix A**.

The lowest reduced level (mAHD) of the primary basement's finished floor level (FFL) is 30.46 mAHD. The bulk excavation level (BEL) is assumed to be approximately 0.5 m below the basement FFL. Therefore, the lowest BEL of the primary basement is assumed to be 29.96 mAHD, which will require excavation depths of up to approximately 5 m below the existing ground levels at the site.

The reduced level of the lower basement is understood to be 28.24 mAHD (not currently marked in the preliminary development plans), therefore with a BEL of 27.74 mAHD. The lower basement will require excavation depths of up to approximately 6 m below the existing ground levels at the site.

Given the expected minimal groundwater inflows from the low permeability fractured and weathered shale/siltstone water bearing zones of the Bringelly Shale geology it is understood the basements are proposed to be constructed as 'Drained Basements' with traditional sub-slab drainage systems and vertical strip drains behind the basement walls.

A summary of the proposed basement design parameters is provided in **Table 8** below.

Table 8. Summary of Proposed Design Parameters

ITEM	DESCRIPTIONS
Basement Excavation Areas (m^2)	Primary Basement[1]: Approximately 6,100 m^2 Lower Basement: Approximately 210 m^2
Site Surface Elevation	The site slopes from northeast to southwest, with a fall from approximately 38 mAHD in the northeast corner of the site to approximately 31 mAHD in the southwest corner of the site over a distance of approximately 130 m.
Basement Finished Floor Levels (FFL)	Primary Basement: 30.46 RL mAHD Lower Basement: 28.24 RL mAHD
Bulk Excavation Levels[2] (BEL)	Primary Basement: 29.96 RL mAHD Lower Basement: 27.74 RL mAHD

[1] Determined from the outline of the entire primary basement (i.e., conservatively includes the non-basement area between Building B and Building E).

[2] Assumed to be 0.5 m below the basement FFLs.

5.2 Basement Construction Methodology

The proposed construction methodology is of a "drained basement" design.

The site is situated on Bringelly Shale, with water bearing zones typically occurring within fractured and/or decomposed weathered shale/siltstone and/or along the bedding layer fractures. No groundwater bearing zones were encountered in the overlying unconsolidated fill and residual clay soils.

It is anticipated that during periods of extended rainfall perched groundwater seepage will likely occur along the top of the clay and rock, and through joints and along bedding planes within the rock exposed in the basement floor and walls above the groundwater table.

Reditus anticipate that the proposed basement construction will consist of a sub-slab drainage system and vertical strip drains behind the basement walls. The basement floor is understood to consist of slab-on-grade, strip, or pad footings where high-strength shale/siltstone bedrock is exposed at the BELs of RL 29.96 mAHD and 27.74 mAHD.

It is understood that permanent batter slopes are not proposed for the development. As such temporary shoring will be required, which will also be incorporated into the permanent foundation and retaining works.

Given the presence of shale/siltstone from shallow depths, the proposed shoring is likely to consist of conventional shoring with soldier piles and steel walers, or soldier piles and shotcrete infill panels (e.g., 600 mm diameter solider piles at 2800 mm centres, with 170 mm shotcrete infill panels). As part of the drained basement design, the soldier pile wall will include vertical drainage strips to be connected to the proposed sub-slab drainage system. Alternately, if there are geotechnical constraints a contiguous or secant pile wall retention system may be used for the basement excavation.

Given the naturally low permeability of the Bringelly Shale water bearing zones (based on site specific measurements, see **Section 4.3**), the long-term steady-state predicted groundwater inflows (detailed in **Section 6** below) are expected to be negligible (<3 ML/yr) and considered able to be effectively managed under a Drained Basement design with implementation of an appropriate management plan.

Reditus note that construction dewatering is exempt from requiring a Water Access Licence (WAL) under the Water Management (General) Amendment (Exemptions for Instructure) Regulation 2025. Additionally, ongoing dewatering under a drained basement design would also likely be exempt given the predicted inflows are <3 ML/yr. If more than 3 ML/yr occur during the ongoing dewatering under a drained basement design, a WAL will need to be acquired with the appropriate number of shares from the groundwater source.

5.3 Dewatering Extraction Rate and Duration

It is anticipated that a solider pile wall (with piles extending into low permeability shale/siltstone) shoring method will be adopted with an internal drainage sump and pump dewatering system during construction.

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 1** below).

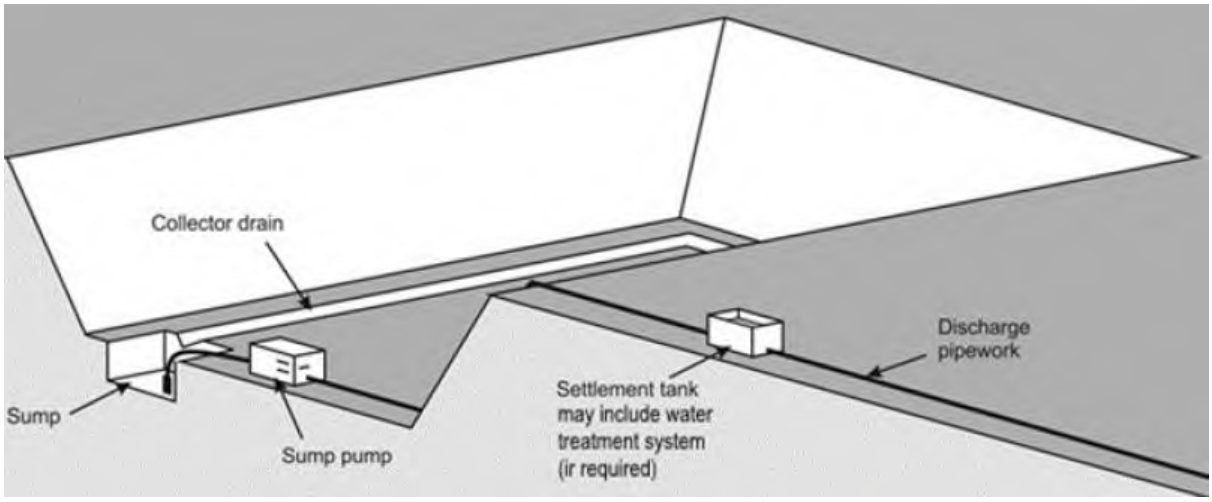


Figure 1 Conceptual layout of a sump and pump dewatering system

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.

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 the construction works.

The uncertainty around the final dewatering method prevents absolute quantitative assessment of the pumping rates and project volumes. The many variables involved in dewatering make predicting flow rates problematic. These variables include variations in recharge rates, effects of varying geology on hydraulic conductivity and soil porosity, and natural and built hydraulic barriers and recharge zones. As such, the rate of groundwater extraction will be highly dependent on the required time frame for excavation works and can be varied to match excavation depth speed and/or discharge restrictions (if any).

The duration to complete the necessary excavation works and basement construction is assumed to be approximately 6 months. The predicted period for the construction of the entire development is not known at this preliminary stage. In the absence of a known construction schedule, annual dewatering or prediction for an initial 12-month period for the construction stage of the basement has been undertaken as well as ongoing annual groundwater inflows after construction of the basement is complete, for the proposed drained basement design.

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.

The predicted extraction volume required to be dewatered is provided in **Section 6** below, with the 'Most Likely' groundwater take predicted to be **0.45 ML** over the initial 12 months of construction, representing the maximum total groundwater take over a 12-month period (i.e., including both inflows and matrix take for all three basements).

The predicted long term (steady-state) ongoing groundwater take through the Drained Basement (post constructure) was predicted to be **0.32 ML/year**, equivalent to approximately 0.01 L/s.

5.4 Discharge Methods

Approval shall be obtained from Canterbury-Bankstown Council (Council) to direct dewatered and treated groundwater to the stormwater network.

A permit from Council is required for any dewatering of groundwater. Council require groundwater/tailwater 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.

A direct connection to stormwater is a preferred and it is expected that a direct connection to the local stormwater pit from the dewatering and treatment system will be completed.

Treatment of extracted groundwater will be required during the proposed dewatering program to improve the water quality and minimise potential impacts to the receiving waters, relevant details are provided in **Section 11**.

The water quality of the extracted groundwater shall be assessed prior to discharge to the stormwater network, and then weekly thereafter during its release to monitor the waters suitability for continuous discharge. This monitoring will guide the initial type and level of treatment required to minimise environmental risks associated with the waters release, and reassessment of the treatment measures during the dewatering program.

5.4.1 OPTIONAL ONSITE REUSE

Groundwater may potentially be used for onsite construction purposes (i.e., dust suppression, washing) following treatment. The total volume of groundwater required to be dewatered precludes onsite reuse as the primary discharge and disposal method.

Permanent onsite reuse of groundwater inflows collected through the Drained Basement should be considered as part of the development design in accordance with the general principals of ecological sustainable development. This may include onsite reuse to supplement irrigation of gardens and/or flushing of toilets.

Treatment of extracted groundwater may be required to improve the water quality and minimise potential impacts to the potential receptors. The water quality of the extracted groundwater shall be assessed prior to reuse. This monitoring will guide the initial type and level of treatment required to minimise environmental risks associated with the waters release, and reassessment of the treatment measures during the dewatering program.

5.4.2 OPTIONAL REINJECTION

Whilst unlikely (based on the fractured shale/siltstone geology and dominant groundwater flow through fractures), reinjection of groundwater may be required to control drawdown and potential settlement effects.

Treatment of extracted groundwater will be required to improve the water quality and minimise potential impacts to the potential receptors prior to re-injection.

Regulatory approval from WaterNSW/NRAR would be required for any reinjection.

6 Groundwater Take and Drawdown Estimates

6.1 Summary of Site Characterisation

The generalised subsurface profile at the site is comprised of fill/topsoil (0.15-1.2 mbgl), residual clay (0.15-1.25 mbgl), overlying shallow bedrock shale and siltstone (from 1.0-1.6 mbgl).

The groundwater system within the development extent on the site is described as a **semi-confined/confined groundwater system within weathered and fractured shale/siltstone** of middle Triassic Bringelly Shale.

The site is located within the administrative boundary of the **Sydney Basin Central Groundwater Source**, which is managed under the WM Act through the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023.

The maximum standing groundwater level measured onsite was RL 32.91 mAHD recorded in MW7 during the recent 2-month monitoring period from 11 August 2025 to 10 October 2025. For conservatism, this maximum value has been used in the prediction of groundwater take. This value was adopted in both analytical models (lower basement modelled separately) to predict groundwater take and extent of groundwater drawdown.

Based on the assumed basement bulk excavation levels (BELs) of RL 29.96 mAHD and 27.74 mAHD, there is 1.92 to 4.14 m of groundwater which will be encountered and require dewatering during, and ongoing post development works at the site (i.e., proposed drained basement).

6.2 Conceptual Flow Model

A conceptual model is a description of the site, site works, and groundwater systems presented both as text and graphically. This description can then be approximated using an analytical solution to allow prediction of groundwater behaviour.

The groundwater extraction estimate comprises two key components to be considered:

a) The component of groundwater present within the aquifer matrix, which will be removed as part of the excavation process (pore water).

b) The component of inflow into the excavation from the surrounding aquifer (walls and base) during the dewatering activity.

The conceptual flow models developed for this assessment are “steady state” models – a snapshot in time representing average conditions. This snapshot was completed based on conservative assumptions of the excavation depth and proposed shoring wall designs, which estimate the greatest groundwater inflow. Note that a more detailed analysis can be provided through a three-dimensional flow model (beyond the scope of the current assessment).

Conceptually, the drained basement design (Solider Pile Wall and Drainage Layer) will not limit any groundwater inflow into the excavation void and is assumed to be in direct connection with the surrounding Fractured Shale/Siltstone Confined Aquifer.

To estimate the groundwater extracted present within the aquifer matrix, which will be removed as part of the excavation process, the porosity of the matrix is multiplied by the saturated excavation volume. The saturated excavation volume was calculated by determining the difference between the conservative standing groundwater level and the BEL, multiplied by the approximate excavation area for each basement.

To estimate the groundwater inflow volumes, Reditus used the Marinelli and Niccoli (2000)[2] steady-state analytical solution. This solution provides a convenient means for estimating groundwater inflows into excavations and is considered applicable to use as a conservative assessment for the ongoing groundwater seepage into the proposed drained basement design.

The analytical method of Marinelli and Niccoli (2000) requires a simplification of the hydrogeological environment and was used to provide a broad range of potential drawdown and groundwater inflow. The equations calculate groundwater inflow from the aquifer based on the conceptual model.

[2] Marinelli, F, and Niccoli, W.L. (2000) Simple analytical equations for estimating ground water inflow to a mine pit: Groundwater, v. 38, no.2, p. 311-314

The conceptual flow model was approximated by analytical models, which are divided into two zones separated by a conceptual no-flow boundary where horizontal flow will occur level with the excavation base:

- **Zone 1** – exists above the base of the excavation and represents lateral flow to the excavation via the surrounding walls and drainage layer.
- **Zone 2** – extends from the bottom of the excavation downward and considers vertical upward groundwater inflow through the excavation base into the void and drainage layer.

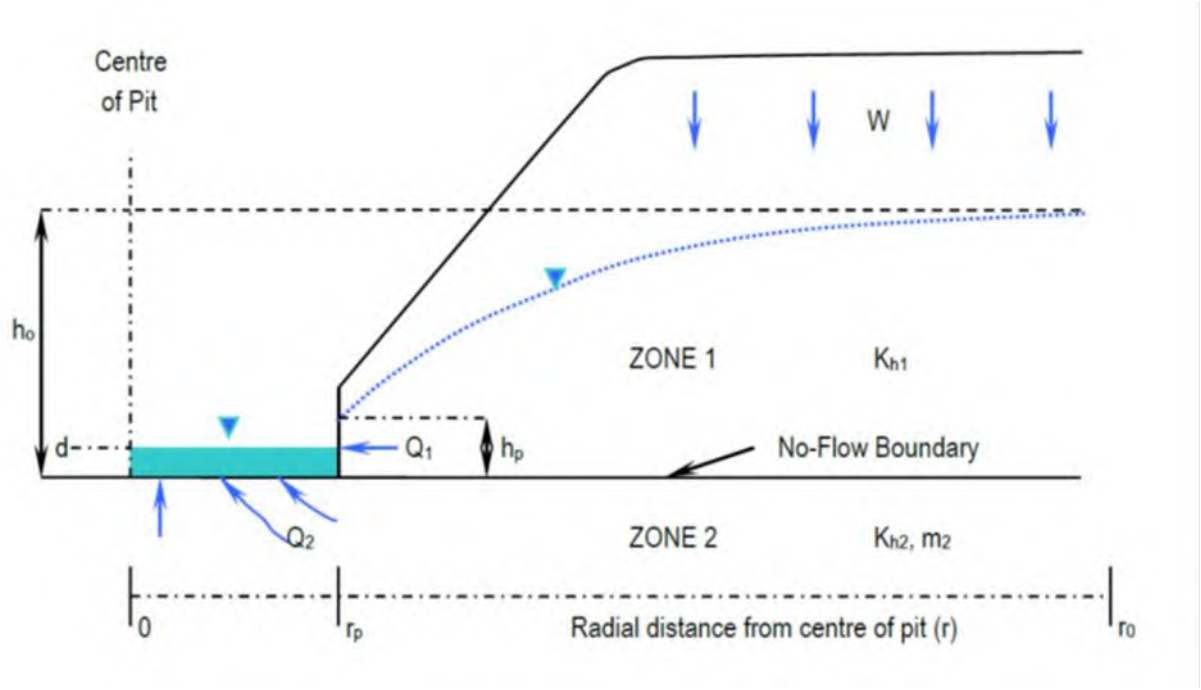


Figure 2 Conceptual Model of the Analytical Solution

The analytical solution for Zone 1 considered steady state, unconfined, horizontal radial flow, with uniformly distributed recharge at the water table. This represents the volume of water laterally flowing into the excavation through the excavation walls.

The analytical solution for Zone 2 is based on steady-state flow to one side of a circular disk sink of constant and uniform drawdown. The circular disk sink represents the volume of water needing to be removed to dewater the site to the target dewatering levels of RL 29.96 mAHD and 27.74 mAHD (respective BELs).

For the development of the conceptual flow model for the proposed excavation, the circular disk sink was assumed to encompass the approximate area of the excavation footprint. The total excavation is approximated as a single large well and as such the circular disk sink was assigned a radius of based on the footprint of the proposed excavation.

Monthly rainfall data was obtained from the Australian Government Bureau of Meteorology (BoM), from a weather station located approximately 4.2 km south of the site (Bankstown Airport AWS, 066137). The data set from the weather station extends back to 1968, which provided 55 years of rainfall data encompassing longer term climatic trends. The mean annual rainfall (based on monthly observations) from a period between 1968 and 2023 was 890.5 mm. This converted to an assumed average daily rainfall of 0.00244 m/day.

It is noted that separate analytical models were developed for the proposed primary basement and lower basement. Therefore, the total groundwater inflow for the proposed development was determined by adding each of the model totals together. Given aquifer interference between the models or basements has not been accounted for, the total combined groundwater inflows determined are considered to be conservative values.

6.3 Summary of Aquifer Parameters

The hydraulic conductivity of the fractured shale/siltstone rock will be restricted by the connectivity and extent of the bedding layers and joints or faults, as well as the degree of connection to the drainage layer.

Site specific test data of the fractured shale/siltstone (see **Section 4.3**) has provided an estimate of the hydraulic conductivity (summarised in **Table 9** below), which has been used to predict groundwater inflow volumes. These

values are presented as representative averages over the area of the site, and localised natural variation up to an order of magnitude is to be expected in parts of the site.

Table 9. Summary of Hydraulic Conductivity Values

		HYDRAULIC CONDUCTIVITY (m/day)
Fractured Shale/Siltstone	Minimum	2.28×10^{-4}
	Maximum	5.45×10^{-3}
	Geometric Mean	9.13×10^{-4}
	Median	1.13×10^{-3}

Site specific porosity values were not measured. As such, representative porosity values were adopted from literature sources. Given groundwater storage of the shale/siltstone aquifer is likely confined to secondary porosity features (fractures), a porosity value 1% was assumed for the fractured shale/siltstone unit.

The fractured shale/siltstone was assumed to be isotropic, with the horizontal permeability equal to vertical permeability. Given majority of fractures and bedding joints were reported as sub-horizontal (Asset Geotechnical, 2022), the isotropic assumption is considered conservative.

6.4 Model Scenarios

All groundwater models include some degree of uncertainty in their predictions as they are, by necessity, simplifications of complex real world systems. Whilst every effort is made to ensure that the primary model reflects the best-case, most-likely case and upper-case understanding of site conditions, this cannot be guaranteed and any model result presented as a single number should be viewed with a degree of caution.

Factors which affect the dewatering rate, groundwater take and extent of drawdown within the steady state model include dewatering rate, dewatering design, dewatering period, aquifer characteristics and degree of aquifer variability (including hydraulic conductivity, specific yield/storativity, porosity, recharge, heterogeneity).

It is considered impractical to determine these factors by pumping tests and further analytical assessment, based on the relatively small scale of the development and the likely relatively low risk of impact to groundwater in the shallow water bearing zone in the top of the low yielding fractured shale/siltstone aquifer.

Typical representative values were used in the model. Assessment of the range of typical values and their effects on the model predictions were made to allow sound management decisions using **Best Case**, **Most Likely, and Upper Case** scenarios.

Table 10. Analytical Model Scenarios

SCENARIO	DESCRIPTION
Best Case	Minimum hydraulic conductivity used for both Zone 1 and Zone 2: • 2.28×10^{-4} m/day
Most Likely	Geometric Mean hydraulic conductivity used for both Zone 1 and Zone 2: • 9.13×10^{-4} m/day
Upper Case	Maximum hydraulic conductivity used for both Zone 1 and Zone 2: • 5.45×10^{-3} m/day

6.5 Analytical Model Equations

6.5.1 GROUNDWATER TAKE VOLUME WITHIN THE EXCAVATION MATRIX

The following equation was utilised to estimate the groundwater volume present in the aquifer matrix directly removed through excavation:

$$V = \emptyset \times m \quad (1)$$

$$m = (H_0 - BEL) \times A \quad (2)$$

where:

V = groundwater volume present in the aquifer matrix directly removed through excavation (m3).

ϕ = matrix porosity

m = volume of saturated aquifer matrix to be excavated

H_0 = initial water table elevation (RLm)

BEL = basement excavation level (RLm)

A = area of excavation

6.5.2 GROUNDWATER INFLOW TAKE VOLUME

The steady state inflow rate into the disk sink is given by the following equations[2]:

Zone 1:

$$Q_1 = W\pi\left(r_o^2 - r_p^2\right) \quad (3)$$

$$h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}}\left[r_0^2 ln\left(\frac{r_o}{r_p}\right) - \frac{\left(r_0^2 - r_p^2\right)}{2}\right]} \quad (4)$$

Zone 2:

$$Q_2 = 4r_p\left(\frac{K_{h2}}{m_2}\right)(h_0 - d) \quad (5)$$

$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}} \quad (6)$$

where:

Q = groundwater flux (m^3/day)

K_{h1} = horizontal hydraulic conductivity (m/day) at Zone 1

K_{h2} = horizontal hydraulic conductivity (m/day) at Zone 2

K_{v2} = vertical hydraulic conductivity (m/day) at Zone 2

m_2 = vertical hydraulic conductivity anisotropy parameter

d = depth of water (above target dewatering level) within final excavation (m) (*assumed to be 0 at final excavation depth*)

r_p = radius from centre of excavation (circular disk sink) (m)

r_o = drawdown radius from centre of excavation (iterative calculation)

h_0 = initial saturated thickness above base of excavation (m)

h_p = saturated thickness above the base of excavation at the excavation wall (rp), which is assumed 0 m

W = rainfall recharge rate (assumed % of the mean daily rainfall)

6.5.3 GROUNDWATER DRAWDOWN EXTENT

The following equations were used to calculated the groundwater drawdown resulting from the groundwater take into the excavation[2]:

$$H_{1(r)} = H_0 - h_0 + \sqrt{h_p^2 + \frac{W}{K_{h1}}\left[r_o^2 \ln\left(\frac{r}{r_p}\right) - \frac{\left(r^2 - r_p^2\right)}{2}\right]} \quad (7)$$

where:

$H_{1(r)}$ = hydraulic head elevation (m) at a radial distance (r) from excavation centre

H_0 = initial groundwater elevation (mRL)

h_0 = initial saturated thickness above base of excavation (m)

r = radial distance from excavation centre (m)

z = vertical depth below the excavation bottom (assumed to be 0 m)

W = rainfall recharge rate (assumed % of the mean daily rainfall)

K_{h1} = horizontal hydraulic conductivity (m/day) at Zone 1

6.6 Model Assumptions and Input Parameters

6.6.1 ASSUMPTIONS

The analytical solution was based on the following assumptions, after Marinelli and Niccoli (2000):

- Steady state, unconfined, horizontal radial flow, with uniformly distributed recharge at the water table.
- The excavation walls are approximated as a circular cylinder.
- Groundwater flow is horizontal. The Dupuit-Forchheimer approximation (McWhorter and Sunada 1977) is used to account for changes in saturated thickness due to depression of the water table.
- The static (pre-excavation) water table is approximately horizontal.
- Uniform distributed recharge occurs across the site as a result of surface infiltration. All recharge within the radius of influence (cone of depression) of the pit assumed to be captured by the excavation.
- Groundwater flow toward the pit is axially symmetric.
- Hydraulic head is initially uniform (hydrostatic) throughout Zone 2. Initial head is equal to the elevation of the initial water table in Zone 1.
- The disk sink has a constant hydraulic head equal to the elevation of the “pit lake water surface”. If the pit is completely dewatered, the disk sink head is equal to the elevation of the pit bottom – in this case the target dewatering level.
- Flow to the disk sink is three dimensional and axially symmetric.
- Materials within Zone 2 are anisotropic, and the principal coordinate directions for hydraulic conductivity are horizontal and vertical.

6.6.2 PARAMETERS

The parameters used to estimate the groundwater removal (excavation and inflow) within the analytical solution for the primary basement and lower basement at the site are provided in **Table 11 to Table 12** below.

Table 11. Groundwater Inflow Analytical Model Input Parameters – Primary Basement

PARAMETER	UNIT	BEST CASE	MOST LIKELY	UPPER CASE
Excavation Matrix Storage				
Effective Porosity (ϕ)	-	1%	1%	1%
Bulk Excavation Level (BEL)	RL mAHD	29.96	29.96	29.96
Excavation Area	m^2	6,100	6,100	6,100
Zone 1				
r_p	m	44.06	44.06	44.06
r_o	m	46.03	47.97	53.44
W	m/day	2.44×10^{-4} (10% of average annual rainfall)	2.44×10^{-4} (10% of average annual rainfall)	2.44×10^{-4} (10% of average annual rainfall)
h_0*	m	1.97	1.97	1.97
h_p**	m	0	0	0
K_{h1}	m/day	2.28×10^{-4}	9.13×10^{-4}	5.45×10^{-3}
Zone 2				
K_{h2}	m/day	2.28×10^{-4}	9.13×10^{-4}	5.45×10^{-3}
K_{v2}	m/day	2.28×10^{-4}	9.13×10^{-4}	5.45×10^{-3}
d	RL m	0	0	0

Table 12. Groundwater Inflow Analytical Model Input Parameters – Lower Basement

PARAMETER	UNIT	BEST CASE	MOST LIKELY	UPPER CASE
Excavation Matrix Storage				
Effective Porosity (ϕ)	-	1%	1%	1%
Bulk Excavation Level (BEL)	RL mAHD	27.74	27.74	27.74
Excavation Area	m^2	210	210	210
Zone 1				
r_p	m	8.18	8.18	8.18
r_o	m	12.04	15.56	24.78
W	m/day	2.44×10^{-4} (10% of average annual rainfall)	2.44×10^{-4} (10% of average annual rainfall)	2.44×10^{-4} (10% of average annual rainfall)
h_0*	m	4.14	4.14	4.14
h_p**	m	0	0	0
K_{h1}	m/day	2.28×10^{-4}	9.13×10^{-4}	5.45×10^{-3}
Zone 2				
K_{h2}	m/day	2.28×10^{-4}	9.13×10^{-4}	5.45×10^{-3}
K_{v2}	m/day	2.28×10^{-4}	9.13×10^{-4}	5.45×10^{-3}
d	RL m	0	0	0

6.7 Summary of Analytical Model Results

6.7.1 ESTIMATE OF GROUNDWATER MATRIX VOLUME REMOVED WITHIN EXCAVATIONS

The groundwater matrix removal was estimated using equation 1 and equation 2, with predictions provided in **Table 13** below.

Table 13. Prediction of Groundwater Volume Removed within the Excavation Matrix

DEWATERING AREA	GROUNDWATER VOLUME REMOVED FROM MATRIX (ML)		
	BEST CASE	MOST LIKELY	WORST CASE
Primary Basement	0.13	**0.13**	0.13
Lower Basement	0.01	**0.01**	0.01

6.7.2 PREDICTION OF GROUNDWATER INFLOW

The annual groundwater inflow was estimated using equation 3, 4, 5 & 6, with predictions provided in **Table 14** below, assuming a 12-month dewatering program and continued dewatering of the drained basements.

Table 14. Prediction of Annual Groundwater Inflows

DEWATERING AREA	GROUNDWATER INFLOW (ML) – ZONE 1 & ZONE 2		
	BEST CASE	MOST LIKELY	UPPER CASE
Primary Basement	0.08	**0.22**	0.97
Lower Basement	0.03	**0.10**	0.43

6.7.3 SUMMARY OF 'MOST LIKELY' TOTAL PREDICTED GROUNDWATER TAKE

Based on the initial 12-months of dewatering for the primary and lower basement (including both the initial matrix storage removed via excavation over the first ~6 months, and the groundwater inflow over the 12-month period) the following total groundwater extraction volumes for each of the proposed basements were predicted and are presented in **Table 15** below for the first 12 months of dewatering.

Table 15. 'Most Likely' Predicted Groundwater Take

DEWATERING AREA	PREDICTED MATRIX TAKE (ML)	PREDICTED ANNUAL GROUNDWATER INFLOW TAKE (ML/YR)	TOTAL GROUNDWATER TAKE DURING FIRST 12-MONTHS OF DEWATERING (ML)
Primary Basement	0.13	0.22	0.35
Lower Basement	0.01	0.10	0.10
Totals	**0.14**	**0.32**	**0.45**

Table 16. Summary of Predicted Groundwater Take During and Post Construction ('Most Likely' Scenario)

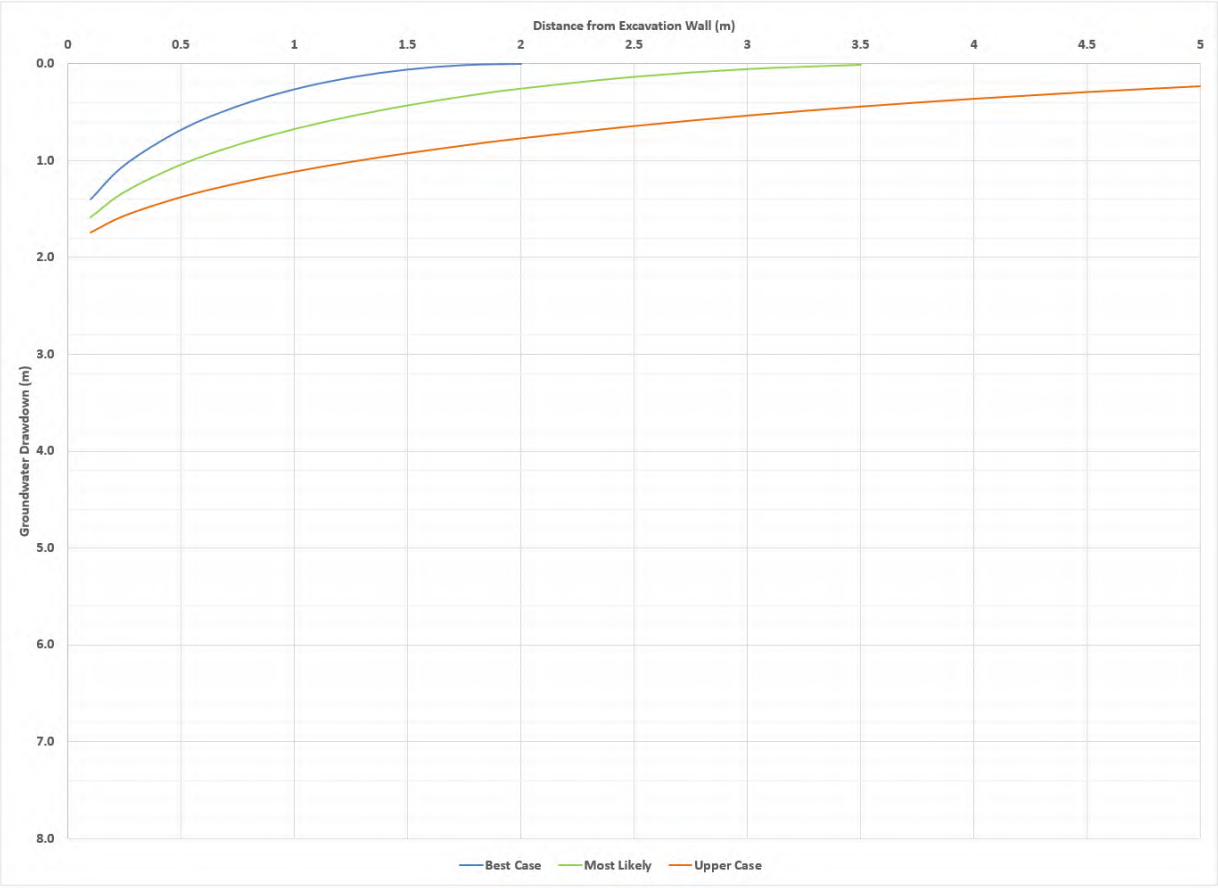
PERIOD	PREDICTED GROUNDWATER TAKE
Maximum Potential Annual Take During Construction (includes groundwater inflows and matrix removals for the primary and lower basements over a 12-month period)	**0.45 ML**
Post Construction – Long Term Groundwater Inflow (Steady-state groundwater inflows from permanent/ongoing Drained Basement Design for both basements)	**0.32 ML/year**

It is noted that the predicted groundwater takes detailed in Table 16 above are considered conservative in nature given the basement excavation footprint for the primary basement was determined from the outline of the entire basement (i.e., includes the non-basement area between Building B and Building E) and the groundwater take modelled for the lower basement includes groundwater already accounted for in the primary basement analytical model.

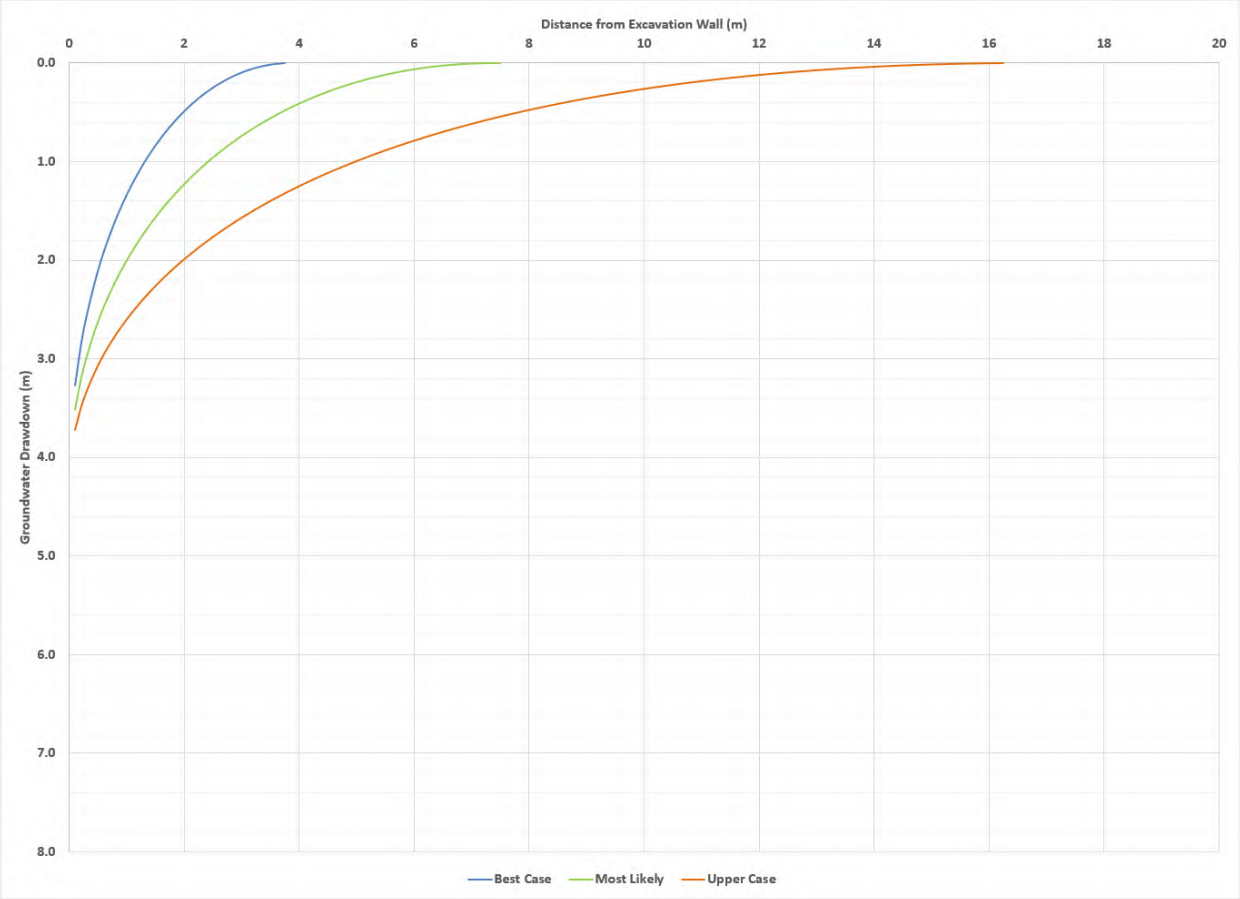
Based on the predicted groundwater extraction volumes, it is the opinion of Reditus that the proposed basement could be effectively constructed and managed under a drained based design.

6.7.4 PREDICTION OF DRAWDOWN DISTANCE

As part of the dewatering assessment, the extent of groundwater drawdown was estimated at regular distance intervals from the edge of the circular disk sinks (approximate excavation edge) and at the nearest neighbouring building (Primary basement ~1.5 m, Lower basement >30 m). The estimated drawdown at distance from the excavation/basement walls have been provided in **Graph 3 and Graph 4** below.



Graph 3. Extent of Drawdown from Basement/Excavation Wall – Primary Basement



Graph 4. Extent of Drawdown from Basement/Excavation Wall – Lower Basement

It is the professional experience of Reditus that the groundwater levels in fractured Bringelly Shale in the Sydney region can vary naturally by ±4 m or more during prolonged periods of dry or wet weather. Accordingly, a temporary drop in the water table of 1 m or less is considered unlikely to result in off-site geotechnical settlement impacts, particularly within rock.

There is potential that drawdown outside the site may be sufficient to induce settlement in overlying buildings unless an appropriate Dewatering Management Plan (DMP) is implemented. 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.

If drawdown approaching 1.0 m is identified in the monitoring points outside the excavation shoring walls, consideration should be given to control the off-site water table depression, in consultation with a geotechnical and structural engineer. This is likely to have in implication on the costs of the project but is recommended in order to reduce the risk of damage to adjacent buildings and roadways (refer to **Section 10 and 11**).

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 (refer to **Section 11 and 13)** to ensure that local variations in hydraulic properties in the aquifer do not result in unacceptable groundwater table depression.

7 Legislation, Regulation and Relevant Endorsed Guidelines

To facilitate the construction and basement dewatering, in relation to impacts of groundwater resources and the surrounding environment, the following statutory requirements need to be achieved to address the WaterNSW regulations.

The majority of NSW groundwater is covered by statutory Water Sharing Plans and the *NSW Aquifer Interference Policy*. In the absence of a relevant Water Sharing Plan, groundwater is regulated under the Water Act 1912.

Given that groundwater will be incepted and dewatered as part of the development, the proposed development is considered to be an aquifer inference activity requiring authorisation from WaterNSW under either the WM Act and/or the Water Act 1912.

7.1 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.

7.2 Protection of the Environment Operations (POEO) Act 1997

The POEO Act 1997 and its associated schedules and regulations are directly relevant to dewatering operations. 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 **Table 20** to the stormwater and where any unacceptable impact to the receiving waters is identified).

7.3 NSW Water Quality Objectives (2006)

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).
- A range of water quality indicators to help us assess whether the current condition of our waterways supports those values and uses.

The site is located within the 'Georges River' catchment area. The water quality objectives of the Georges River Catchment and estuaries include aquatic ecosystems, visual amenity, secondary contact recreation, primary contact recreation and aquatic food (cooked).

7.4 Canterbury-Bankstown Council – Dewatering Discharge Approval/Permit

A permit from Council is required for any dewatering of groundwater.

Council require groundwater/tailwater 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.

Council typically requires that the Principal Contractor provide a copy of the DMP to Council prior to commencing discharge of groundwater from site.

Council are required to provide 'written approval' (usually in the form of a permit) as part of "Application for approval for water supply works, and/or water use" with the WaterNSW prior to discharge of the treated groundwater to the stormwater network.

7.5 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 WM Act, which includes regulation of all aquifer interference activities within Water Sharing Plan management areas. WaterNSW also are responsible for Water Supply 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 WM Act, 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.

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.
- A Dewatering Management Plan, 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 Sources (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 Water Access Licence (WAL).

7.5.1 WATER SHARING PLANS (WSPS)

WSPs are being progressively developed for rivers and groundwater systems across NSW following the introduction of the Water Management Act 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 Sources (2023) – Sydney Basin Central Groundwater Source.

7.5.2 WATER SHARING PLAN FOR THE GREATER METROPOLITAN REGION GROUNDWATER SOURCES (2023) – SYDNEY BASIN CENTRAL GROUNDWATER SOURCE

The Sydney Basin Central Groundwater Source is bounded by the main arm of the Hawkesbury River to the north and by the Nepean River to the west and south. Much of Sydney's population is within this groundwater source (with a total area of 3,757.59 km^2), and bores are evenly distributed across the area. The geology consists of sedimentary sandstone and siltstone formations with intervening coal seams.

The Sydney Basin is an elongate structural sedimentary basin consisting of Carboniferous to Triassic age rocks. The Basin is geologically bounded by fractured rocks of the Lachlan Fold Belt to the west and New England Fold Belt to the east.

Private bore yields are typically low at around 0.1–1 L/s but higher bore yields up to 20 L/s are associated with fracture zones which allow for improved groundwater flow. Extraction is often self-regulating with yields being limited by the connection between fractures in the rock. In many cases a bore will be pumped dry before any significant impact can be seen on dependent ecosystems or other water users.

The Sydney Basin Central Groundwater Source is recharged primarily from rainfall. The valley floors with overlying Quaternary alluvium are areas for groundwater discharge with water levels within monitoring bores observed to be sub-artesian to artesian.

The long-term average annual extraction limit (LTAAEL) is 45,915 ML/yr. There was 91% (41,783 ML/yr) unassigned volume of water from the Sydney Basin Central management area based on the 2020-2021 entitlements.

7.6 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 removed from at least one aquifer. Accordingly, groundwater licensing may be required.

7.6.1 LICENCING 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.

7.7 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 2017).

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 highly urbanised environment). In the absence of ANZG (2018) DGVs, the ANZECC (2000) trigger values (TVs) were adopted.

The DMP will need to be revised if changes to the DGVs occur. If this change occurs during the current proposed dewatering period, this is to be reflected in a revised DMP.

There are currently no endorsed water quality guideline values in NSW for secondary contact which may occur during recreational activities. Reditus notes that the health-based drinking water guidelines criteria (NHMRC 2017) were derived based on the long-term consumption of 2 L/day of the water. Incidental ingestion of water from Prospect Creek and Georges River during recreational activities unlikely to exceed more than 50 mL/day, which is equivalent to approximately two mouthfuls of water. For conservatism, the greater of the health-based drinking water criteria or the aesthetic criteria (NHMRC 2017) multiplied by ten (10) has been chosen to address the secondary contact recreational uses of water. This factor of ten (10) is considered conservative as it is equivalent to long-term ingestion of 200 mL/day of water.

8 Groundwater Impact Assessment

8.1 Minimal Impact Considerations

The WM ACT 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 WM ACT, the Water Act 1912 and those decided under other legislation. The NSW DPE (2022) 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.

Thresholds for minimal impact considerations have been developed for each groundwater source in NSW within the *NSW Aquifer Interference Policy*, Table 1 – Minimal Impact Considerations for Aquifer Interference Activities and are categorised into type of groundwater sources, presented in **Table 17** below. The thresholds relate to impacts on groundwater table and pressure, and to groundwater and surface water quality.

Table 17. Highly and Less Productive Groundwater Source Types

HIGHLY PRODUCTIVE	LESS PRODUCTIVE
• Alluvial • Coastal Sands • Porous Rock – Great Artesian Basin - Eastern Recharge and Southern Recharge; – Great Artesian Basin – Surat, Warrego and Central – other porous rock • Fractured Rock	• Alluvial • **Porous and Fractured Rock**

The proposed development is considered to be located in a 'Less Productive' groundwater source as yields are less than 5 L/s and salinity >1,500 mg/L.

An assessment of the 'Minimal Impact Considerations' is provided in **Table 18** below, with primary reference to the NSW DPE (2023) *Groundwater impact assessment criteria*.

Table 18. NSW DPE (2023) *Groundwater Impact Assessment Criteria*

AQUIFER GROUNDWATER SOURCE	Porous and fractured rock groundwater sources, excluding all GAB groundwater sources
CATEGORY	Semi-Confined/Confined System (Less Productive)
IMPACT ASSESSMENT CRITERIA	**1.** 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.** a distance of 200 metres from any production water supply works including the applicant's bores (e.g., bores on an approval linked to an access licence). **b.** any other water supply work (i.e., at any basic landholder rights bores). **2.** Additional drawdown over a ten-year period cannot exceed 10% of the *Total Available Drawdown* to a maximum of 3 metres at any 3rd-party water supply works.
ASSESSMENT RESULTS	There are no registered groundwater supply bores within a 500 m radius of the site. **Additionally, given the predicted drawdown radius of influence for the 'Most Likely' scenario is <10 m, the dewatering works are very unlikely to exceed the cumulative or additional drawdown impact assessment criteria at any third-party water supply works.**

Additionally, it is noted that no groundwater dependant ecosystems (GDEs), culturally significant sites, third order or higher streams, or vegetation GDEs (i.e., HEVAE) have been identified within a 500 m radius of the site.

Based on the above assessment, the dewatering activities are considered to be of **Minimal Impact** under the NSW DPE (2022) *Groundwater impact assessment criteria*, *NSW Aquifer Interference Policy* and WM ACT.

8.2 WSP Rules for Water Access Approval

A summary of the water sharing rules for granting of access licences (as detailed within the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023 – Sydney Basin Central Groundwater Source), compared against the results of the above assessment, are presented **Table 19** below. Reditus note that the following rules are used as a guide only and actual approval conditions are granted at the discretion of the Department.

Table 19. Summary of Water Access Rules and Findings of Assessment

RELEVANT WSP RULE	ASSESSMENT
Granting of access licences may be considered for the following: • Local water utility, major water utility, domestic and stock and town water supply. • Commercial access licences under a controlled allocation order made in relation to any unassigned water in this water source.	The dewatering works for the development are not specified but may be considered as under a Commercial access licence conditions.

RELEVANT WSP RULE	ASSESSMENT
To minimise interference between neighbouring water supply works, no water supply works to be granted or amended within the following distances of existing bores: • 400 m from an aquifer access licence bore on another landholding, or • 100 m from a basic landholder rights bore on another landholding, or • 50 m from a property boundary (unless written consent from neighbour), or • 1,000 m from a local or major water utility bore, or • 200 m from a Department monitoring bore (unless written consent from NSW Office of Water). *The plan lists circumstances in which these distance rules may be varied and exemptions from these rules.*	There are no registered groundwater supply bores within a 1 km radius of the site. Written consent may be required from neighbouring properties as the dewatering will occur adjoining the site boundary.
To protect bores located near contamination, no water supply works are to be granted or amended within: • 250 m from the edge of a plume of a contamination source. • 250 m and 500 m from the edge of a plume associated with a contamination source, unless no drawdown or water will occur within 250 m of the plume. • 250 m of an onsite sewage disposal system unless the water supply work is: – Constructed with cement grout in the borehole annulus to a minimum depth of 20 m from the ground surface. – Located at sufficient distance from the on-site sewage disposal system to prevent migration of septic contamination in the aquifer. *The plan lists circumstances in which these distance rules may be varied and exemptions from these rules*	One notified site (149 Orchard Road Chester Hill) that is currently regulated under the CLM Act is located approximately 100 m south of the site. However, given that the notified site is located topographically and hydraulically down-gradient from the development site and the maximum predicted drawdown radius of influence resulting from the proposed basement excavation under the 'upper-case' scenario is 16 m, the contaminated site is not considered to be a risk to the proposed basement excavations and dewatering activity Given the site location within metropolitan Sydney, onsite sewage disposals systems within 250 m of the site are unlikely.
To protect bores located near sensitive environmental areas, no water supply works (bores) to be granted or amended within the following distances of high priority Groundwater Dependent Ecosystems (GDEs) as identified within the plan: • Waterfront land • 100 m of the top of an escarpment • 200 m of any high-priority, groundwater dependant ecosystem • 200 m of a coastal wetland • 500 m of a Karst environment *The plan lists circumstances in which these distance rules may be varied and exemptions from these rules.*	Based on a review of the WSP, there are no high priority Groundwater Dependent Ecosystems (GDEs) within a 1.0 km radius of the site.

RELEVANT WSP RULE	ASSESSMENT
Rules for bores located near potential acid sulfate soils: New bore cannot be constructed in an area classed as having a high probability of the occurrence of acid sulfate soils if there is a significant risk of acidification of the groundwater source.	Review of the Liverpool Acid Sulfate Soil Risk Map (Murphy, 1997) shows the site is located in area of "No known occurrence of acid sulfate soil materials", where acid sulfate soils are not known or expected to occur in these environments. The Canterbury-Bankstown Local Environmental Plan 2023 also indicates that the site is not located in an area of known acid sulfate soil risk.
To protect groundwater dependent culturally significant sites, no water supply works to be granted or amended within the following distances of groundwater dependent cultural significant sites as identified within the plan: • New works are not permitted within 200 m of groundwater-dependant, culturally significant sites. *The plan lists circumstances in which these distance rules may be varied and exemptions from these rules.*	Based on a review of the WSP, there are no groundwater dependent cultural significant sites within 200 m of the site.
Available Water Determinations (AWDs): • 100% stock and domestic, local and major utilities and specific purpose access licences • 1ML/unit of share aquifer access licences *AWD for aquifer access licences may be reduced in response to a growth in use.*	In accordance with WaterNSW exemptions, A Water Access Licence would not be required for 0.45 ML/yr of groundwater take from the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023 – Sydney Basin Central Groundwater Source.
Trading Rules • INTO groundwater source: Not permitted. • WITHIN groundwater source: Permitted. • Conversion to another category of access licence: Not permitted.	

Based on the above, the proposed dewatering works generally complies with the general rules for granting of a water access licence under the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023 – Sydney Basin Central Groundwater Source.

9 Water Quality Objectives

9.1 Receiving Environment

The site is situated within a highly urbanised residential and commercial/industrial area. The extracted groundwater will likely be treated and discharged to the stormwater network via connection to an approved location by Council (dewatering contactor to confirm exact location).

Based on the local topography, the receiving waters of the stormwater network are understood to be Prospect Creek and Georges River, located to the southwest of the site.

The Prospect Creek and Georges River are considered to be a moderately disturbed ecosystem, which receives water from a highly urbanised environment, including multiple waste streams. Use of the ANZG (2018) 95% protection level for ecological receptors has been adopted on this basis.

9.2 Adopted Discharge Water Quality Guidelines

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) provide detailed approaches and advice on identifying appropriate guideline values for the protection of environmental receptors. These guideline values help to ensure that agreed community values and their management goals are protected.

The ANZG (2018) have been endorsed by the NSW EPA, which supersede the previous ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Applying the ANZECC (2000) guidelines to the range of community values relied largely on a single line of evidence (chemical assessment) to determine whether or not a guideline value was exceeded. The ANZG (2018) Water Quality Guidelines improve confidence in our assessments by:

- Introducing a systematic approach to assessing a number of lines of evidence along the pressure–stressor–ecosystem receptors pathway.
- Promoting decisions on the basis of the integrated weight of evidence.

For the protection of aquatic ecosystems, locally derived guideline values are most appropriate. In the absence of locally derived guideline values or other jurisdictionally-legislated requirements (as in this case), the ANZG (2018) provide default guideline values (DGVs) for assessing the impacts of physio-chemical parameters and potential toxicants on aquatic ecosystems, as well as advice on tailoring DGVs to suit the local region. Where DGVs are not available within the ANZG (2018), the ANZECC (2000) guidelines trigger values (TVs) are adopted.

It is specifically noted in the ANZG (2018) guidelines that "the Water Quality Guidelines are not intended to directly apply to contaminant concentrations in industrial discharges or stormwater quality (unless stormwater systems are regarded as having relevant community value)".

The ANZG (2018) provides guidance on assessing a waste discharge. The ANZG (2018) Water Quality Management Framework and associated monitoring data can be used to assess compliance or potential impacts of a waste discharge on water quality. Assessing a waste discharge in this way aims to ensure that it complies with the conditions of approval and is not causing environmental harm. The Water Quality Management Framework provides a step-by-step approach to protect the community values of waterways.

9.2.1 WATER QUALITY MANAGEMENT FRAMEWORK

The Water Quality Management Frameworks has the following steps which will be adopted as part of this DMP:

- **Step 1: Examine current understanding**
  - Use current understanding to develop or refine a conceptual model of key waterway processes and how the waste discharge could affect local waterways.
  - Site-specific information on the operation and receiving environment (e.g., current water quality and temporal and spatial release characteristics of the discharge, mixing zones and regulatory compliance points, water quality and ecology of the receiving environment).
  - As further monitoring data become available, update and refine the current understanding.

- **Step 2: Define community values and management goals**
  - Establish or refine community values and more specific management goals (including level of protection) for the relevant waterways at stakeholder involvement workshops.
  - The relevant values adopted are the 95% protection level of fresh and marine ecosystems and recreational use.
- **Step 3: Define relevant indicators**
  - Select indicators for relevant pressures identified for the system, the associated stressors and the anticipated ecosystem receptors.
  - Based on previous groundwater quality information, the analytical suite detailed in **Section 4.4** has been adopted as primary indicators. Other indicators include visual inspection at the discharge point of the stormwater into Prospect Creek for any signs of potential adverse effects (e.g., turbidity, increased algae presence, discolouration).
- **Step 4: Determine water quality guideline values**
  - Determine the water quality guideline values for each of the relevant the biological, chemical and physical indicators required to provide the desired level of protection for the management goals of relevant waterways.
  - The DMP adopts the ANZG (2018) DGVs and the ANZECC (2000) TVs in the absence of DGVs. Results of monitoring data from the stormwater drain and Prospect Creek will also be used for the assessment to determine if adverse environmental impact are occurring from groundwater discharge.
- **Step 5: Define draft water quality objectives**
  - Use the guideline values or narrative statements chosen for each selected indicator as draft water quality objectives to ensure the protection of all identified community values and their management goals.
- **Step 6: Assess if draft water quality objectives are met**
  - Use measurements from monitoring of each relevant indicator to assess whether current water quality meets the draft water quality objectives.
  - This includes comparison of the water quality monitoring data for each relevant indicator with the water quality objectives, together with the evidence from any additional lines of evidence (such as results from at the edge of the mixing zone).
  - The weight-of-evidence process evaluates results from multiple lines of evidence across the pressures, stressors and ecosystem receptors relevant to the waste discharge. It is the key process by which the protection of community values is assessed. Multiple potential outcomes are possible from a weight-of-evidence evaluation. The resulting evaluation of water quality results will be used to determine if adverse trends are evident as a result of the discharge of groundwater to stormwater.
  - If the Water Quality Objectives are met, then management should focus on maintaining discharge quality. If Water Quality Objectives are not met and potential adverse trends are evident, the following options will be considered:
    - Formulate, assess, and prioritise management strategies to improve existing water quality associated with the waste discharge (Steps 8 to 10), and/or
    - Reassess the appropriateness of the water quality guideline values (Step 7), and/or
    - Consider selection of additional or alternative indicators or lines of evidence (Step 7).
- **Step 7: Consider additional indicators or refine water quality objectives**
  - Assess the need to revise or add to the lines of evidence or indicators and the water quality guideline values.
- **Step 8: Consider alternative management strategies**
  - Evaluate the effectiveness of current management strategies to address the identified water quality issues and recommend possible improvements. Improved or alternative management strategies are formulated, assessed and prioritised.
- **Step 9: Assess if water quality objectives are achievable**
  - Use information gained from Steps 6 to 8 to assess whether the water quality objectives are achievable.

- **Step 10: Implement agreed management strategy**
  - Document and implement agreed management strategies, including, in some cases, a suitable and agreed adaptive management framework.

This DMP details the current management strategy to be implemented.

9.2.2 ANZG (2018) PHYSICAL AND CHEMICAL STRESSOR DETAILS

As noted above, there are two types of physical and chemical stressors that directly affect aquatic ecosystems that can be distinguished: those that are directly toxic to biota, and those that, while not directly toxic, can result in adverse changes to the ecosystem (e.g., algae blooms). In the absence of site-specific guideline values, the following DGVs were adopted as water quality assessment criteria in order to assess this situation:

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

The adopted DGV criteria are protective of receptors at the point of exposure (i.e., stormwater drain, Prospect Creek, and Georges River), and are overly conservative for the assessment of direct discharge water quality in areas where ecological receptors are not present (i.e. Site discharge into stormwater drains). On this basis, Prospect Creek and Georges River waters are considered the only receiving environment requiring protection. Reditus notes that the use of the DGVs is conservative and may not represent the Prospect Creek/Georges River local system.

Since the publication of ANZECC (2000), an Errata document (Department of Agriculture, Fisheries and Forestry) has been issued which details that Nitrate values in Table 3.4.1 (page 3.4-5) are deleted and replaced with "Under Review". Furthermore, Nitrate guidelines values in ANZECC 2000 have been reviewed and recalculated[3], the recalculated trigger value for 95% level of protection was 2.4 mg/L for Nitrate-N.

It is important to note that the Draft Water Quality Objectives (WQO) listed below are specific to aquatic ecosystems only and are not intended as discharge water quality criteria. The adopted guidelines contain information on the comparison of test data with guideline DGVs & TVs. It emphasises that exceedances of the DGVs and TVs are an early warning mechanism to alert managers of a potential problem and are not intended to be an instrument to assess compliance and should not be used in this capacity.

The guidelines recognise that the environmental values and unique conditions of a site and specific behaviour of contaminants in different environments are important considerations when applying the guidelines. Factors relevant to assessing point source discharges include the flow rote of the discharge, receiving water flows and/or intensity of tidal exchange, and the levels of risk that vary from acute to chronic exposure.

Mixing zones are a tool for responsible management of the environment. As detailed within the ANZG (2018), mixing zone are described as an explicitly defined area around an effluent discharge where some, or all, water quality objectives may not be met. It is a generally accepted practice to apply the concept of a mixing zone for waste water discharges (such as stormwater). As a consequence, some community values of the water body may not be protected. The responsibility lies with the discharger to minimise this impact by keeping the mixing zone as small as practicable. They are designed to limit the impact to the environment that would otherwise occur if discharges were allowed to flow unchecked into waterways.

Critical to assessing the impact of an effluent discharge on beneficial uses and values is understanding the dilution and dispersion of the effluent. For discharges to marine environments, characteristics such as tidal and current movements, density and temperature differences, depth of water and rate of flow need to be considered to assess the dilution capabilities of the waterbody under various scenarios.

9.2.3 RECREATIONAL WATER QUALITY (NHMRC 2012 & 2017)

The greater of the health based drinking water criteria (NHMRC 2012) multiplied by ten or the aesthetic criteria have been chosen to address the primary and secondary contact recreational uses of water.

[3] https://envirolink.govt.nz/assets/Envirolink/1207-ESRC255-Updating-nitrate-toxcity-effects-on-freshwater-aquatic-species-.pdf

9.3 Draft Water Quality Objectives – DGVs

A summary of the discharge water quality criteria is provided in **Table 20** below for the water quality parameters and chemical of concern, which have been selected on the basis of site operational history, regional setting and site groundwater quality.

It is important to note that the Water Quality Objectives (WQO) listed in **Table 20** below are specific to aquatic ecosystems only and are not intended as discharge water quality criteria. The ANZG (2018) framework emphasises that comparison of test data with guideline DGVs that 'exceedances of the DGVs are an "early warning" mechanism to alert managers of a potential problem and are not intended to be an instrument to assess "compliance" and should not be used in this capacity.

ANZG (2018) recognises that the environmental values and unique conditions of a site and specific behaviour of contaminants in different environments are important considerations when applying the guidelines. Factors relevant to assessing point source discharges include the flow rate of the discharge, receiving water flows and/or intensity of tidal exchange, and the levels of risk that vary from acute to chronic exposure.

Table 20. Draft Water Quality Objectives - DGVs

ANALYTE GROUP	ANALYTE	ANZG (2018) 95% MARINE WATER QUALITY GUIDELINES (ug/L)	RECREATIONAL WATER QUALITY CRITERIA (ug/L)
BTEX	Benzene	700	1,000
	Ethylbenzene	80	3,000
	Toluene	180	8,000
	Xylene (m)	-	6,000
	Xylene (p)	-	
	Xylene (o)	-	
Heavy Metals	Arsenic	-	50
	Cadmium	5.5	5
	Chromium (VI)	4.4	50
	Copper	1.3	1,000
	Nickel	70	200
	Lead	4.4	50
	Zinc	8	5,000
	Mercury	0.4	10

ANALYTE GROUP	ANALYTE	ANZG (2018) 95% MARINE WATER QUALITY GUIDELINES (ug/L)	RECREATIONAL WATER QUALITY CRITERIA (ug/L)
PAHs	Phenanthrene	2	-
	Anthracene	0.4	-
	Flouranthane	1.4	-
	Benzo(a)Pyrene	0.2	0.1
	Naphthalene	70	-
Pesticides	Atrazine	13	200
	Carbofuran	0.06	100
	Chlorodane	0.03	20
	Chlorpyrifos	0.009	100
	2,4-D	280	300
	DDT	0.006	90
	Diazinon	0.01	40
	Dimethoate	0.15	70
	Diquat	1.4	70
	Endosulfan	0.005	200
	Endrin	0.04	-
	Fenitrothion	0.2	70
	Glyphosate	370	1,000
	Heptachlor	0.01	-
	Lindane	0.2	100
	Malathion	0.05	700

ANALYTE GROUP	ANALYTE	ANZG (2018) 95% MARINE WATER QUALITY GUIDELINES (ug/L)	RECREATIONAL WATER QUALITY CRITERIA (ug/L)
	Methomyl	3.5	200
	Molinate	3.4	40
	Parathion	0.004	200
	Simazine	3.2	200
	2,4,5-T	36	1,000
	Tebuthiuron	2.2	-
	Temephos	0.05	4,000
	Thibencarb	2.8	400
	Thiram	0.01	70
	Toxafene	0.1	-
	Trifluralin	2.6	900
PCBs	Aroclor 1242	0.3	-
	Aroclor 1254	0.01	-
VOCs	1,1-DCA	90	-
	1,2-DCA	1,900	30
	1,1,1-TCA	270	-
	1,1,2-TCA	1,900	-
	1,1,2,2-TCA	400	-
	PCA	80	-
	DCM	4,000	40
	Chloroform	370	30

ANALYTE GROUP	ANALYTE	ANZG (2018) 95% MARINE WATER QUALITY GUIDELINES (ug/L)	RECREATIONAL WATER QUALITY CRITERIA (ug/L)
	Carbon Tetrachloride	240	30
	Vinyl Chloride	100	3
	DCE	700	600
	TCE	330	-
	PCE	70	500
	CB	55	100
	1,2-DCB	160	10
	1,3-DCB	260	200
	1,4-DCB	60	3
	1,2,3-TCB	3	50
	1,2,4-TCB	20	
	1,3,4-TCB	8	-
	1,2,3,4-PCB	2	-
	1,2,3,5-PCB	3	-
	1,2,4,5-PCB	5	-
	PCB	1.5	-
Total Petroleum Hydrocarbons	TPH/TRH	2 (mg/L) [a]	-
Total Nitrogen	Total Nitrogen	300 [b]	-
Nitrate	Nitrate	2,400 [c]	500,000
Total Phosphorus	Total Phosphorus	30 [b]	-
Ammonia	Ammonia	910 (pH dependant)	5,000

ANALYTE GROUP	ANALYTE	ANZG (2018) 95% MARINE WATER QUALITY GUIDELINES (ug/L)	RECREATIONAL WATER QUALITY CRITERIA (ug/L)
pH	pH	7.0-8.0 [b]	6.5-8.5
Total Suspended Solids	TSS	50,000	-
Turbidity	Turbidity	10 NTU	5 NTU
Temperature	Temperature	15-30 °C	-
Sheens/Odours	Sheens/Odours	No Observable Sheen or Odour	-

a - Recommended water quality criteria (NSW EPA).

b - ANZECC (2000) Default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems for Estuaries (Table 3.3.2 Chapter 3 Aquatic Ecosystems).

c - Errata document has been issued which details that Nitrate values in Table 3.4.1 (page 3.4-5) are deleted and replaced with "Under Review" (Department of Agriculture, Fisheries and Forestry). The Nitrate guidelines values in ANZG (2018) have been reviewed and recalculated[4] with the value for 95% level of protection reported at 2.4mg/L for Nitrate-N.

Analytes such as Total Suspended Solids (TSS) and other easily observable aspects from the dewatering process will need to monitored closely as adverse public interest in this site is a foreseeable possibility. Which includes the following water quality objectives:

- Total suspended solids (TSS) < 50 mg/L
- No observable sheen or odour
- Turbidity < 10 NTU
- Temperature < 30˚C

[4] https://envirolink.govt.nz/assets/Envirolink/1207-ESRC255-Updating-nitrate-toxcity-effects-on-freshwater-aquatic-species-.pdf

10 Potential Dewatering Impacts

Dewatering operations have the potential to impact receptors and the surrounding environment if not managed appropriately. This section outlines key areas of concern with respect to dewatering and potential environmental impacts.

Procedures for the management of potential environmental impacts are detailed in **Section 11**.

10.1 Receiving Water Quality

Typically, large volume and/or well flushed water bodies have a capacity to buffer the discharge of potential contaminants depending on the flow rate and duration of discharge. While the receiving waters are subject to the influences of an urbanised catchment, dewatering activities must not contribute to or cause significant decreases in receiving waters quality. Potential impacts associated with releasing dewatered groundwater to receiving waters (via the stormwater network) are summarised below.

10.1.1 PHYSICOCHEMICAL PARAMETERS

Changes to natural pH levels in a receiving waterway can be directly or indirectly detrimental to aquatic biota as particular species can be intolerant to specific conditions caused by dewatering processes.

Acidifying the receiving waters can cause metals bound to sediment and organic matter to be liberated, increasing toxicity, and enhancing the bioavailability of background metals. Oxidation of dissolved metals can also strip oxygen from the receiving waters resulting in fish kills, however this is less likely in medium to high flow systems such as Georges River and ultimately Botany Bay.

Turbidity and suspended solids impact on a receiving environment include siltation, reduction of the euphotic zone affecting photosynthetic organisms by limiting light transmission through the water column, this has a flow on effect as the food chain is disrupted affecting benthic organisms and higher level organisms.

10.1.2 NUTRIENTS

Streams/rivers, canals and coastal lakes environments have the ability to assimilate and export nutrients (such as nitrogen and phosphorus) through a variety of pathways including flushing, bacterial conversion and permanent accumulation in sediments. Under favourable conditions these cycles can help buffer the receiving environment from potentially deleterious effects of nutrient loading. These effects can include eutrophication, potentially toxic algal blooms, increased oxygen demand and ammonia toxicity.

While the buffering ability of the receiving environment should not be relied upon as a management strategy, the efficiency of a particular water body to process nutrients is an important consideration in assessing the potential impacts of eutrophication of a water body.

10.1.3 HEAVY METALS

High concentrations of potentially harmful metals may be encountered in the groundwater depending on geology and historical uses of the site (and surrounding properties).

Whilst metals and associated compounds occur naturally in the environment and are essential for many organisms, the potential toxicity of metals to aquatic biota generally increases with concentration, particularly when in dissolved form. Furthermore, concentrations of dissolved metals may fluctuate throughout dewatering as water is drawn in from surrounding environments.

Metal toxicity also varies between different species of a particular metal, the physical and chemical characteristics of the receiving environment, and biological receptors. Thus, the size, tidal/mixing/flushing regime, and background concentrations of metals in the receiving waterway must be taken into account when assessing compliance.

Importantly, the total load and duration of metals discharged also needs to be considered when assessing potential chronic effects of metals on biota, though this is less crucial in deeper water with strong tidal interaction where the risk of accumulation is minimised.

10.1.4 PETROLEUM HYDROCARBONS AND CHLORINATED SOLVENTS

The majority of the site has primarily been used for residential purposes (aged care facility). The southeast portion of the site is noted to have contained a former service station (140 Campbell Hill Road, Lots 6 & 7 DP 30305), which included a number of underground storage tanks (USTs). However, groundwater sample analytical results reported no exceedances or detections above the laboratory limit of reporting (LOR) in any of the groundwater samples collected from the onsite groundwater monitoring wells on 7 June 2023 for TRH/TRP (see **Section 4.4**).

Research indicates that petroleum hydrocarbons toxicity is highly variable, as they contain many hydrocarbon chain compounds. Generally, petroleum hydrocarbon based compounds can naturally biodegrade given the right conditions and generally degrade to lesser toxic substances.

The chemical degradation products of the potential VOC contaminants in groundwater, specifically chlorinated hydrocarbons including tetrachloroethene (PCE) and degradation daughter products trichloroethene (TCE), dichloroethene (DCE) and vinyl chloride (VC) can be of greater ecological and human health risk than the parent compounds and are therefore considered to be significant.

Whilst not currently required based on recent analytical results, TRH and VOC compounds may require treatment prior to discharge, which can be achieved via several methods. The treatment system may consist of a single remediation method, such as air stripping or filtered through activated carbon (sorption) to remediate the water to a suitable standard for disposal or re-injection.

10.1.5 OTHER CONTAMINANTS

Other hydrocarbon contamination (PAHs and Phenols) and other common anthropogenic contaminants (OCPs, OPPs and PCBs) have not been identified exceeding the adopted ecological criteria within the localised groundwater.

Whilst these contaminants are not expected to be present at elevated concentrations during the dewatering process (based on the most recent groundwater quality data), historical use of pesticides and other chemicals are known in the surrounding area. As such, monitoring of these compounds (as identified in previous environmental investigations) is strongly recommended.

10.2 Settlement of Unconsolidated Soils

Dewatering has the potential to induce settlement in loose sands and soft sediments, possibly compromising the structural integrity of surrounding structures. This is likely to be lessor of an issue with water bearing rock aquifers, as in the case of the proposed development within a fractured shale/siltstone aquifer.

There is potential that drawdown outside the site may be sufficient to induce settlement in overlying buildings unless an appropriate DMP is implemented. A suitability qualified geotechnical consultant will be required to determine the potential settlement impacts caused by the potential drawdown because of the proposed dewatering activities. Detailed geotechnical considerations are beyond the scope of this assessment.

A suitably qualified engineer is required to determine the risk of settlement, potential impacts on the integrity of adjacent structures (i.e., buildings, roads, pipelines, etc.), and appropriate management measures.

10.3 Acid Sulphate Soils

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

Review of the Liverpool Acid Sulfate Soil Risk Map (Murphy, 1997) shows the site is located in area of “No known occurrence of acid sulfate soil materials”, where acid sulfate soils are not known or expected to occur in these environments.

The Canterbury-Bankstown Local Environmental Plan 2023 also indicates that the site is not located in an area of known acid sulfate soil risk.

Based on the above, the proposed development and associated groundwater dewatering will unlikely pose an unacceptable risk in regard to the generation and associated impacts due to acid sulfate soils.

10.4 Impact to Water Supply Works and GDEs

As detailed in **Section 8** above, the basement dewatering works will not adversely impact on any water supply works, high priority GDEs, and is not expected to result in a change to water quality.

Based on the above assessment, the basement dewatering activities are considered to be of **Minimal Impact** under the NSW DPE (2022) Groundwater impact assessment criteria, NSW DPI (2012) AIP, and WM ACT.

10.5 Noise, Vibration and Odour

Noise and vibrations are generated by pumps, generators and treatment systems which typically operate 24 hours a day during dewatering operations. Offensive odours, such as hydrogen sulphide can also be liberated through excavation of sand and or soils with high organic content. Other odours from volatile organic compounds can occur from sites contaminated with petroleum hydrocarbons or solvents. It is also common for diesel fumes to emanate from dewatering pumps and generators where electric systems cannot be used.

Noise, vibrations and odour have the potential to cause a public nuisance, particularly in dense residential areas such as the site, and may also impact on the natural movements or behaviour of wildlife.

11 Management of Potential Impacts

11.1 Drawdown

The depth of groundwater extraction infrastructure and the rate of extraction shall be limited to the minimum requirements set in the hydrogeological model to achieve the lowering of groundwater within the site to undertake construction works and implement a drained basement.

Dewatering shall be managed in consultation with a suitably qualified environmental and geotechnical engineer to ensure the structural integrity as built structures is not compromised.

Whilst 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 to ensure that local variations in hydraulic properties do not result in unacceptable groundwater table depression or mounding.

Monitoring of groundwater levels outside the basement wall at a minimum of three locations is recommended on a daily basis (refer to Section 13 for further details).

If drawdown approaching 1.0 m is identified in the monitoring points outside the shoring wall or near existing buildings, geotechnical and structural engineering advise should be sought, and consideration should be given to control of the off-site water table depression (if deemed required). This is likely to have in implication on the costs of the project but may be recommended in order to reduce the risk of damage to adjacent buildings and roadways.

11.2 Discharge of Groundwater

Groundwater discharge shall be controlled in a manner which does not create a flooding hazard. The rate of groundwater extraction will be highly dependent on the required time frame for excavation works and can be varied to match excavation depth speed and/or discharge restrictions (if any).

An average groundwater extraction and discharge rate of <0.01 L/s is expected to be maintained to keep each excavation and basement free of water.

During extreme rainfall/storm/tide events the local stormwater drainage system can become full or flooded. If combined stormwater and dewatering flows exceed the capacity of the stormwater drainage system, discharge shall be reduced or, if necessary, stopped until stormwater flows, and/or tidal inundation subsides. Routine inspections at the stormwater inlet will need to be conducted by the Site Manager or on appropriate delegate during storm events and greater than average tides.

The flowing sections may be required during the dewatering process if deemed necessary by the licencing provider and Council.

11.2.1 WATER QUALITY TESTING PRIOR TO DISCHARGE

Prior to discharge of extracted groundwater, the groundwater will be recirculated back into the open excavation or temporary onsite water storage to allow clearing of sediment from the dewatering system and allow water quality to stabilised. Once conditions have stabilised, initial batch testing of extracted water will be completed and compared against the WQO listed in **Table 20** (see **Section 9.3**).

The treated groundwater will be tested for analytes specified in **Section 13**, following receipt of the test results, the Environmental Manager/Consultant, in consultation with Council (where required), shall determine the suitability for discharge to the stormwater network. Compliance with the WQO set out in **Table 20** is required prior to discharge. Additional components to the water treatment process may be required if initial batch testing results do not meet the WQO.

Reditus note that the period between collecting the pre-start samples and discharging from site can exceed one week (more if test results are not favourable and retesting is required) and that this should be accounted for in the construction program.

11.3 Noise and Vibration

The following methods shall be employed to reduce noise emissions resulting from dewatering operations:

- Preference shall be given to electric powered dewatering pumps over diesel / fuel powered equipment (due to the sound generated being lower with electric pumps).
- Installation and maintenance of high efficiency mufflers for all noise generating plant. All reasonable steps shall be taken to acoustically baffle and muffle all plant and equipment.
- Pump equipment and generators shall be located away from site boundaries where possible, with consideration to adjoining residences, Installation of acoustically baffled enclosures around and generators and pump is recommended to minimise noise issues or complaints.
- All subcontractors to be managed to ensure they work only within defined hours.
- Where there are several noise generating equipment, schedule operations to minimise cumulative impacts.
- Keep equipment well maintained.
- Ensure engine shrouds (acoustic linings) are installed (where feasible).

It is the responsibility of the Site Manager to ensure appropriate management of vibration, noise and odour during dewatering operations, and that the management approaches adopted are in accordance with the Council Conditions of Consent and any relevant management plan (e.g., Construction Environmental Management Plan, Demolition Management Plan, Excavation Management Plan, or Construction Noise and Vibration Management Plan).

11.4 Odour

Routine odour monitoring should be undertaken to identify offensive odours and avoid potential impacts on adjacent site users. Control measures, such as deodorants or passing the discharge through a carbon filter tank, shall be adopted in the event odours are considered unacceptable levels at the site boundary. Where odour controls prove ineffective, activities that cause an offensive odour shall cease until odour emissions are resolved.

12 Dewatering and Water Treatment System

The proposed dewatering system and treatment system (if required) to be operated at the site is specified below.

12.1 Dewatering System

Dewatering is proposed to commence following the excavation into the shale/siltstone. Groundwater is proposed to be extracted using a combination of a series of spearpoints internally around the permitter of the excavation and/or internal large diameter extraction wells. Groundwater is proposed to be extracted using an internal drainage sump and pump dewatering system during construction. Once the development is constructed, groundwater seepage will be collected through a sub-slab and vertical strip drainage system, where groundwater will be pumped from a sump to stormwater.

The exact specification of the construction dewatering system will be determined by the Dewatering Contractor and will be dependent on pump sizing and water flow capacity. Reinjection is currently not proposed.

If water quality results deem that treatment is required prior to discharge, a water treatment system (detailed in **Section 12.2** below) will be implemented prior to proposed discharge to the stormwater pit.

12.2 Water Treatment System (if required during construction)

Depending on the water quality results established during initial dewatering monitoring works, a water treatment plant (WTP) may be required during construction, given the excavation and dewatering method. The process diagram for a potential water treatment system is provided in **Figure 3** below.

The water treatment system may comprise the following elements:

- Sediment Tank.
- Chemically Enhanced Primary Treatment (CEPT) System:
  - Including internal Chemical Dosing Unit for pH Adjustment and Flocculent Dosing

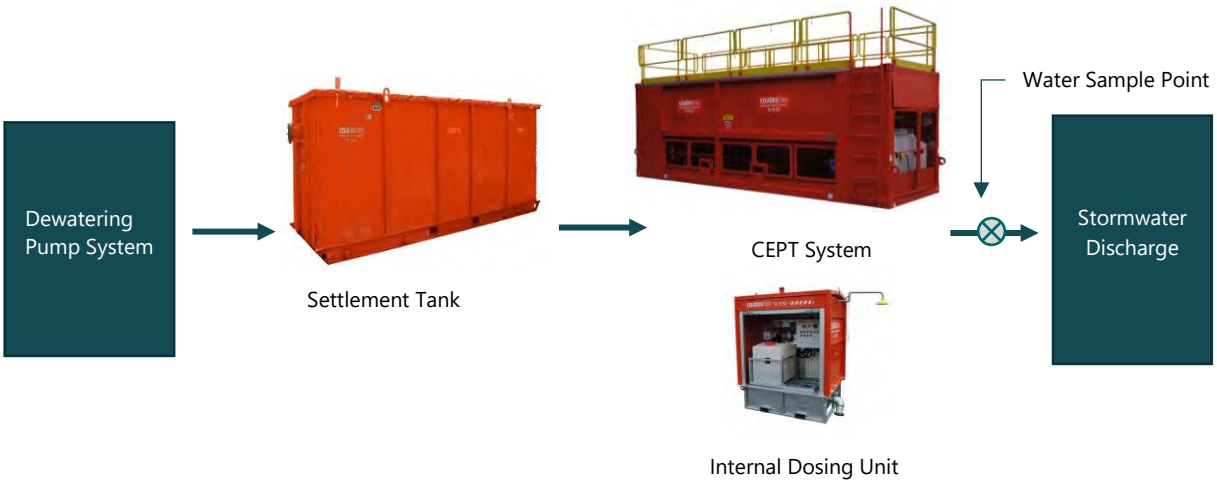


Figure 3. Water Treatment Plant Process Diagram

Details of each component of the WTP is provided in the sections below.

12.2.1 SETTLEMENT TANK

A suitability sized Sediment Tank will be installed to initially to allow for the heavy suspended particles in waters to settle and also to serve as a balance tank to regulate any inconsistent or irregular flows. The settlement tank allows for a maximum settling time for a continuous flow of water.

12.2.2 CHEMICALLY ENHANCED PRIMARY TREATMENT (CEPT) SYSTEM

Following the initial sedimentation primary treatment, the water is then preferentially piped to a "Chemically Enhanced Primary Treatment (CEPT) System" unit which has an inbuilt dosing and control system provide automatic water treatment.

Physio-chemical processes allow the operator to adjust pH, remove total suspended solids and control heavy metal precipitation. The following sequence of water treatment process is proposed:

- Adjustment of pH; if pH recorded outside a range of 6.5-8.5.
- Chemical dosing with a flocculate (aluminium chloride) to remove fine sediments.
- Following the flocculation process the water flows upwards through a clarifier (similar to lamella box) to further filter suspended matter before discharging through a fabric filter.
- The CEPT is fitted with a flow meter capable of monitoring the total volume of water treated/discharged.

Groundwater monitoring and discharge will be completed in stages to ensure the protection of the receiving water environments.

Prior to any groundwater discharge commencing from the site to stormwater, an initial round of sampling must be conducted during the installation of the dewatering system. All groundwater will be retained onsite until water quality objectives have been achieved.

Once groundwater discharge water quality objectives are demonstrated to be achieved (which may require modifications to the dewatering systems or implementation of water treatment technologies if required), continuous discharge may occur in accordance with the DMP (still to be produced for the site).

12.2.3 CONTINGENCY WATER TREATMENT EQUIPMENT

Where the above procedures prove ineffective at decreasing concentrations of dissolved and/or total metals or other contaminants to appropriate levels, the inclusion of the following procedures in the treatment train may be recommended:

- Media Filtration Units to remove additional sediment loads to target any suspended heavy metal particulate, as well as removal of dissolved heavy metals via ionic exchange;
- pH/Eh Modification to maximum metal precipitation/flocculation;
- Air-stripping unit or Granulated Activated Carbon (GAC) unit to target any dissolved phase TPH/VOC contamination.

The role of the Media Filtration units (if required) will be to provide secondary water treatment for the removal of any residual heavy metals from the water. The Media Filtration Units may encompass a combination of sand and ionic resin units. The sand media will be appropriately sized to remove fine suspended particular matter and any bound heavy metals. The ionic resin media will be selected based on the particular heavy metal chemical properties, which will remove targeted dissolved heavy metals from the water stream through adsorption and ionic exchange. The rate of heavy metal removal will be dependent on the residence time of the water within the vessel.

The role of pH modification is to utilise the heavy metal geochemistry to change dissolved metals to insoluble precipitates by modifying pH and Eh. Certain metals will form mineral complexes under specific pH/Eh conditions, which are then able to be removed from the water stream as particulate through flocculation and coagulation process. Following removal of the heavy metals, the treated water pH/Eh is then adjusted back to within the adopted discharge criteria. This process can be enhanced through Media Filtration.

The role of the air strippers is to volatilise dissolved volatile contaminants, removing them from the groundwater influent stream. The vapour phase contaminants are captured and diverted through external GAC hoppers where they are sorbed. Treated groundwater influent then undergoes tertiary polishing treatment to remove any remaining dissolved phase hydrocarbons and reduce background heavy metals through particulate filtration. This is achieved via filtration of the groundwater influent through GAC and ion exchanging media filtration vessels via the process of adsorption and ion exchange.

Initial monitoring of discharge water quality shall provide the information required to optimise the water treatment regime.

Any addition of chemical agents must be managed by a suitably qualified environmental scientist and the chemicals approved for use by the NSW EPA. Intensive monitoring of treatment agent dose rates and discharge water quality must be untaken to optimise the water treatment regime specific to the site.

12.2.4 MAINTENANCE OF WATER TREATMENT SYSTEM

Routine maintenance of the treatment equipment will be required to ensure optimum performance. The discharge pipeline and any protective structures, such as driveway ramps/culverts, must be checked for leaks and damage on a regular basis. Retention structures must also be inspected regularly to ensure adequate performance and structural integrity.

Chemical treatment and settlement is likely to result in the retention of organic and/or inorganic material. Removal of the accumulated material will be required periodically to avoid re-suspension of accumulated sediment and reduction of treatment system capacity. Strategies to limit the volume of waste to be removed should be developed in consultation with the project environmental consultant.

13 Water Quality Monitoring Program

Monitoring of the discharge water will be completed for the duration of the dewatering activities in accordance with the monitoring schedules below.

All monitoring of water quality will be completed by a suitably qualified person, using calibrated equipment to collect samples that are representative of the discharge and analysis completed by a NATA accredited laboratory.

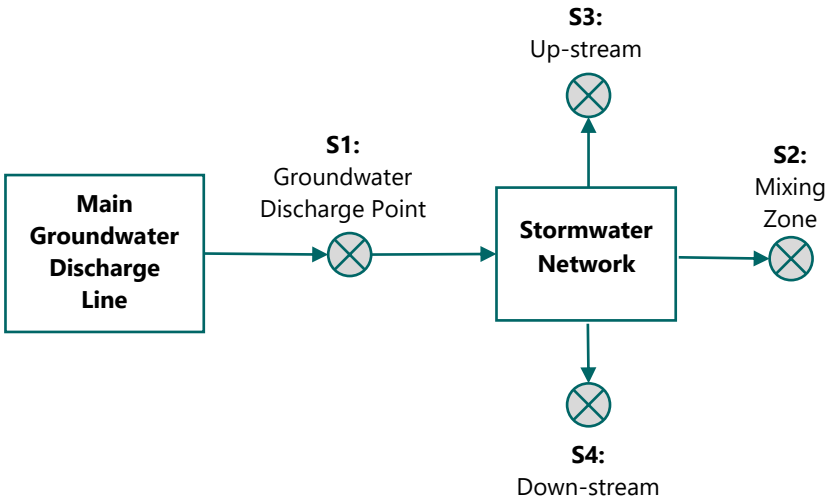
Council must be notified of any results received that indicate an adverse environmental impact within 24 hours of results being obtained.

Monitoring of the discharge water will be completed for the duration of the construction dewatering activities in accordance with the monitoring schedules below. All monitoring of water quality will be completed by a suitably qualified person, using calibrated equipment to collect samples that are representative of the discharge.

Specifications set out in the dewatering and discharge licence (if any) will outline the specific frequency of assessment, an interim sampling and monitoring program is outlined below.

13.1 Water Quality Monitoring Locations

Water quality samples will be collected from the following locations as presented in the flow chart below.



The following descriptions of the sampling locations are provided below:

- S1: Groundwater Discharge Point:
  - A sample of the groundwater discharge prior to discharge into the stormwater drain. The sample will be collected directly from the main groundwater discharge line, representing the water quality following final treatment.
- S2: Stormwater Channel – Mixing Zone:
  - A sample of the receiving waters at the mixing zone boundary.
- S3: Stormwater Channel – Up-stream:
  - A sample of the receiving waters at a location approximately 100m up-stream from the stormwater discharge point.
- S4: Stormwater Channel / Broad Water Outlet– Down-stream:
  - A sample of the receiving waters at either an accessible location within the stormwater channel or at the discharge point at Prospect Creek.

In the event that groundwater discharge waters (S1) can be demonstrated to consistently meet the adopted DGVs, sampling of the receiving waters at monitoring points S2, S3 and S4 can cease. The proposed water quality sample locations are presented in **Figure 4** below.

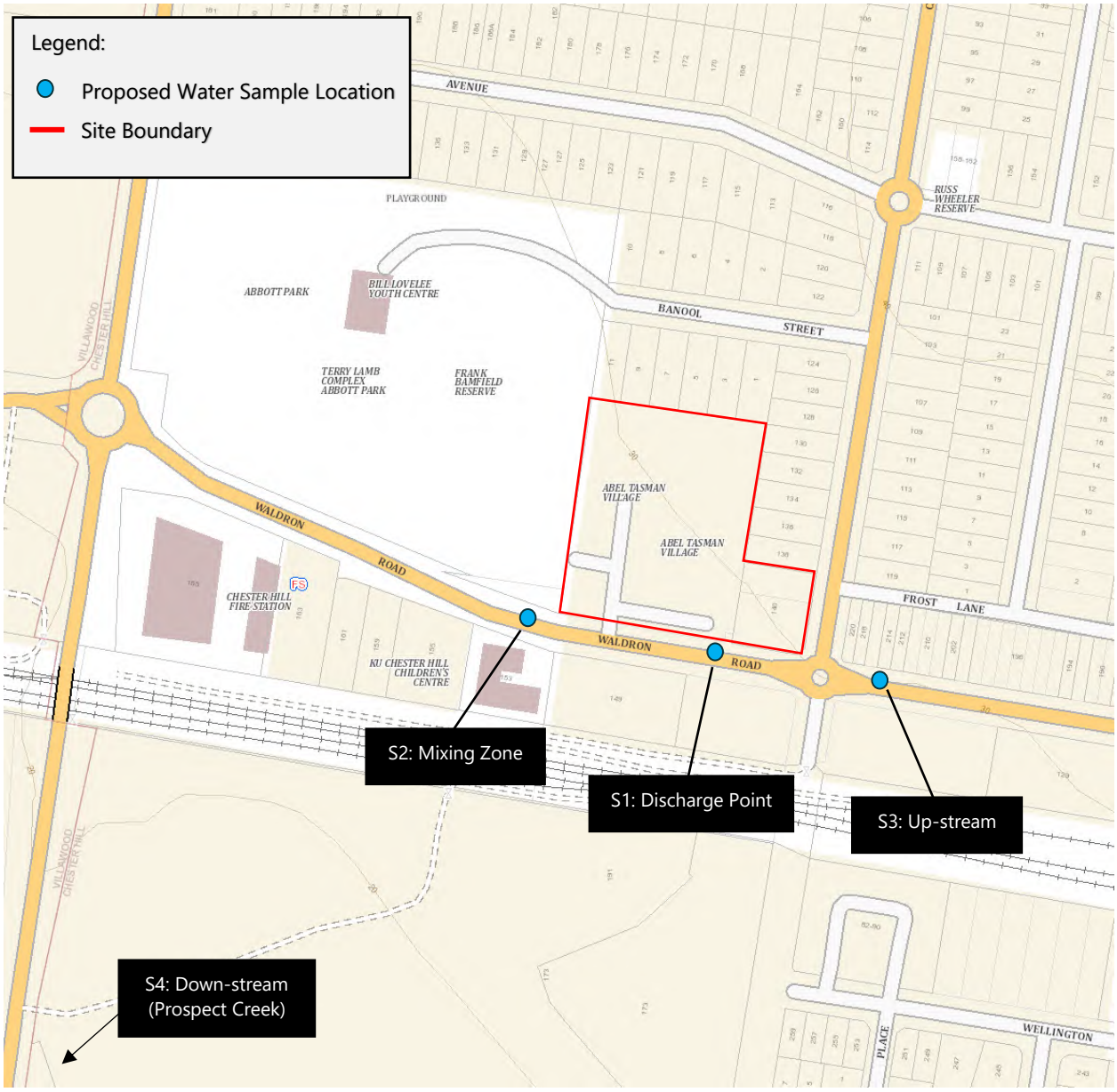


Figure 4. Proposed Water Quality Sample Locations

13.2 Water Quality Monitoring Frequency and Analysis

Water quality treatment may be required prior to discharge of the extracted groundwater to the Council stormwater system.

Water quality monitoring would need to be performed prior to commencement of treated water discharge. This monitoring period is defined as the 'Stage 1: Initial Assessment / Trial Run Period' and will allow for assessment of water quality treatment performance, compliance against the adopted discharge criteria, establish if additional water treatment methods are required to achieve discharge criteria and establish background water quality in the event that deviations from the adopted discharge criteria are technically justifiable.

Subsequent ongoing monitoring will also be required to confirm the on-site treatment system is functioning as intended. This monitoring has been segmented into two stages, 'Stage 2: Initial Operational Discharge Monitoring Period' to establish treated water quality trends during continuous discharge, and 'Stage 3: Ongoing Operational

Discharge Monitoring Period' with a lower testing frequency to confirm ongoing treatment performance once Stage 2 water quality trends have been established.

Council must be notified immediately of any pollution incidents as the regulator (including discharges above the set limits in **Table 20** to the stormwater and where any unacceptable impact to the receiving waters is identified).

13.2.1 STAGE 1: INITIAL COMMISSIONING ASSESSMENT/TRIAL RUN PERIOD

An initial sampling program must be conducted during the installation and commissioning of the dewatering pumping and treatment system, prior to any discharge of groundwater form the site. This will enable baseline discharge water quality to be established and determine if the employed level of groundwater treatment is suitable to ensure compliance with the adopted discharge criteria, prior to offsite discharge.

The initial commissioning sampling program should be completed on at least three (3) consecutive sampling events, and at minimum comprise two (2) representative samples, one collected prior to treatment, and one collected from the discharge line of the dewatering treatment system.

Representative samples of the receiving waters (S2, S3 and S4) should also be collected to establish baseline/ background conditions. This should include at least two (2) baseline sampling events, preferable one during drier periods and one during wetter periods.

The samples must be analysed for all water quality parameters as per below and as listed in **Table 21**.

Daily field monitoring of the following parameters from the inlet and outlet sides of the treatment system.

- pH
- Electrical Conductivity(EC)
- Dissolved oxygen (DO);
- Redox Potential (mV)
- Turbidity (NTU)

As per Appendix A of the NSW DPIE (2021) *Minimum Requirements for Building Site Groundwater Investigations and Reporting guidelines*, discharge water quality samples collected will be submitted for analysis to a NATA accredited laboratory for the following analytes listed in **Table 21** below.

Table 21. List of Required Laboratory Water Quality Tests and Schedule (NSW DPIE 2021 – Appendix A)

TYPE	CORRESPONDING LABORATORY ANALYSIS	TESTING REQUIREMENT
Physical Parameters	Alkalinity (bicarbonate, carbonate, hydroxide and total), electrical conductivity (EC), pH, redox potential (Eh), total dissolved solids (TDS), total hardness, temperature, dissolved oxygen (DO).	Mandatory
Other Physical Parameters	Turbidity* (NTU), total suspended solids* (TSS), total organic carbon* (TOC), sodium absorption ratio* (SAR)	Mandatory for discharge to any receiving waters
Major Anions	Sulfate (SO_4), chloride (Cl), carbonates (CO3), bromide (Br), fluoride (F)	Mandatory
Major Cations	Calcium (Ca), magnesium (Mg), sodium (Na), potassium (K)	Mandatory
Ionic Balance	Cation/Anion balance (as a percentage)	Mandatory
Dissolved Inorganics and Dissolved Heavy Metals	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),	Mandatory for baseline thereafter negotiable, depending on site setting unless otherwise required by another regulatory body

TYPE	CORRESPONDING LABORATORY ANALYSIS	TESTING REQUIREMENT
	silica (dissolved SiO2), silver (Ag), strontium (Sr), uranium (U), vanadium (V), zinc (Zn)	
Nutrients	Ammonia (NH_3), nitrate (NO_3), total nitrogen (N), oxidised nitrogen (N), total phosphorus (P), reactive phosphorus (P)	Mandatory for baseline thereafter negotiable, depending on site setting unless otherwise required by another regulatory body
Microbiological organisms	Faecal coliforms, faecal streptococci, Escherichia coli	Mandatory for baseline thereafter negotiable, depending on site setting unless otherwise required by another regulatory body
Organics	Benzene toluene ethylbenzene xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), total recoverable hydrocarbons (TRHs)	Mandatory for baseline thereafter negotiable, depending on site contamination status unless otherwise required by another regulatory body.
Other	Range of analytes relevant to site-specific contaminants of environmental concern:	As required by the NSW EPA, on the advice of a specialist environmental consultant or as required by another regulatory body.

The sampling frequency should be maintained until the target parameters and chemical concentrations in treated water stabilised (i.e., consecutive tests are within ±10% of the observed results) and within the adopted discharge criteria for three consecutive periods.

Following completion of the initial baseline/trail run monitoring program, an assessment will be completed by a suitability qualified environmental consultant to determine that groundwater discharge will not pose an environmental risk and will not result in adverse environmental effects. If potential unacceptable impact to the receiving waters is identified, contingency groundwater treatment options should be considered and adopted where appropriate.

The Stage 1 Initial Assessment / Trial Run Period may be extended if stabilisation is not observed, or the treated water exiting the treatment system does not satisfy the adopted discharge criteria.

During the Stage 1 Initial Assessment / Trial Run Period, all collected groundwater seepage (including treated waters) must be retained/recirculated on-site and is not permitted to be discharged to Council Stormwater network until it is proven to meet the adopted discharge criteria or considered to not pose an unacceptable risk to the receiving waters.

13.2.2 STAGE 2: INITIAL OPERATIONAL DISCHARGE MONITORING PERIOD

After successful completion of the Stage 1 Trial Run period, treated groundwater may be continuously discharge directly to the Council Stormwater system.

A daily sampling frequency of the S1 discharge waters for a 2 week period is recommended during the Stage 2 Initial Operational Discharge of the onsite water treatment system.

The daily sampling program should at minimum comprise two (2) representative samples, one collected prior to treatment, and one collected from the discharge line of the dewatering treatment system.

Representative samples of the receiving waters (S2, S3 and S4) should also be collected to establish background conditions and allow assessment of any impact from the discharge.

The samples must be analysed for all water quality parameters as per below and as listed in **Table 21** above.

The daily sampling frequency should be maintained for a minimum of 2 weeks, until the target parameters and chemical concentrations in treated water stabilised (i.e., consecutive tests are within ±10% of the observed results) and within the adopted discharge criteria for five consecutive days.

Following completion of the initial operational period, an assessment will be completed by a suitability qualified environmental consultant to determine that groundwater discharge is not posing an environmental risk and is not resulting in adverse environmental effects. If an unacceptable impact to the receiving waters is identified, discharge of groundwater must stop, and contingency groundwater treatment options should be considered and adopted where appropriate.

Council must be notified immediately of any pollution incidents as the regulator (including discharges above the set limits in **Table 20** to the stormwater and where any unacceptable impact to the receiving waters is identified).

13.2.3 STAGE 3: ONGOING OPERATIONAL DISCHARGE MONITORING PERIOD

After successful completion of the Stage 2 Initial Operation Discharge period, treated groundwater may be continuously discharged directly to the Council Stormwater system.

Daily monitoring of pH and Turbidity of the Treated Discharge Waters (S1) must be maintained throughout the dewatering process. Daily field monitoring of the following parameters from the inlet and outlet sides of the treatment system.

- pH
- Turbidity (NTU)

The sampling program should at minimum comprise two (2) representative samples, one collected prior to treatment and one collected from the discharge line of the dewatering treatment system.

Representative samples of the receiving waters (S2, S3 and S4) should also be collected to establish background conditions and allow assessment of any impact from the discharge.

Weekly water samples will be collected from the dewatering discharge point during the active construction dewatering and discharge activities, as listed in **Table 21** above.

The weekly sampling frequency should be maintained for the remainder of the dewatering and discharge program.

Monthly groundwater sampling is also required from the three (3) groundwater monitoring wells, with laboratory testing as per **Table 21** above.

Results of the monitoring must be reviewed by the appointed environmental consultant on a weekly basis to determine that groundwater discharge is not posing an environmental risk and is not resulting in adverse environmental effects. If an unacceptable impact to the receiving waters is identified, discharge of groundwater must stop and contingency groundwater treatment options should be considered and adopted where appropriate.

Council must be notified immediately of any pollution incidents as the regulator (including discharges above the set limits in **Table 20** to the stormwater and where any unacceptable impact to the receiving waters is identified).

13.3 Water Sample Collection

Discharge and receiving waters will be analysed in the field using a calibrated water quality meter to assess the EC, DO, pH, Turbidity, ORP and Temperature.

Water samples will be taken directly from the discharge line sample ports or using a surface water grab sampler for the remaining analytes mentioned in **Section 13.2** above.

Samples are to be placed directly into appropriately preserved, laboratory supplied sampling containers, labelled with the project identification, sample name/location, sample date and who collected the sample. Samples for dissolved heavy metal analysis shall be field filtered using 0.45um disposable filters.

Once samples are obtained, they are to be stored and transported in an ice cooled Esky to the laboratory under a chain-of-custody (CoC).

13.4 Monitoring of Discharge Flow Rate, Groundwater Drawdown & In-Situ Groundwater Quality

Discharge flow rates, as well as groundwater levels and groundwater quality outside the excavation shall be monitored in general accordance with the NSW DPIE (2021) *Minimum Requirements for Building Site Groundwater Investigations*, as per **Table 22** below.

Table 22. Monitoring Program for Discharge Flow Rates and Groundwater Levels

PARAMETER	LOCATION	FREQUENCY
Discharge Rates and Volumes	Calibrated flow meter (e.g. inline Magflow meter) on discharge pipeline	**Daily**
Groundwater Level	From three (3) groundwater monitoring wells located outside the excavation.	**Daily:** For 2 weeks prior to dewatering commencement. During the entire dewatering period For a minimum of two months following the cessation of pumping.
Groundwater In-situ Quality Measurements: • Electrical conductivity (specific conductance at 25°C). • Temperature, • pH. • Reduction-oxidation (redox) potential.	From three (3) groundwater monitoring wells located outside the excavation.	**Weekly:** For 2 weeks prior to dewatering commencement. During the entire dewatering period For a minimum of two months following the cessation of pumping.
Groundwater Quality Testing: As per **Table 22**		**Monthly:** At least 2 sampling rounds prior to dewatering to establish baseline conditions.

13.5 Contingencies

Based on the above proposed management and mitigation measures to be employed during the dewatering activities, the DMP should be effective to manage the potential impacts, however contingent actions may be required should the scenarios listed in **Table 23** below arise.

Table 23. Mitigation Measures for Potential Dewatering Issues

POTENTIAL SCENARIO	MITIGATION MEASURES
Treated water does not achieve the adopted discharge criteria following completion of the Stage 1 monitoring period.	Implementation/adjustment of physical and/or treatment processes and/or installation of larger retention structures should be completed. As per **Section 12.2.3**, additional water treatment measures may include Media Filtration Units (Sand, GAC or Ionic Resins), Air-stripping Units or pH/Eh modification. Once additional treatment technologies are installed, the Stage 1 monitoring period should be repeated to confirm that the adopted discharge criteria will be achieved. Council must be notified immediately of any pollution incidents as the regulator (including discharges above the set limits in **Table 20** to the stormwater and where any unacceptable impact to the receiving waters is identified).

POTENTIAL SCENARIO	MITIGATION MEASURES
During the Stage 2 and Stage 3 monitoring periods, if quality of treated water does not meet the adopted discharge criteria.	Discharge to the stormwater system must be suspended, tail water should be retained onsite and stored in appropriate bulk containers for further on-site treatment and sampling until it is proven to meet the adopted discharge criteria. If unexpected monitoring results indicate that the quality of the receiving water has changed (as a direct result of the dewatering activities), modification of management practices must be implemented, including up-scaling of the treatment measures. Implementation/adjustment of physical and/or treatment processes and/or installation of larger retention structures should be completed as an initial procedure to mitigate unacceptable levels of chemical contaminants (e.g., dissolved heavy metals, petroleum hydrocarbons, VOCs or pesticides). Where increased dissolved oxygen of the discharge waters is required, an aerator should be installed within the treatment line. Where implemented contingencies prove ineffective at mitigating risks to the receiving water way, ceasing dewatering may be the only options until such time that other management techniques can be applied. To avoid potential damage to the constructed basement in such a situation, consideration should be given to obtaining an Emergency Permit to discharge to sewer with Sydney Water. Otherwise, it may be necessary to have collected waters removed by a licenced liquid waste contractor should quantities accumulate beyond the onsite storage capacity. Council must be notified immediately of any pollution incidents as the regulator (including discharges above the set limits in Table 8-1 to the stormwater and where any unacceptable impact to the receiving waters is identified).
The treated groundwater quality cannot satisfy the nominated discharge criteria.	Should all feasible onsite water treatment options become exhausted, application to Council for a Trade Waste Licence could potentially be obtained for discharge to sewer. Alternatively, an Environmental Protection Licence (EPL) may be applied for with the NSW EPA for direct discharge into Broad Water.
Excessive groundwater drawdown (>1m), as determined by geotechnical/ structural engineer, resulting in unacceptable offsite settlement.	If offsite drawdown is <1.0 m but approaching 1.0 m is identified in the monitoring points outside the excavation, or if groundwater quality is observed to change beyond 'pre-dewatering' baseline conditions, consideration should be given to control of the off-site water table depression (i.e., through re-injection). This is likely to have in implication on the costs of the project but is recommended in order to reduce the risk of damage to adjacent buildings and roadways. The primary control method of reinjection would require some injection well to be installed outside the excavation boundary and may require a variation to the dewatering licence obtained from the WaterNSW / NRAR. **If groundwater drawdown exceeds levels >1.0 m, immediately cease dewatering and contact hydrogeologist, geotechnical engineer and structural engineer.**

13.6 Principal Contractor Inspection Requirements

The Principal Contractor will be responsible for the following inspection activities and reporting requirements:

- Perform daily visual inspection of groundwater discharge stream at the stormwater connection point for any signs of unexpected conditions (e.g., discolouration, odours, sheens, oils, sediment).

- Routine maintenance of the groundwater dewatering system will be required to ensure optimum performance. The discharge pipeline and any protective structures, such as driveway ramps/culverts, must be checked for leaks and damage on a regular basis. Retention structures must also be inspected regularly to ensure adequate performance and structural integrity.
- Record and report any incidents of poor drainage, uncontrolled discharge or spills within the basement drainage system capture zone. Groundwater discharge must be immediately suspended in the event of any spills or environmental incidents and immediately reported to a suitability qualified environmental consultant. Groundwater discharge must not re-commence until discharge quality can be demonstrated to not result in unacceptable adverse environmental impact.
- Maintain erosion and sediment control measures in a functioning condition until all earthwork activities are completed.
- Devise and implement appropriate remedial measures where any controls or devices are not functioning effectivity or are inappropriate.
- The site manager will maintain records and comments on the condition of existing erosion and run-off controls (drains, silt fences, catch drains etc) dewatering procedures and test results, discharge rates and volumes, groundwater level and pH measurements, and any site instruction issued to contractors to undertake works on the dewatering and treatment equipment.
- Maintain rainfall data, to be filled onsite.
- All daily inspection reports, environmental incidents and controlled discharge records will be maintained and the information provided within monitoring assessment reports.
- Council must be notified immediately of any pollution incidents as the regulator (including discharges above the set limits in **Table 20** to the stormwater and where any unacceptable impact to the receiving waters is identified).

14 Records and Reporting

The Principal Contractor shall maintain a record of all water quality and groundwater level monitoring, along with details of corrective and preventative actions implemented in relation to the dewatering activity.

The following reports shall be prepared:

- Stage 1 & 2: A weekly (interim) report issued upon receipt of laboratory analysis results that identifies potential compliance issues or water quality impacts that require immediate action, and other recommended preventive/corrective actions.
- Stage 3: Fortnightly dewatering report summarising the water quality data and management strategies implemented during the entire works. The report shall include a summary of discharge and receiving waters quality results, a statistical appraisal of the data, control charts showing quality results, a compliance assessment, indications of potential environmental harm, and comments and/or corrective actions implemented during the works.

The following information must be maintained and may be required to be submitted to WaterNSW / NRAR on completion of construction dewatering as part of the "Completion Report" within six months of completion of the dewatering during construction:

- Volume of groundwater pumped, the volume discharged offsite (and/or reinjected if applicable), the discharge/ reinjection rate and the duration of pumping.
- Groundwater level monitoring data and water table map depicting the aquifer's settled groundwater conditions and a comparison to the baseline conditions.
- All water quality monitoring data including results of any water quality testing.
- Location and construction of groundwater extraction works that are abandoned after dewatering has ceased.
- A detailed interpreted hydrogeological report identifying all actual resource and third party impacts, including an assessment of altered groundwater flows and an assessment of any subsidence or excessive settlement induced in nearby buildings and property and infrastructure.

Reditus note that if approval is granted under the WM ACT, construction dewatering is exempt from requiring a Water Access Licence (WAL) under the Water Management (General) Amendment (Exemptions for Instructure) Regulation 2025. Additionally, ongoing dewatering under a drained basement design would also likely be exempt given the predicted inflows are <3 ML/yr. If more than 3 ML/yr occur during the ongoing dewatering under drained basement design, a WAL will need to be acquired with the appropriate number of shares from the groundwater source.

Based on the predicted groundwater extraction volumes, groundwater quality underlying the site, and the impact assessment completed, it is the opinion of Reditus that the proposed basement could be effectively constructed and managed under a drained based design.

It is noted once construction works are complete, the on-going operation and management of the proposed drained basement will likely be required to be managed under a long-term groundwater management plan and separate Water Supply Work Approval.

15 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 (The Abel Tasman Village Association care of Centurion Project Management) 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 and 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.

16 References

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A

Figures

REDITUS

Map	25254_rp01_f01_siteloc_v2
Date of Export	28/10/2025
Author	RC
Approver	SM
Data Source	Metromap, Google Maps, Open Street Map, NSW Government

Legend

- Site Boundary
- Major Roads
- Railways
- Surface Water

Watercourses

- Rivers
- Stream (Perennial)
- Stream (Non-Perennial)
- Unnamed Stream (Non-Perennial)
- Other Channels

Figure 1 - Site Location

222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW

25254 - Dewatering Management Plan

The Abel Tasman Village Association
c/- Centurion Project Management

REDITUS

Map	25254_rp01_f02_sitelayout_v2
Date of Export	28/10/2025
Map Scale (approx. at A3)	1:600
Author	RC
Approver	SM
Data Source	Metromap, Google Maps, Open Street Map, Geoscience Australia

Legend

- Site Boundary
- Primary Basement Area
- Lower Basement Area
- NSW Contours - 2m

Monitoring Well Locations

- Reditus 2023 Monitoring Well
- Asset 2022 Monitoring Well
- ES 2014 Monitoring Well

Figure 2 - Site Layout

222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW

25254 - Dewatering Management Plan

The Abel Tasman Village Association
c/- Centurion Project Management

REDITUS

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Date of Export	**Map Scale (approx. at A3)**
28/10/2025	1:600
Author	**Approver**
RC	SM
Data Source	
Metromap, Google Maps, Open Street Map, Geoscience Australia	

Legend

- Site Boundary
- Groundwater Monitoring Well Location
- Groundwater Contours (mAHD)

Figure 3a - Groundwater Contours
June 2023

222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW

25254 - Dewatering Management Plan

The Abel Tasman Village Association
c/- Centurion Project Management

REDITUS

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Date of Export	**Map Scale (approx. at A3)**
28/10/2025	1:600
Author	**Approver**
RC	SM
Data Source	
Metromap, Google Maps, Open Street Map, Geoscience Australia	

Legend

- Site Boundary
- Groundwater Monitoring Well Location
- Groundwater Contours (mAHD)

Figure 3b - Groundwater Contours September 2023

222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW

25254 - Dewatering Management Plan

The Abel Tasman Village Association
c/- Centurion Project Management

REDITUS

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Date of Export	**Map Scale (approx. at A3)**
28/10/2025	1:600
Author	**Approver**
RC	SM
Data Source	
Metromap, Google Maps, Open Street Map, Geoscience Australia	

Legend

- Site Boundary
- Groundwater Monitoring Well Location
- Groundwater Contours (mAHD)

Figure 3c - Groundwater Contours
January 2024

222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW

25254 - Dewatering Management Plan

The Abel Tasman Village Association
c/- Centurion Project Management

REDITUS

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Date of Export	**Map Scale (approx. at A3)**
28/10/2025	1:600
Author	**Approver**
RC	SM
Data Source	
Metromap, Google Maps, Open Street Map, Geoscience Australia	

Legend

- Site Boundary
- Groundwater Monitoring Well Location
- Groundwater Contours (mAHD)

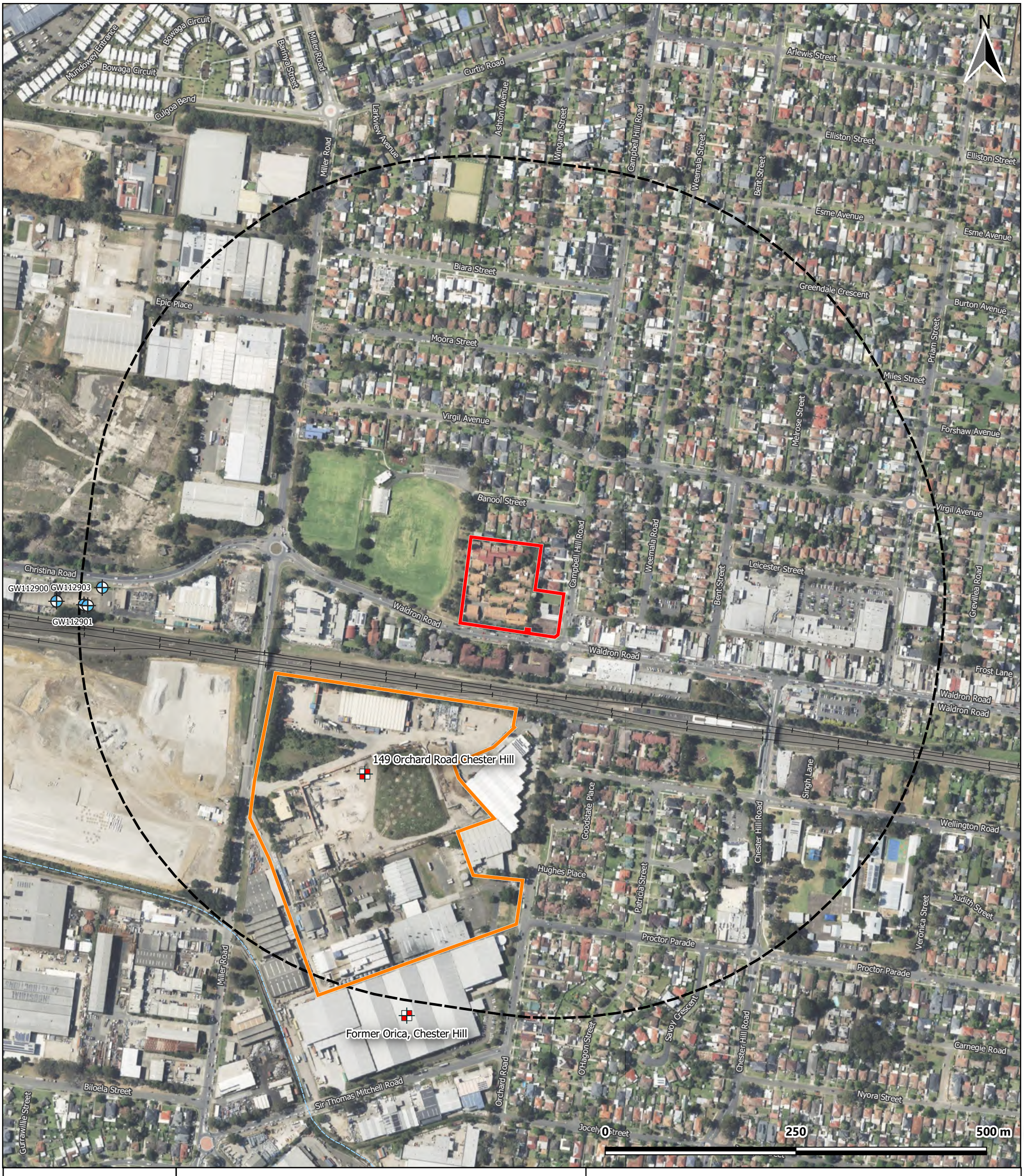
Figure 3d - Groundwater Contours October 2025

222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW

25254 - Dewatering Management Plan

The Abel Tasman Village Association
c/- Centurion Project Management

REDITUS



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RC	SM
Data Source	
Metromap, Google Maps, Open Street Map, Geoscience Australia	

Legend

- Site Boundary
- 500 m Assessment Radius
- EPA Notified Sites
- 149 Orchard Road - Property Boundary
- Railways

Registered Groundwater Bores

- Monitoring Bore

Watercourses

- Rivers
- Stream (Perennial)
- Stream (Non-Perennial)
- Unnamed Stream (Non-Perennial)
- Other Channels

Figure 4 - Groundwater Receptors & Risks

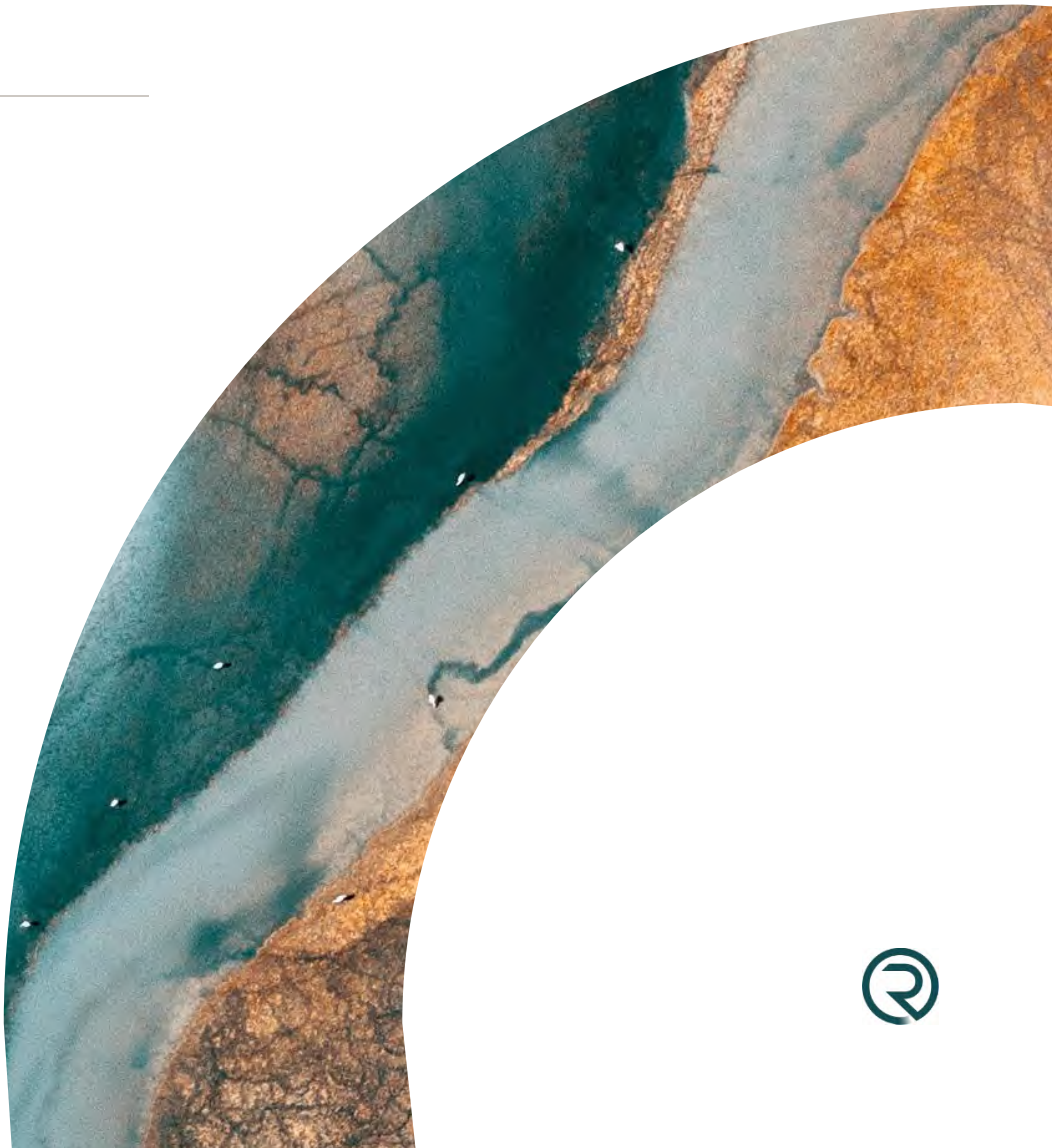
222 Waldron Road, 138 & 140 Campbell Hill Road, Chester Hill NSW

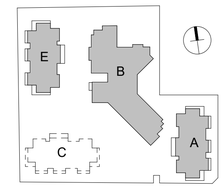
25254 - Dewatering Management Plan

The Abel Tasman Village Association
c/- Centurion Project Management

B

Basement Development Plans





TREE LEGEND

- Existing trees to remain
- Existing trees to remove
- Proposed trees
- TPZ
- SRZ

PRELIMINARY

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SCALE: 1:100

No.	Amendment	Date
B	Preliminary Issue	04.09.23

Project
ATV REDEVELOPMENT
222 Waldron Road & 138 Campbell Hill Road, Chester Hill

Drawing
GROUND FLOOR PLAN - OVERALL

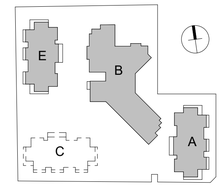
CENTURION GROUP
YOUR TRUSTED ADVISOR

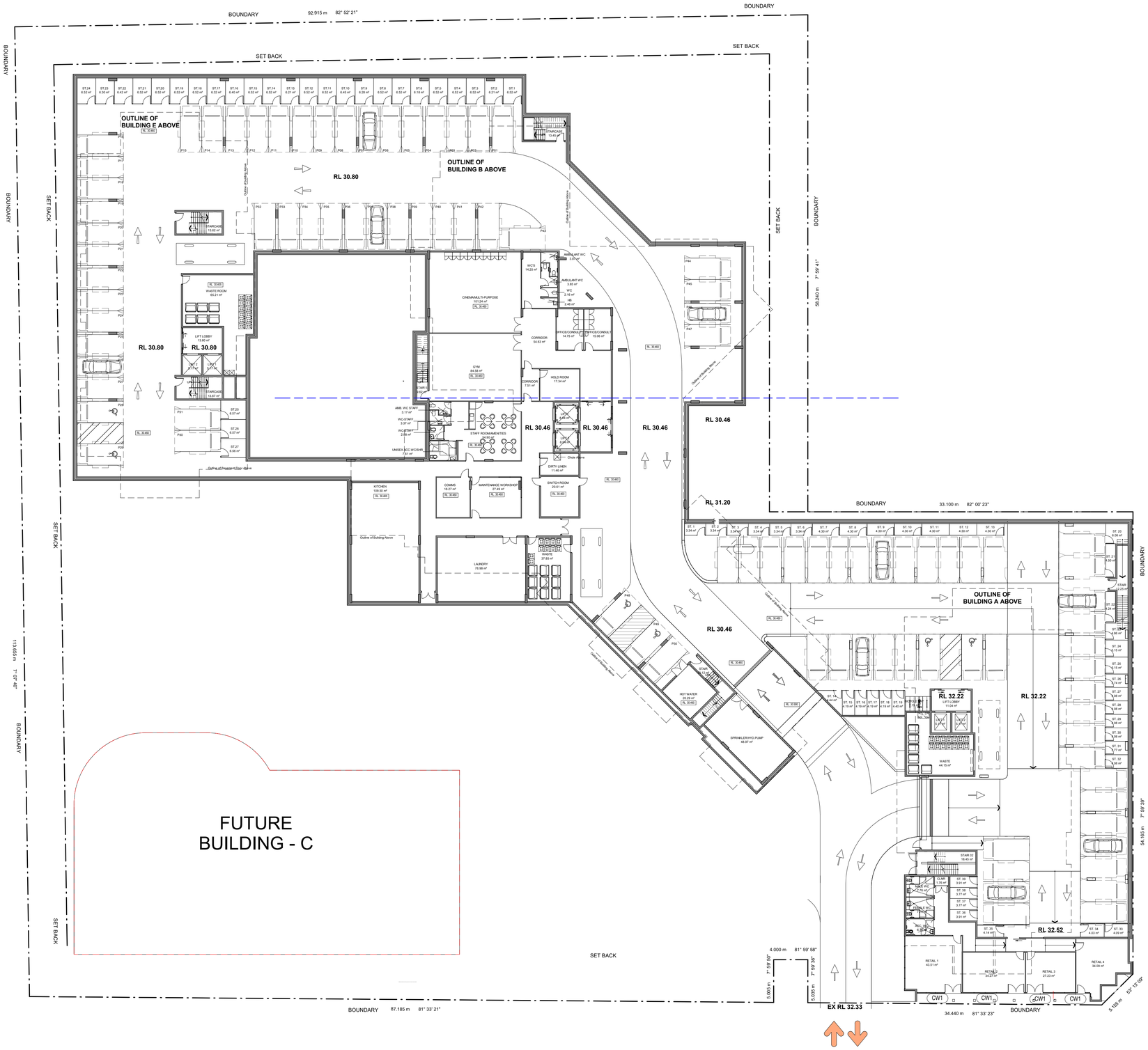
Abel Tasman Village
A Culture of Care

boffa robertson group
architecture, health and aged care planning, project management
Suite 7, Level 1 Epica, 9 Railway Street
Chatswood NSW 2067
AUSTRALIA
Tel. (02) 9406 7000
Fax. (02) 9406 7099
Email : brgroup@brgr.net

Date	08/09/22	Job No. : Drawing	
Scale	As indicated @ A1		
Drawn	Author	2108/A1DA05	
Amendment	B		

BUILDING E
BUILDING B
BUILDING A
PAVILION
FUTURE BUILDING - C
CAMPBELL HILL ROAD
WALDRON ROAD
BOUNDARY
SET BACK
92.915 m 82° 52' 21"
58.240 m 7° 59' 41"
134.655 m 7° 07' 49"
87.185 m 81° 33' 21"
4.000 m 89° 59' 37"
4.000 m 81° 59' 58"
33.100 m 82° 00' 23"
37.600 m 89° 59' 58"
54.165 m 7° 59' 39"
54.165 m 7° 00' 00"
34.440 m 81° 33' 23"
34.440 m 89° 33' 03"
5.035 m 40° 13' 29"
5.105 m 53° 13' 29"
2 BED TYPE 4 106.40 m² 44.40 m²
1 BEDTYPE 1A 67.50 m² 34.00 m²
2 BEDTYPE 3B 95.50 m² 31.20 m²
1 BEDTYPE 1A 65.10 m² 17.00 m²
1 BED TYPE 2 80.50 m² 33.00 m²
2 BED TYPE 4 106.40 m² 67.20 m²
2 BED Type 3B 95.50 m² 31.20 m²
1 BEDTYPE 1A 65.10 m² 17.00 m²
1 BEDTYPE 1A 65.10 m² 17.00 m²
1 BEDTYPE 1A 67.50 m² 34.00 m²
2 BED TYPE 4 106.40 m² 44.40 m²





PRELIMINARY

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No.	Amendment	Date
B	Preliminary Issue	04.09.23

Project
ATV REDEVELOPMENT
222 Waldron Road & 138 Campbell Hill Road, Chester Hill

Drawing
BASEMENT FLOOR PLAN - OVERALL

CENTURION GROUP
YOUR TRUSTED ADVISOR

Abel Tasman Village
A Culture of Care

boffa robertson group
architecture, health and aged care planning, project management
Suite 7, Level 1 Epica, 9 Railway Street
Chatswood NSW 2067
AUSTRALIA
Tel. (02) 9406 7000
Fax. (02) 9406 7099
Email : brgroup@brgr.net

Date	08/09/22	Job No. : Drawing	
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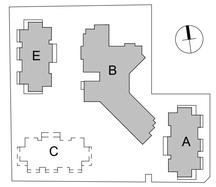
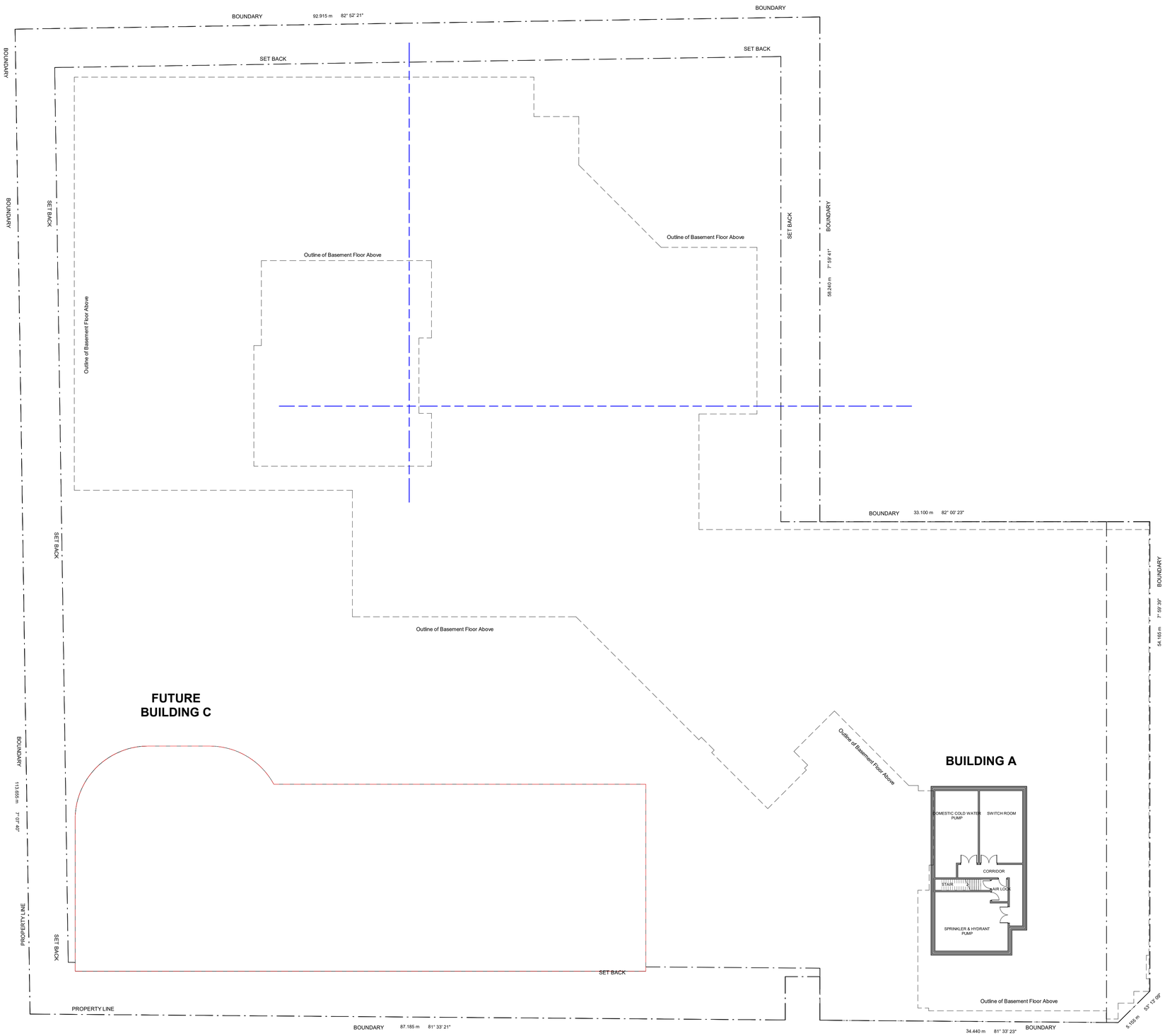
Drawn	Author		
Amendment	B		





PRELIMINARY

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SCALE: 1:100

No.	Amendment	Date
B	Preliminary Issue	04.09.23

Project
ATV REDEVELOPMENT
222 Waldron Road & 138 Campbell Hill Road, Chester Hill

LOWER BASEMENT FLOOR PLAN - OVERALL

CENTURION GROUP
YOUR TRUSTED ADVISOR

Abel Tasman Village
A Culture of Care

boffa robertson group
architecture, health and aged care planning, project management
Suite 7, Level 1 Epica, 9 Railway Street
Chatswood NSW 2067
AUSTRALIA
Tel. (02) 9406 7000
Fax. (02) 9406 7099
Email : brgroup@brgr.net

Date	03/16/23	Job No. : Drawing	
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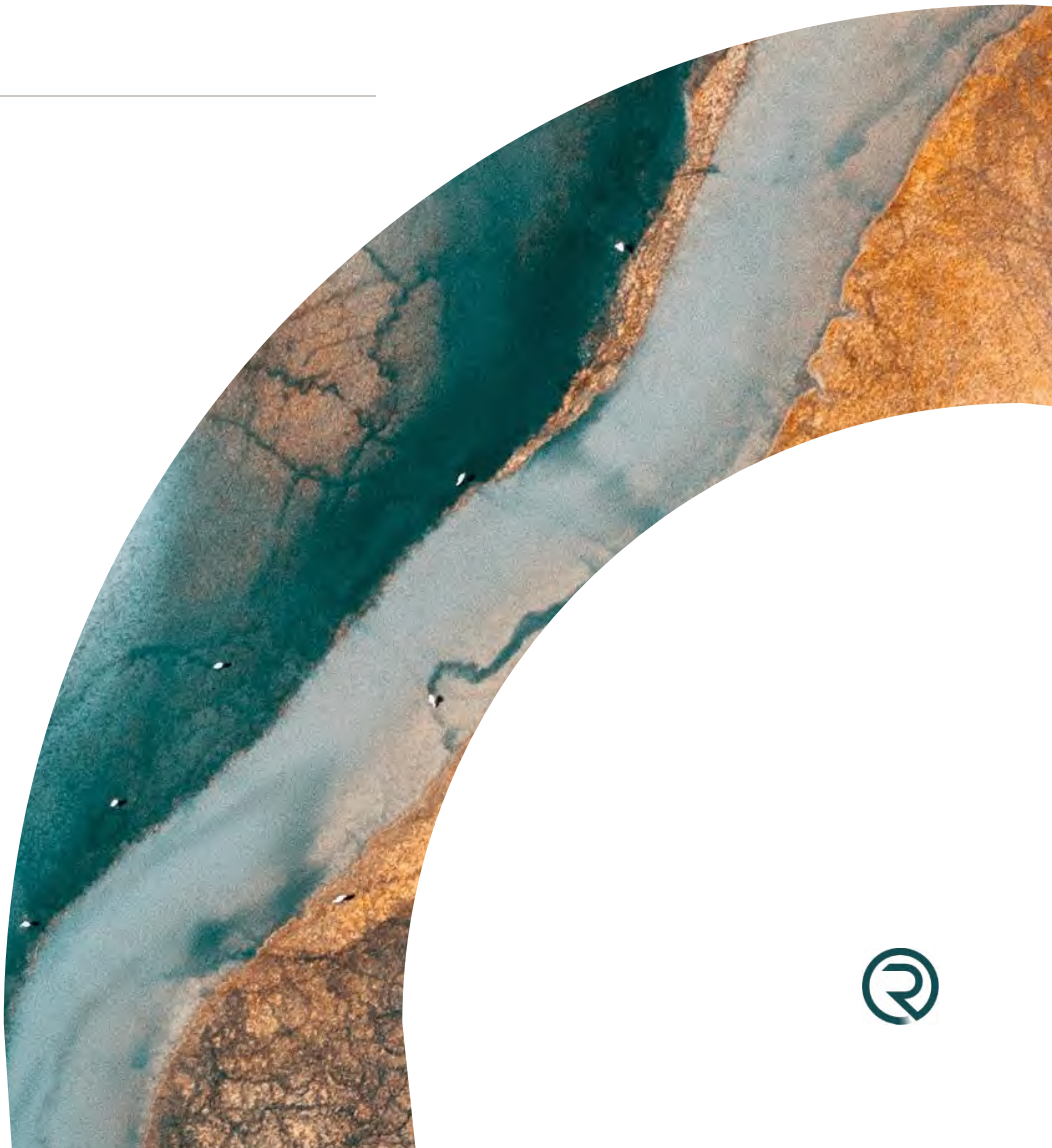
Drawn	Author		
Amendment	B		

C

Borehole & Monitoring Well Logs



Borehole Log

Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**BH1**
Project Number:	**13126**
Hole Depth:	**4.00 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**
Client:	**Chevelle**
Drilling Company:	**Numac Drilling**
Drill Method:	**Hand Auger / Solid Stem Auger**

Date Started:	**14/01/2014**
Date Completed:	**14/01/2014**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
CC		0.13				Fill	**CONCRETE**.				
		0.20					**FILL** - SAND.				
Hand Auger		0.5			CL		**Silty CLAY** - red / grey mottled, plastic, with subrounded gravel.	slightly moist	0.6	BH1_0.5	
		1.00							0.3	BH1_1.0	
Solid Stem Auger		1.5			CL		**Silty CLAY** - grey, some red mottles, becoming stiff, plastic.	slightly moist	0.1		
		2.00				Natural	**Weathered SHALE** - light brown, stiff, some clay bands.	slightly moist			
		2.5									
		3.0							0.3		
		3.5									
		4.00							0.1	BH1_4.0	
							End of Hole at 4.00 m				

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Colin Biggs**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove**
		Date:	**14/01/2014**
		Date:	**23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:34:58 PM

Borehole Log

Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**BH2**
Project Number:	**13126**
Hole Depth:	**4.00 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**
Client:	**Chevelle**
Drilling Company:	**Numac Drilling**
Drill Method:	**Hand Auger / Solid Stem Auger**

Date Started:	**14/01/2014**
Date Completed:	**14/01/2014**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
CC		0.15				Fill	**CONCRETE**.				
Hand Auger		0.30				Fill	**FILL** - Sandy CLAY, dark brown, 2% rootlets, <5% siltstone lithics.	moist	805	BH2_0.2	Strong hydrocarbon odour.
		0.5			CL	Natural	**Silty CLAY** - brown, plastic. Orange brown from 0.5m. blueish grey from 0.6m, >50% orange mottling.	moist	899.1 953.3	BH2_0.5	High PID result ikely associated with a former leaky fuel line to the bowser in the vicinity of BH2. The site representative J McHale indicated the leaky fuel line had been removed approximately 15 years previous.
		1.0							562	BH2_1.0	
		1.50			CL		<20% mottling from 1.2m, grades to blueish grey with <10% reddish orange mottling, stiff, rootlets, crumbly.	slightly moist	62.1	BH2_1.5	
Solid Stem Auger		2.00					**Weathered SILTSTONE / Silty CLAY** - 50% reddish brown siltstone lithics, 50% blueish grey orange silty clay.	slightly moist			Top of weathering profile at 1.5m.
		2.5					**Weathered Clayey SILTSTONE**.	dry	1.3		
		3.0							50		
		3.5									
		4.00					**End of Hole at 4.00 m**		2.5	BH2_4.0	

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Claire Hardgrove**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove**
		Date:	**14/01/2014**
		Date:	**23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:34:59 PM

Borehole Log

Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**BH3**
Project Number:	**13126**
Hole Depth:	**4.00 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**
Client:	**Chevelle**
Drilling Company:	**Numac Drilling**
Drill Method:	**Hand Auger / Solid Stem Auger**

Date Started:	**14/01/2014**
Date Completed:	**14/01/2014**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
CC		0.15				Fill	**CONCRETE**.				
Hand Auger		0.20					**FILL** - Silty SAND, well sorted.	damp	---	BH3_0.2	
		0.5			CL		**Silty CLAY** - brownish orange with red mottling, weathering to dark brown, with shale fragments, minor vegetation (rootlets), angular lithics. Orange brown from 0.5m. blueish grey clay from 0.6m, orange mottling.	moist	1.2		
									---	BH3_0.5	Rootlets rare below 0.4m, <5% rounded mudstone grits.
		1.0									Branches from 0.65 to 0.75m, 2-5% vegetation (twigs / bark).
									0.5		15% bark at 1.0m, tree roots common for 100mm.
							Dark orange red mottling intensifying, possible of water pathway.				Mottling and moisture decrease from 1.2m, vegetation absent.
		1.46									
		1.50			CL		**Silty CLAY** - grey, stiff, micaceous, <1% rootlets, <10% mottling, red lithic siltstone fragments.	sl.moist	0.2		
Solid Stem Auger							**Weathered SILTSTONE** - grey, increasing lithics.	dry			
		2.00				Natural			0.5		
							Weathered Clayey SILTSTONE - brown.	dry			
		2.5									
		3.0							1.0		
		3.5									
		4.00							0.4	BH3_4.0	
							End of Hole at 4.00 m				

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Claire Hardgrove**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove**
		Date:	**14/01/2014**
		Date:	**23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:35:01 PM

Monitoring Well Log

Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**BH4/MW3**
Project Number:	**13126**
Hole Depth:	**7.00 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**	Date Started:	**15/01/2014**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**	Date Completed:	**15/01/2014**
Client:	**Chevelle**	Ground Level :	
Drilling Company:	**Numac Drilling**	Top of Casing :	
Drill Method:	**Hand Auger / Solid Stem Auger**	Easting:	
		Northing:	

Method	Depth (mbgl)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments	Well Details	Well Construction
CC	0.15			Fill	**CONCRETE**.						Gatic
Hand Auger	0.40			Fill	**FILL** - Silty SAND, brown, well sorted.	moist	0.1	BH4_0.2			
	0.5		CL	Natural	**Silty CLAY** - blueish grey, 20% orange mottling increasing to 60% at 0.8m.	slightly moist	0.2	BH4_1.0	Faint hydrocarbon odour at 0.5m? <5% root matter at 0.6m, sandier, increasing plasticity.		Grout
	1.20										
Solid Stem Auger	1.5		CL		**Weathered SILTSTONE / Silty CLAY** - dark brown / blueish grey, 40% lithics.	slightly moist	0.1		Black brown shale grits to 5mm at 0.7m.	1.50	
	2.0				Grey layered silty clays, laminations well preserved, stiff.	dry	0.1		Plasticity decreasing from 0.9m, low moisture, gravel gone, no vegetation, stiff. 30% mottling at 1.1m. Sample falling off bottom of auger from 1.2m.		Bentonite
	2.70				**Weathered SILTSTONE** - dark brown.	dry					
	3.00				**Silty CLAY** - brown, <30% siltstone lithics.	dry	0.1			3.50	
	3.5		CL								
	4.00				**Silty CLAY** - brown.	dry	0.2		Progress slowed below 4.0m.		Gravel Pack
	4.50		CL		**Weathered SILTSTONE** - brown.	dry					
	5.0				Moderately hard from 5.0m, decreasing to slightly hard at 6.5m.		0.1				
	5.5										Screen
	6.0						0.3				
	6.50				**Weathered MUDSTONE** - brown.	dry					
	7.00				**Silty CLAY at 7.0m** - brown, soft, plastic.	sl.moist	0.1	BH4_7.0	Progress slowed below 6.8m for about 0.2m.		
	7.5				**End of Hole at 7.00 m** Refusal.						

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Claire Hardgrove**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove**
		Date:	**15/01/2014**
		Date:	**23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:35:02 PM

Monitoring Well Log

Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**BH5/MW2**
Project Number:	**13126**
Hole Depth:	**7.50 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**
Client:	**Chevelle**
Drilling Company:	**Numac Drilling**
Drill Method:	**Hand Auger / Solid Stem Auger**

Date Started:	**15/01/2014**
Date Completed:	**15/01/2014**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Depth (mbgl)	USCS Symbol	Material Type	Material Description	Moisture	PID ppm	ID No.	DUP TRIP	Observations / Comments
CC	0.15		Fill	**CONCRETE**.					
Hand Auger	0.20	CL		**FILL** - SAND, orange, medium grained, well sorted, well rounded.	slightly moist	0.0	BH5_0.2		Peaty odour.
	0.5			**Silty CLAY** - blueish green to orange, high plasticity, very fine to fine, thinly laminated, <2% sand. Decreasing grained size to very fine silty clay, alternating plastic and dry / crumbly layers between 0.8 and 1.0m.		0.1			
	1.00				very dry	0.2	BH5_1.0		Tree root at 0.6m. Band of decomposing tree roots 0.6 to 0.8m, 50mm gravelly layer at 0.65m (blueish red, very fine grained sandstone gravel up to 8mm). Dry and crumbly layer at 0.8m with soft weathered lithics (clayey siltstone) up to 20mm for 50mm. Hand auger refusal at 1.0m.
	1.5								
	2.0			**Weathered Silty SHALE** - brown, breaks between fingers but doesn't crumble, micaceous.		0.0			
	2.5								
	3.0					0.1			
	3.5				very dry				
Solid Stem Auger	4.0		Natural			0.1			
	4.5								
	5.0					0.2			
	5.5								
	6.0					0.2			
	6.5			Colour changes slightly at 6.5m from brown to blackish brown.					
	7.00			**Silty CLAY and Weathered Silty SHALE** - plastic.	dry	1.2			
	7.50					0.6	BH5_7.3 BH5_7.5	Dup1 Trip1	
	8.0			**End of Hole at 7.50 m** Refusal.					

Well Details: Gatic; Grout; 1.50; Bentonite; 3.50; Gravel Pack; Screen

Well Construction

Additional Comments

Dup1 / Trip 1 from BH5_7.5.

Strike Groundwater Level Static Groundwater Level

Log Drawn By: Laurie White
Contact: laurie.white@reumad.com.au

Logged By: **Claire Hardgrove** Date: **15/01/2014**
Checked By: **Claire Hardgrove** Date: **23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:35:04 PM

Borehole Log

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Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**BH6**
Project Number:	**13126**
Hole Depth:	**1.50 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**	Date Started:	**15/01/2014**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**	Date Completed:	**15/01/2014**
Client:	**Chevelle**	Ground Level :	
Drilling Company:	**Numac Drilling**	Top of Casing :	
Drill Method:	**Hand Auger / Solid Stem Auger**	Easting:	
		Northing:	

Method	Depth (mbgl)	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
CC	0.15	**CONCRETE**.				
Hand Auger	0.20	**FILL** - SAND, orange, medium.	slightly moist	120	BH6_0.2	
	0.5	**FILL** - Silty CLAY, mottled orange / red / grey, plastic, shale fragments.		17.6	BH6_0.5	Slight hydrocarbon odour, hydrocarbon sheen in 0.5m sample.
Solid Stem Auger	1.0	Slightly stiff at 0.8m, gradually increasing and stiffer to 0.9m. Weathered clayey siltstone fragments and very fine grained sandy siltstone, micaceous.		13.5	BH6_0.9	Sample quantity low. Hand auger refusal at 0.9m.
	1.50	**End of Hole at 1.50 m** Terminated on pipe. Hole relocated.				
	2.0					
	2.5					
	3.0					
	3.5					
	4.0					

Water Level: Fill
USCS Symbol:
Material Type: Fill
Graphic Log: Concrete

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Claire Hardgrove**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove**
		Date:	**15/01/2014**
		Date:	**23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:35:05 PM

Borehole Log

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2 Locomotive Street
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Tel: +61 (0)2 9690 2555
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Hole ID.	**BH6A/MW1**
Project Number:	**13126**
Hole Depth:	**6.80 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**	Date Started:	**15/01/2014**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**	Date Completed:	**15/01/2014**
Client:	**Chevelle**	Ground Level :	
Drilling Company:	**Numac Drilling**	Top of Casing :	
Drill Method:	**Hand Auger / Solid Stem Auger**	Easting:	
		Northing:	

Depth (mbgl)	Method	USCS Symbol	Material Type	Material Description	Moisture	PID ppm	ID No.	Observations / Comments
0.15	CC		Fill	**CONCRETE**.				
0.30	Hand Auger		Fill	**FILL** - CLAY with Sand pockets, brownish, blueish grey orange, orange sand, slightly plastic, sand is medium grained, well sorted, well graded.		0.7	BH6A_0.2	No hydrocarbon odour. 5% vegetation (rootlets, decaying roots).
0.5		CL	Fill			0.6	BH6A_0.5	No hydrocarbon odour. 5% vegetation.
0.90			Fill	**Silty CLAY** - blueish grey orange, slightly plastic, noticeably stiffer at 0.7m but still slightly plastic, orange mottled below 0.82m.		0.7 0.8 0.5	BH6A_0.9 BH6A_0.93 BH6A_1.0	2-3% reddish fill sand mixed in backfill at 0.7 to 0.8m, may be off side of hole, possibly weathered sandstone.
1.0			Fill	**Weathered Clayey SILTSTONE** - brown.		0.8		
1.50		ML	Fill	**Clayey SILT** - brown.				
2.00			Natural	**Clayey SILTSTONE** - brown, >50% lithics (brown hard siltstone, unable to be broken between fingers) in cuttings.		0.7		
2.5			Natural					
3.0			Natural	Lithics from below 3.0m can be broken by fingers (slightly competent).		0.6		
3.5	Solid Stem Auger		Natural					
4.00			Natural	**Clayey SILTSTONE** - grey, slightly competent.				
4.5			Natural					
5.00			Natural	**Clayey SILTSTONE** - brown.		0.4		
5.5			Natural					
6.00			Natural	**Silty SHALE** - blackish brown, slightly competent.	slightly moist	0.5	BH6A_6.0	
6.5			Natural					
6.80			Natural			0.6	BH6A_6.8	
7.0				**End of Hole at 6.80 m**				
7.5								

Well Details: Gatic; Grout; Bentonite; Gravel Pack; Screen; 1.50; 3.20

Well Construction

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Claire Hardgrove** Date: **15/01/2014**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove** Date: **23/01/2014**

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Borehole Log

Environmental Strategies Pty Ltd
Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**BH7**
Project Number:	**13126**
Hole Depth:	**4.00 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**
Client:	**Chevelle**
Drilling Company:	**Numac Drilling**
Drill Method:	**Hand Auger / Solid Stem Auger**

Date Started:	**14/01/2014**
Date Completed:	**14/01/2014**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
CC		0.05				Fill	**CONCRETE fragments**.	dry	3.4	BH7_0.1	Insufficient material for sample of roadbase.
		0.10				Fill	**ROADBASE**.	dry			
Hand Auger		0.30				Fill	**FILL** - Clayey Sandy SILT, brown.	dry			Material 0.1 to 0.3m is possibly the upper part of natural with the fines eroded out. No obvious contact between fill and natural.
Solid Stem Auger		0.5			CL	Natural	**Silty CLAY** - orange / grey, 5% lithic fragments (siltstone).		0.7		
		1.0									
		1.5									
		2.0							0.1		
		2.50					grading to				
							Weathered SILTSTONE - brown, hard.	dry			Progress slowed from 2.5m.
		3.0					Very hard from 3.0m.		0.2		
		3.5									
		4.00							0.2	BH7_4.0	
							End of Hole at 4.00 m				

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Claire Hardgrove**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove**
		Date:	**14/01/2014**
		Date:	**23/01/2014**

ES LOG LT CHESTER HILL 13126.GPJ ES.GDT 23/1/14 3:35:08 PM

Borehole Log

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Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**BH8**
Project Number:	**13126**
Hole Depth:	**4.00 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**
Client:	**Chevelle**
Drilling Company:	**Numac Drilling**
Drill Method:	**Hand Auger / Solid Stem Auger**

Date Started:	**14/01/2014**
Date Completed:	**14/01/2014**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
CC		0.15				Fill	**CONCRETE**.				
Hand Auger		0.25					**FILL** - Sandy CLAY, blueish grey, 60% orange mottling, 5% grits.	slightly moist			
		0.50			CL		**Silty CLAY** - brown, black mottling, plastic, rare grits, reddish purple shale fragments up to 20mm.	slightly moist	0.5		
		1.0			CL		**Silty CLAY** - blueish grey, >50% orange mottling, plastic, rare sand and grits.				Malodourous natural smell at 0.7m. Tree branch up to 100mmØ and rootlets. Stiffer (more silt). 5% to 10% organic matter at 0.8m, intersection of 15% reddish mottling and >50% orange mottling. 40% mottled at 0.85m, <5% organics, <5% shale fragments to 10mm. 20% mottled at 1.1m, <5% organics, decreasing moisture down hole. No mottling at 1.2m, <5% organics. Cyclic deposition with immature soil horizons. Well preserved bedding at 1.4m. No bedding or vegetation visible.
		1.20			CL		**Silty CLAY** - alternating approximately 50mm layers or grey reddish brown silty clay and grey silty clay, grading into brown weathered shale from 1.4m.	slightly moist	0.4		
		1.45					**Weathered SHALE** - brown.				
Solid Stem Auger		1.5									
		2.00				Natural	**Sandy Silty CLAY** - brown.		0.2		
		2.5									
		3.0			CL		Upper part of Weathered Siltstone (Bringelly Shale) at 3.0m.		0.2		Increasing lithics in cuttings, increasing competence.
		3.5									
		4.00					Weathered SILTSTONE, brownish grey, (mostly lithics) at 4.0m.		0.2	BH8_4.0	
							End of Hole at 4.00 m				

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Claire Hardgrove**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove**
		Date:	**14/01/2014**
		Date:	**23/01/2014**

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Borehole Log

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Suite 15201, Locomotive Workshop
2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
www.environmentalstrategies.com.au

Hole ID.	**BH9/MW**
Project Number:	**13126**
Hole Depth:	**7.00 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**
Client:	**Chevelle**
Drilling Company:	**Numac Drilling**
Drill Method:	**Hand Auger / Solid Stem Auger**

Date Started:	**15/01/2014**
Date Completed:	**15/01/2014**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Depth (mbgl)	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
CC	0.15	**CONCRETE**.		0.7	BH9_0.15	
Hand Auger	0.30	**FILL** - Sandy CLAY, orange to clear sand, orange brown clay, sand is medium grained, well sorted, well rounded, 10% vegetation (roots).	dry	1.0		
	0.50		very moist	0.9	BH9_0.5	Peaty odour.
	0.60		dry			Slight hydrocarbon odour at 0.6m.
	1.0	**Silty CLAY / Sandy MUD** - black grey, very soft.	dry	0.7	BH9_1.0	2-3% orange to clear sand at 0.7m, rounded, medium grained, well sorted.
	1.40	**Silty CLAY** - orange brown, minor sand, <5% vegetation.	dry	0.4		Plastic from approximately 1.50 0.8m.
Solid Stem Auger	1.5	**Silty CLAY** - grey / blueish grey to orange, 5% vegetation.				
	2.00	**Silty CLAY** - brown, slightly stiff, top of shale.	dry	0.3		Slightly plastic form 1.0m, very fine sand / siltstone lithic fragments <5%, decreasing plasticity down hole.
	2.5	**Silty CLAY** - brown, 20% lithics (weathered silty mudstone).				Hand auger refusal at 1.5m.
	3.00	**Weathered Clayey SILTSTONE** - orange brown, >50% lithics, slightly hard but can snap with fingers.	dry	0.2		
	3.5					3.50
	4.0		very dry	0.2		Progress slowed and very dry from 4.0m, very hard.
	4.5					
	5.00	**Weathered Clayey SILTSTONE** - greyish brown.	very dry	0.4		
	5.5					
	6.00	**Weathered Clayey SILTSTONE (50%) / Silty CLAY (50%)** - greyish brown, slightly plastic.	slightly moist	0.2		Decreasing dryness.
	6.5					
	7.00			0.3	BH9_7.0	Clay balling in auger.
	7.5	**End of Hole at 7.00 m** Refusal.				

Fill: CL, CL, CL, CL, CL

Natural

Well Details: Gatic, Grout, Bentonite, Gravel Pack, Screen

Well Construction

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Claire Hardgrove** Date: **15/01/2014**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove** Date: **23/01/2014**

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Borehole Log

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2 Locomotive Street
Eveleigh NSW 2012
Tel: +61 (0)2 9690 2555
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Hole ID.	**BH10**
Project Number:	**13126**
Hole Depth:	**4.00 m**
Sheet:	**1 of 1**

Project Name:	**Chester Hill**
Location / Site:	**138-140 Campbell Hill Road, Chester Hill NSW**
Client:	**Chevelle**
Drilling Company:	**Numac Drilling**
Drill Method:	**Hand Auger / Solid Stem Auger**

Date Started:	**14/01/2014**
Date Completed:	**14/01/2014**
Ground Level :	
Top of Casing :	
Easting:	
Northing:	

Method	Water Level	Depth (mbgl)	RL (mAHD)	Graphic Log	USCS Symbol	Material Type	Material Description	Moisture	Samples / Tests: PID ppm	Samples / Tests: ID No.	Observations / Comments
							Grass on surface.				
Hand Auger		0.20				Fill	**FILL** - Silty SAND, with coarse angular gravel to 10mm, concrete cobbles, foreign material including glass, radiator cap.				
		0.5			CL		**Silty CLAY** - reddish brown, stiff, with 5% rounded shale gravels <5mm, weathered shales.	dry	0.2 0.2	BH10_0.5	
		1.00							0.2		
Solid Stem Auger		1.5			CL		**Silty CLAY** - grey, 40% red mottling, extremely weathered shale.	dry			Change in lithology is gradational to 3.0m.
		1.70									
		2.0			CL	Natural	**Silty CLAY** - brownish grey, weathered shale. With 15% orange mottling below 2.0m.	dry	0.2		
		2.5									
		2.90									
		3.00					**Weathered Clayey SILTSTONE** - micaceous.		0.2		
					CL		**Sandy Silty CLAY** - brown, 30% orange mottling, with <5% sand, with <10% angular siltstone fragments.	dry			
		3.50							0.2		
							Weathered Clayey SILTSTONE - micaceous.				
		4.00							0.5	BH10_4.0	
							End of Hole at 4.00 m				

Additional Comments

Strike Groundwater Level Static Groundwater Level

Log Drawn By:	Laurie White	Logged By:	**Claire Hardgrove** Date: **14/01/2014**
Contact:	laurie.white@reumad.com.au	Checked By:	**Claire Hardgrove** Date: **23/01/2014**

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Soil and Rock Explanation Sheets (1 of 2)

Log Abbreviations & Notes

METHOD

borehole logs		excavation logs	
AS	auger screw *	NE	natural excavation
AD	auger drill *	HE	hand excavation
RR	roller / tricone	BH	backhoe bucket
W	washbore	EX	excavator bucket
CT	cable tool	DZ	dozer blade
HA	hand auger	R	ripper tooth
D	diatube		
B	blade / blank bit		
V	V-bit		
T	TC-bit		

* bit shown by suffix e.g. ADV

coring
NMLC, NQ, PQ, HQ

SUPPORT

borehole logs		*excavation logs*	
N	nil	N	nil
M	mud	S	shoring
C	casing	B	benched
NQ	NQ rods		

CORE—LIFT

casing installed

barrel withdrawn

NOTES, SAMPLES, TESTS

D	disturbed
B	bulk disturbed
U50	thin-walled sample, 50mm diameter
HP	hand penetrometer (kPa)
SV	shear vane test (kPa)
DCP	dynamic cone penetrometer (blows per 100mm penetration)
SPT	standard penetration test
N*	SPT value (blows per 300mm) * denotes sample taken
Nc	SPT with solid cone
R	refusal of DCP or SPT

USCS SYMBOLS

GW	Gravel and gravel-sand mixtures, little or no fines.
GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels
GM	Gravel-silt mixtures and gravel-sand-silt mixtures.
GC	Gravel-clay mixtures and gravel-sand-clay mixtures.
SW	Sand and gravel-sand mixtures, little or no fines.
SP	Sand and gravel sand mixtures, little or no fines.
SM	Sand-silt mixtures.
SC	Sand-clay mixtures.
ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity.
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays.
OL	Organic silts
MH	Inorganic silts
CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity, organic silt
PT	Peat, highly organic soils.

MOISTURE CONDITION

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

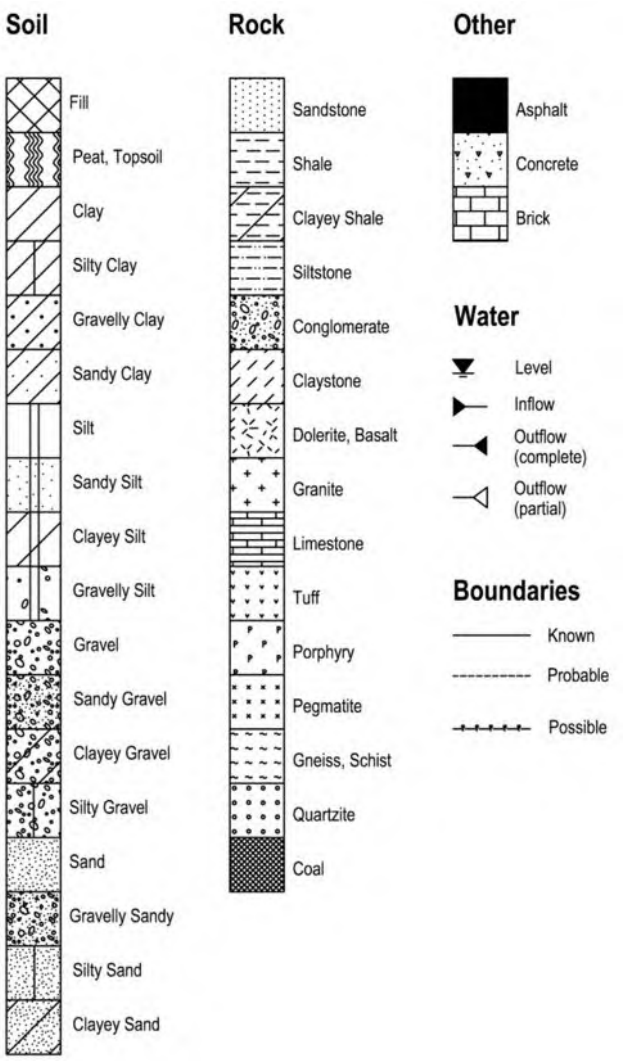
CONSISTENCY

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable

DENSITY INDEX

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Graphic Log



WEATHERING

XW	extremely weathered
HW	highly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

STRENGTH

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

RQD (%)

= sum of intact core pieces > 2 x diameter x 100
total length of core run drilled

DEFECTS:

type		*coating*	
JT	joint	cl	clean
PT	parting	st	stained
SZ	shear zone	ve	veneer
SM	seam	co	coating

shape		*roughness*	
pl	planar	po	polished
cu	curved	sl	slickensided
un	undulating	sm	smooth
st	stepped	ro	rough
ir	irregular	vr	very rough

inclination
measured above axis and perpendicular to core

Soil and Rock Explanation Sheets (2 of 2)

AS1726-2017

Soils and rock are described in the following terms, which are broadly in accordance with AS1726-2017.

Soil

MOISTURE CONDITION

Term	Description
Dry	Looks and feels dry. Fine grained and cemented soils are hard, friable or powdery. Uncemented coarse grained soils run freely through hand.
Moist	Soil feels cool and darkened in colour. Fine grained soils can be moulded. Coarse soils tend to cohere.
Wet	As for moist, but with free water forming on hand.

Moisture content of cohesive soils may also be described in relation to plastic limit (W_P) or liquid limit (W_L) [>> much greater than, > greater than, < less than, << much less than].

CONSISTENCY OF FINE-GRAINED SOILS

Term	Su (kPa)	Term	Su (kPa)
Very soft	< 12	Very Stiff	>100 – ≤200
Soft	>12 – ≤25	Hard	> 200
Firm	>25 – ≤50	Friable	–
Stiff	>50 – ≤100		

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Term	Density Index (%)	Term	Density Index (%)
Very Loose	< 15	Dense	65 – 85
Loose	15 – 35	Very Dense	>85
Medium Dense	35 – 65		

PARTICLE SIZE

Name	Subdivision	Size (mm)
Boulders		> 200
Cobbles		63 – 200
Gravel	coarse	19 – 63
	medium	6.7 – 19
	fine	2.36 – 6.7
Sand	coarse	0.6 – 2.36
	medium	0.21 – 0.6
	fine	0.075 – 0.21
Silt & Clay		< 0.075

MINOR COMPONENTS

Term	Proportion by Mass:	
	coarse grained	*fine grained*
Trace	≤ 15%	≤ 5%
With	>15% – ≤30%	>5% – ≤12%

SOIL ZONING

Layers	Continuous across exposures or sample.
Lenses	Discontinuous, lenticular shaped zones.
Pockets	Irregular shape zones of different material.

SOIL CEMENTING

Weakly	Easily broken up by hand pressure in water or air.
Moderately	Effort is required to break up by hand in water or in air.

USCS SYMBOLS

Symbol	Description
GW	Gravel and gravel-sand mixtures, little or no fines.
GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels.
GM	Gravel-silt mixtures and gravel-sand-silt mixtures.
GC	Gravel-clay mixtures and gravel-sand-clay mixtures.
SW	Sand and gravel-sand mixtures, little or no fines.
SP	Sand and gravel sand mixtures, little or no fines.
SM	Sand-silt mixtures.
SC	Sand-clay mixtures.
ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity.
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays.
OL	Organic silts
MH	Inorganic silts
CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity, organic silt
PT	Peat, highly organic soils.

Rock

SEDIMENTARY ROCK TYPE DEFINITIONS

Rock Type	Definition (more than 50% of rock consists of …..)
Conglomerate	... gravel sized (>2mm) fragments.
Sandstone	... sand sized (0.06 to 2mm) grains.
Siltstone	... silt sized (<0.06mm) particles, rock is not laminated.
Claystone	... clay, rock is not laminated.
Shale	... silt or clay sized particles, rock is laminated.

LAYERING

Term	Description
Massive	No layering apparent.
Poorly Developed	Layering just visible. Little effect on properties.
Well Developed	Layering distinct. Rock breaks more easily parallel to layering.

STRUCTURE

Term	Spacing (mm)	Term	Spacing
Thinly laminated	<6	Medium bedded	200 – 600
Laminated	6 – 20	Thickly bedded	600 – 2,000
Very thinly bedded	20 – 60	Very thickly bedded	> 2,000
Thinly bedded	60 – 200		

STRENGTH (NOTE: Is50 = Point Load Strength Index)

Term	Is50 (MPa)	Term	Is50 (MPa)
Extremely Low	<0.03	High	1.0 – 3.0
Very low	0.03 – 0.1	Very High	3.0 – 10.0
Low	0.1 – 0.3	Extremely High	>10.0
Medium	0.3 – 1.0		

WEATHERING

Term	Description
Residual Soil	Material is weathered to an extent that it has soil properties. Rock structures are no longer visible, but the soil has not been significantly transported.
Extremely …..	Material is weathered to the extent that it has soil properties. Mass structures, material texture & fabric of original rock is still visible.
Highly …..	Rock strength is significantly changed by weathering; rock is discolored, usually by iron staining or bleaching. Some primary minerals have weathered to clay minerals.
Moderately …..	Rock strength shows little or no change of strength from fresh rock; rock may be discolored.
Slightly …..	Rock is partially discolored but shows little or no change of strength from fresh rock.
Fresh	Rock shows no signs of decomposition or staining.

DEFECT DESCRIPTION

Type	
Joint	A surface or crack across which the rock has little or no tensile strength. May be open or closed.
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering/bedding. May be open or closed.
Sheared Zone	Zone of rock substance with roughly parallel, near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects.
Seam	Seam with deposited soil (infill), extremely weathered insitu rock (XW), or disoriented usually angular fragments of the host rock (crushed).
Shape	
Planar	Consistent orientation.
Curved	Gradual change in orientation.
Undulating	Wavy surface.
Stepped	One or more well defined steps.
Irregular	Many sharp changes in orientation.
Roughness	
Polished	Shiny smooth surface.
Slickensided	Grooved or striated surface, usually polished.
Smooth	Smooth to touch. Few or no surface irregularities.
Rough	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper.
Very Rough	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper.
Coating	
Clean	No visible coating or discolouring.
Stained	No visible coating but surfaces are discolored.
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	Visible coating =1mm thick. Thicker soil material described as seam.

Borehole Log

BH no:	**BH101**
sheet:	1 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	4.5.2022
principal:		**finished:**	4.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	approx.
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
ADT	N	None observed during augering						Bitumen.	--	--		BITUMEN.
					0.075		GPS	FILL, gravelly, cemented SAND, fine to medium grained, subangular gravels, brown/ dark grey.	D	MD?		FILL. Appeared to be well-compacted.
					0.15		CL-CH	CLAY, medium to high plasticity, yellow brown with traces of pale grey.	<Wp	VSt		RESIDUAL.
					0.5							
					1.0						× 120	
			D		1.5							
					1.6			SHALE/SILTSTONE, HW-XW, clayey, silty matrix, light grey, very low strength, assessed as Class 5 Shale/Siltstone.				BEDROCK. High TC-bit resistance.
					2.0			Borehole No: BH101 continued as cored hole from 2m				Auger TC-bit refusal @ 2.0m on less weathered Shale.
					2.5							
					3.0							
					3.5							
					4.0							
					4.5							
					5.0							

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Cored Borehole Log

BH no:	**BH101**
sheet:	2 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	4.5.2022
principal:		**finished:**	4.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH MPa)	$Is_{(50)}$ MPa (D=diametral ×, A=axial ○)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating (specific / general)
				1.5								
				1.6								
				2.0		Continued from non-cored borehole from 2m						
NMLC				2		SHALE, brown/ pale brown with dark grey lamination, generally thinly laminated, subhorizontal lamination, slightly fractured.	SW					
				2.18		CLAY INFILL.	MW					
				2.22		SHALE, dark grey with brown layering, generally thinly laminatedm subhorizontal lamination, slightly fractured.						
				2.5								
				2.67		CLAY INFILL.	MW					JT, 87°, sm, cl, pl.
				2.71		SHALE, dark grey/ brown/ dark brown with some pale grey, generally thinly laminated, subhorizontal lamination, slightly fractured.				81		
				3.0								FZ
				3.5								
				3.9		SHALE, dark grey/ brown/ pale grey, generally thinly laminated, subhorizontal lamination, moderately fractured, ironstained, well-developed layering.	MW - HW					PT, 5°, PT, un, ro, filled, ct.
				4.0								
				4.5					D=0.02 A=0.05	88		FZ
				5.0								JT, 68°, un, ro, filled, clay.
				5.4		SHALE/ SILTSTONE, pale grey with dark grey lamination, subhorizontal to horizontal lamination, generally thinly to very thinly laminated.	SW - FR					PT, 0°, un, ro, closed.
				5.5								JT, 65°, un, ro, filled.
				6.0								PT, 0-3°, un, ro, filled.
												PT, 0-3°, un, ro, filled, ct.

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Cored Borehole Log

BH no:	**BH101**
sheet:	3 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	4.5.2022
principal:		**finished:**	4.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	$Is_{(50)}$ MPa (D=diametral ×, A=axial o)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC				6.5		SHALE/ SILTSTONE, pale grey with dark grey lamination, subhorizontal to horizontal lamination, generally thinly to very thinly laminated. *(continued)*	SW - FR		D=0.37 A=0.43	88		PT, 0°, un, ro, tight. PT, 0°, un, ro, tight.
				7.0								XW, SM, 20mmt.
												PT, 3-5°, un, ro, cl. VJ, 87°, pl, sm, cl.
				7.3		Sandstone interbedded with SILTSTONE, light grey with dark grey lamination, generally very thinly laminated, subhorizontal lamination.	FR			95		XW, Sm, 20mmt.
				7.5								PT, 0°, un, ro, filled.
				8.0					D=1.06			PT, 5-8°, un, ro, filled.
				8.12		NMLC terminated @ 8.12m, target depth. BH101 terminated at 8.12m			A=5.12			
				8.5								
				9.0								
				9.5								
				10.0								
				10.5								
				11.0								

6851 BOREHOLE LOGS.GPJ 21/5/22

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PROPOSED REDEVELOPMENT,
Abel Tasman Village
Chester Hill NSW
for
Centurion Project Management

CORE PHOTO – BH101

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date: 11.5.22
checked: AT
scale: 1:4 @ A4

job no.: 6851
fig: —
issue: A

Borehole Log

BH no:	**BH102**
sheet:	1 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	4.5.2022
principal:		**finished:**	4.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	approx.
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
ADT	N	None observed during auger drilling			0.04		SP	PAVERS.	--	--		PAVER
					0.5			FILL, SAND with some clay/ Sandy CLAY, dark brown/ brown, fine to medium grained,15-20% gravels, subangular gravels, low to medium plasticity.	D	D?		FILL. (SUBBASE + SUBGRADE). Appeared to be moderately compacted.
					1.0							
					1		CL-CH	CLAY, medium to high plasticity, red brown/ pale grey/ pale brown.	<Wp	VSt?		RESIDUAL.
					1.5			Borehole No: BH102 continued as cored hole from 1.3m				Auger TC-bit refusal @ 1.3m on less weathered Shale
					2.0							
					2.5							
					3.0							
					3.5							
					4.0							
					4.5							
					5.0							

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Cored Borehole Log

BH no:	**BH102**
sheet:	2 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	4.5.2022
principal:		**finished:**	4.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	$Is_{(50)}$ MPa (D=diametral ×, A=axial o)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
				1		Continued from non-cored borehole from 1.3m						
NMLC				1.3		SILTSTONE, brown/ pale grey, clay bands, thinly to medium bedded, slightly fractured.	MW					PT, stepped, filled, vr.
				1.5								clay infill.
				2.0					D=0.69			PT, 3-5°, un, ro, filled, clay.
				2		SILTSTONE, pale grey/ brown with orange brown/ red brown layering, slightly fractured, ironstained.	SW - MW		A=1.17	93		PT, 3-5°, un, ro, cl.
				2.5								PT, 0-3°, un, ro, filled, clay.
				2.8		SHALE interbedded with SILTSTONE, dark grey/ dark brown/ pale grey with dark grey lamination, generally thinly laminated, subhorizontal lamination, slightly fractured, ironstained.	MW					FZ
				3.0								
				3.5					D=0.01			XW, SM, 20mmt.
									A=0.14	92		
				4.0								PT, 0-3°, un, ro, cl.
				4.18		SHALE interbedded with SILTSTONE, dark brown/ brown/ pale grey with dark grey lamination, generally thinly laminated, horizontal lamination, slighly fractured, poorly to well-developed layering.						JT, 10°, un, ro, cl. JT, curved, un, ro, cl.
				4.5								PT, 0-3°, un, ro, cl.
												XW, SM, 30mmt.
				5.0								PT, 0-3°, un, ro, closed.
												XW, SM, 30mmt.
				5.5					D=0.03	95		curved, un, ro, cl.
									A=0.52			
				6.0								JT, 10°, stepped, ro, st.

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Cored Borehole Log

BH no:	**BH102**
sheet:	3 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	4.5.2022
principal:		**finished:**	4.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength (MPa: EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	$Is_{(50)}$ MPa (D=diametral ×, A=axial ○)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC							MW			95		JT, 5-7°, un, ro, cl. JT, 55°, un, ro, cl.
				6.23		SHALE interbedded with SILTSTONE, dark grey/ brown grey with pale grey lamination, generally thinly laminated, horizontal lamination, slighly fractured.	SW - MW					FZ
				6.5								
				7.0								XW, SM, 30mmt.
				7.5						96		
				7.44		SILTSTONE interbedded with SHALE, pale grey/ dark grey, generally thinly to very thinly laminated, horizontal lamination.	SW - FR		D=0.22 A=1.24			VJ, 89°, un, ro, filled.
				8.0								
				8.19		NMLC terminated @ 8.19m, target depth. BH102 terminated at 8.19m						
				8.5								
				9.0								
				9.5								
				10.0								
				10.5								
				11.0								

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Chester Hill NSW
for
Centurion Project Management

CORE PHOTO – BH102

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date: 11.5.22
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Borehole Log

BH no:	**BH103**
sheet:	1 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	4.5.2022
principal:		**finished:**	5.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	approx.
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetro-meter kPa (100 200 300 400)	structure and additional observations
ADT	N	None Observed during auguring					CL	TOPSOIL, CLAY with some silt, medium to high plasticity, dark brown, rootlets.	<Wp	St-VSt?		TOPSOIL.
					0.3		CH	CLAY, medium to high plasticity, brown/ orange brown.				RESIDUAL.
			D		0.5							
					1.0							
					1.3			SHALE/ SILTSTONE, brown, grading to pale grey, ~~XW-HW (remoulded to CLAY with some silt), very~~ low strength. Borehole No: BH103 continued as cored hole from 1.4m				BEDROCK. Auger TC-bit refusal @ 1.4m on less weathered bedrock.
					1.5							
					2.0							
					2.5							
					3.0							
					3.5							
					4.0							
					4.5							
					5.0							

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Cored Borehole Log

BH no:	**BH103**
sheet:	2 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	4.5.2022
principal:		**finished:**	5.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH MPa)	$Is_{(50)}$ MPa (D=diametral ×, A=axial o)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
				1.3		Continued from non-cored borehole from 1.4m						
NMLC				1.4		SHALE interbedded with SILTSTONE, generally thinly laminated, 5mm spacing, slightly to moderately fractured, dark grey/ dark brown/ orange brown, iron staining, remnant rock structure.	MW - HW			55		PT, 0°, pl, sm, cl. FZ PT, 0°, un, ro, cl. JT, 45°, un, ro, filled. PT, 0-3°, un, ro, cl.
				2.94		SILTSTONE interbedded with SHALE, brown/ dark brown with dark grey laminaiton, subhorizontal lamination, 5mm spacing, generally thinly laminated, ironstone staining.	SW		D=0.01 A=0.23	95		PT, 4°, un, ro, st. PT, 5-7°, un, ro, cl.
				4.1		SHALE, dark grey/ dark brown with brown layering and dark grey lamination, subhorizontal lamination, 3-5mm spacing, generally thinly laminated, ironstone staining, slightly fractured.			D=0.28 A=0.3	99		PT, 3-5°, un, ro, cl. PT, 3-5°, un, ro, cl. XW, Sm, 40mmt. VJ, 87°, un, ro, cl.

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BH no:	**BH103**
sheet:	3 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	4.5.2022
principal:		**finished:**	5.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

depth metres	RL	water	support & core-lift	method	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH MPa)	$Is_{(50)}$ MPa (D=diametral ×, A=axial o)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
							SW			99		PT, un, ro, 7°, filled.
6.14						SHALE, darkk grey, clayey, blocky matrix, 80% Shale; 20% clay, remnant rock structure.	MW - HW					JT, 48°, un, ro, filled, ct.
												XW, SM, 30mmt.
6.5 6.45						SILTSTONE, pale grey with dark grey lamination, horizontal lamination, generally very thinly laminated.	SW - FR					PT, 3°, un, ro, cl.
									D=0.44			
7.0									A=0.94	85		
7.5												
												JT, 8°, un, ro, filled, ct.
8.0									D=0.55			
8.09						NMLC terminated @ 8.09m, target depth. BH103 terminated at 8.09m			A=0.96			
8.5												
9.0												
9.5												
10.0												
10.5												
11.0												

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Centurion Project Management

CORE PHOTO – BH103

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issue: A

Borehole Log

BH no:	**BH104**
sheet:	1 of 1
job no.:	6851

client:	Centurion Project Management	**started:**	5.5.2022
principal:		**finished:**	5.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	approx.
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
ADT	N	None observed during auger drilling			0.075			Bitumen.	--	--		BITUMEN.
							CL	FILL, CLAY with some silt, brown, red brown, pale grey with traces of yellow brown, medium to high plasticity, trace of fines.	M	F-St?		FILL. Appeared to be moderately compacted.
			D		1.2		CL-CH	CLAY, red brown/ orange brown/ yellow brown, medium plasticity.	,Wp	St-VSt?		RESIDUAL.
					1.45			SILTSTONE/ SHALE, XW, very low to low strength, clayey, blocky matrix, remnant rock structure.				BEDROCK.
					1.82			Borehole No: BH104 terminated at 1.82m				Auger TC bit refusal on less weathered bedrock

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

6851 BOREHOLE LOGS.GPJ 21/5/22

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED — Borehole Log - Revision 10

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au

Borehole Log

BH no:	**BH105**
sheet:	1 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	5.5.2022
principal:		**finished:**	6.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	approx.
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
DT	N	None observed during augering						PAVERS.	--	--		PAVERS.
ADT					0.125		CL	CLAY with some silt and trace of sand, some gravels, 10-15% gravels, subangular gravels, dark brown/ brown/ yellow brown/ pale grey.	Wp	F-St?		FILL.
					0.35		CH	CLAY, brown, high plasticity.		St?		RESIDUAL.
					0.5							
					1.0							
			D		1		CL	SILTSTONE/ SHALE, XW, very low strength, (remoulded as CLAY with some silt with traces of fines), brown grey, low to medium plasticity, assessed as Class 5 Shale/Siltstione.				BEDROCK.
					1.5							
					2.0							
					2.1		SHALEY CLAY	SHALEY CLAY, XW SHALE, dark grey, low plasticity, blocky, clayey matrix, remnant rock structure, very low strength, assessed as Class 5 Shale.				
					2.5							
								Borehole No: BH105 continued as cored hole from 2.55m				Auger TC-bit refusal @ 2.55m on less weathered bedrock
					3.0							
					3.5							
					4.0							
					4.5							
					5.0							

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Cored Borehole Log

BH no:	**BH105**
sheet:	2 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	5.5.2022
principal:		**finished:**	6.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH MPa)	$Is_{(50)}$ MPa (D=diametral, A=axial)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating (specific / general)
				2.1								
				2.5		Continued from non-cored borehole from 2.55m						
NMLC				2.55		SILTSTONE, light grey with dark grey lamination, generally very thinly laminated, horizontal lamination.	SW - FR		D=1.76 A=2.27			PT, 0-3°, un, ro, ct. FZ, 20mmt.
				2.7		SILTSTONE interbedded with SHALE, brown with dark grey lamination, orange brown layering, generally very thinly laminated, subhorizontal lamination, clay bands.	MW					
				3.0					D=0.07 A=0.13	75		VJ, 85-87°, un, ro, cl. FZ, 20mmt. Clay Infill
				3.5								PT, 0°, un, ro, cl.
				3.5		SHALE/ SILTSTONE, pale grey/ dark grey with dark grey lamination, generally very thinly laminated, subhorizontal lamination.	SW - MW					JT, 10°, un, ro, st.
				4.0								
				3.95		SHALE, clayey/blocky matrix, dark grey/ dark brown, remnant rock structure.	XW					HFZ
				4.09		SHALE interbedded with SILTSTONE, pale grey/ brown with dark grey lamination, ironstone staining, subhorizontal lamination, generally thinly to very thinly laminated.	MW		D=0.49 A=0.06			PT, 0°, pl, sm, st.
				4.5								PT, 0°, un, ro, st.
				5.0						88		JT, 67°, un, ro, st. JT, 67°, un, ro, st.
				5.4					D=0.34 A=0.45			XW, SM, 20mmt. PT, 0-3°, un, ro, filled, clay. JT, 20°, un, ro, filled.
				5.5		SHALE/SILTSTONE, brown grading to dark grey, clayey, blocky matrix, remnant rock structure.	MW - HW					
				6.0								JT, 72°, un, ro, cl.
				6.3		SILTSTONE interbedded with SHALE, light grey with dark grey lamination, generally very thinly laminated, subhorizontal lamination.	FR			94		Pt, 0-3°, un, ro, cl.
				6.5								Pt, 0-3°, un, ro, cl. Pt, 0-3°, un, ro, cl. Pt, 0-3°, un, ro, st.
				7.0					D=0.4 A=1.61			

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Cored Borehole Log

BH no:	**BH105**
sheet:	3 of 3
job no.:	6851

client:	Centurion Project Management	**started:**	5.5.2022
principal:		**finished:**	6.5.2022
project:	Proposed Redevelopment	**logged:**	AT
location:	Abel Tasman Village	**checked:**	MAB
equipment:	Geo205 Tracked Rig	**RL surface:**	
diameter:	125mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log / core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength (MPa: EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	$Is_{(50)}$ MPa (D=diametral ×, A=axial o)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC				7.5		SILTSTONE interbedded with SHALE, light grey with dark grey lamination, generally very thinly laminated, subhorizontal lamination. *(continued)*	FR			94		
				7.5		NMLC terminated @ 7.5m, target depth. BH105 terminated at 7.5m						
				8.0								
				8.5								
				9.0								
				9.5								
				10.0								
				10.5								
				11.0								
				11.5								
				12.0								

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issue	date	description
A	11/5/22	INITIAL ISSUE

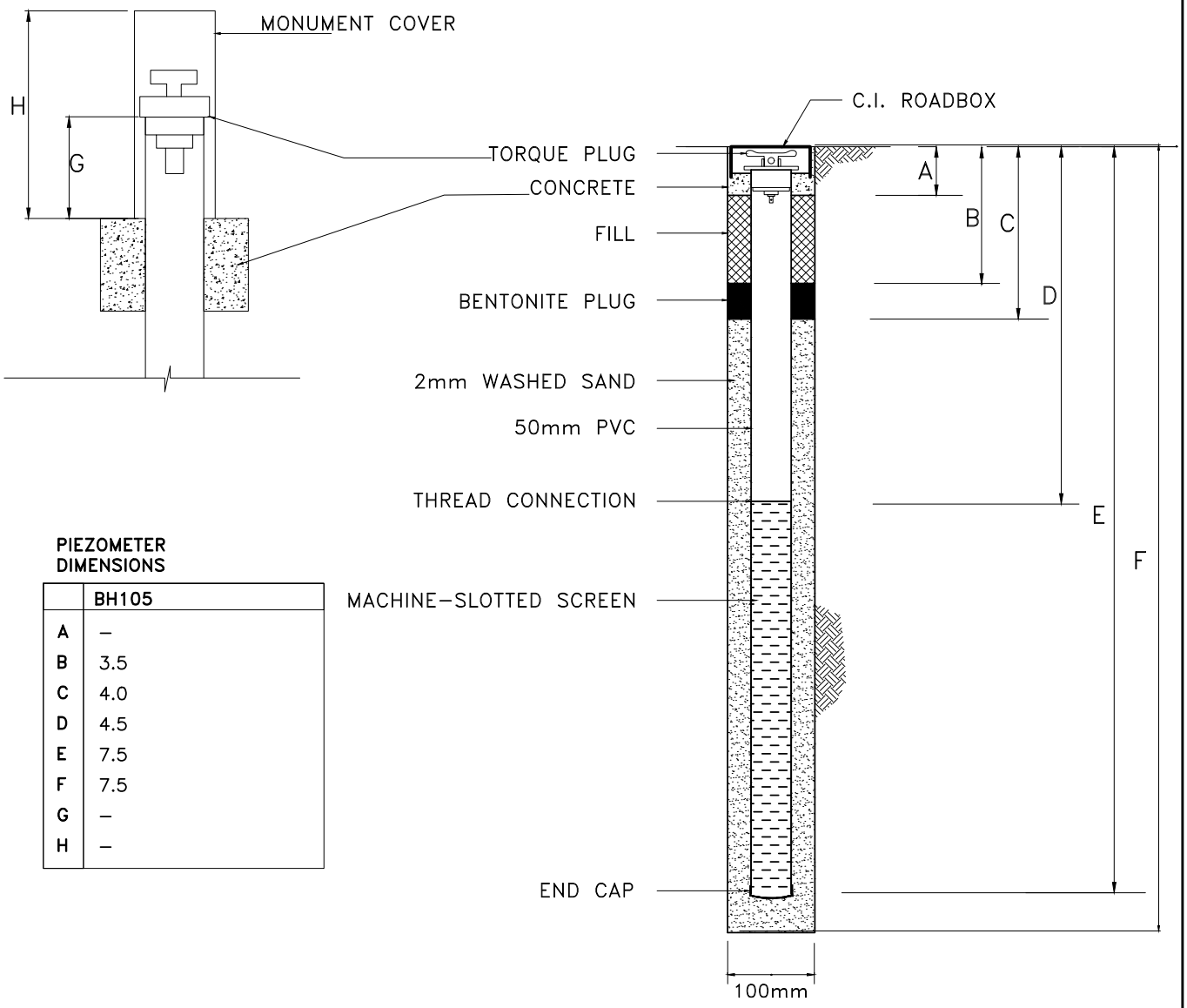
assetgeoenviro
2.06/56 Delhi Rd
North Ryde NSW 2113
t: 02 9878 6005
e: info@assetgeoenviro.com.au

PROPOSED REDEVELOPMENT,
Abel Tasman Village
Chester Hill NSW
for
Centurion Project Management

CORE PHOTO – BH105

drawn: JW
date: 11.5.22
checked: AT
scale: 1:4 @ A4

job no.: 6851
fig: —
issue: A



PIEZOMETER DIMENSIONS

	BH105
A	–
B	3.5
C	4.0
D	4.5
E	7.5
F	7.5
G	–
H	–

GROUNDWATER READINGS

DATE:	BOREHOLE	DEPTH (m)	COMMENTS
6/5/22	105	–	Well installed.

issue	date	description
A	11.5.22	INITIAL ISSUE

assetgeoenviro
2.05/56 Delhi Rd
North Ryde NSW 2113
t: 02 9878 6005
e: info@assetgeoenviro.com.au

Proposed Redevelopment
Abel Tasman Village
Chester Hill NSW
for
Centurion Project Management

Piezometer Details

drawn: JW
date: 11.5.22
checked: AT
scale: NTS

job no.: 6851
fig: —
issue: A

REDITUS

ENVIRONMENTAL BOREHOLE HA01

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.6m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.5

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.5	HA01_0.1		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft, topsoil	
						Filling sands at 0.2-0.3m, gravels at 0.3m
0.5	0.5	HA01_0.5		NATURAL	CLAY: yellow, moderate plasticity, cohesive, firm, moist, w/sands	
					EOH @ 0.6m	
1						

REDITUS

ENVIRONMENTAL BOREHOLE HA02

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.4m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.0

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.0	HA02_0.1		FILL	SILTY SANDY CLAY: slightly plastic, slightly cohesive, moist, soft	Gravels <10mm
0.5					Refusal at 0.4m - EOH	
1						

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ENVIRONMENTAL BOREHOLE HA03

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.6m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.1

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.1	HA03_0.1		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft	
0.5	0.5	HA03_0.5		NATURAL	CLAY: yellow, plastic, cohesive, firm, moist, w/sands	
1					EOH @ 0.6m	

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ENVIRONMENTAL BOREHOLE HA04

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.7m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.7

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.7	HA04_0.1		FILL	SILTY SAND: fine to medium grain, well graded, subrounded, dry, loose, dark brown, trace gravels	
					SILTY GRAVELLY SAND: fine to medium grain, well graded, subrounded, dry, loose, dark brown, with subangular gravels	
0.5	0.2	HA04_0.6		NATURAL	SANDY CLAY: brown, yellow, medium plasticity, moist, firm, slightly cohesive	Ambient PID 0.1 for second reading
					EOH @ 0.7m	
1						

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ENVIRONMENTAL BOREHOLE HA05

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.8m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.1

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.2	HA05_0.1		FILL	SILTY SAND: fine to medium grain, well graded, subrounded, dry, loose, dark brown, trace gravels	
					SILTY SAND: medium grain, well graded, subrounded, w/ angular gravels, dry, loose, brown/grey	
					SANDY CLAY: not plastic, slightly cohesive, red brown	
	0.3	HA05_0.4			REWORKED NATURAL: as above w/filling sands	
0.5						
				NATURAL	SANDY CLAY: medium plasticity, slightly cohesive, dry, red brown	Ambient PID 0.6 for third reading
	1.0	HA05_0.7				
					EOH @ 0.8m	
1						

ENVIRONMENTAL BOREHOLE HA06

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.5m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.2

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	1.4	HA06_0.1		FILL	SANDY SILT: dark brown, black, organic, well graded, not cohesive, not plastic	
	1.3	HA06_0.4		NATURAL	CLAY: yellow orange, plastic, cohesive, firm, moist, w/sands	Ambient 1.0 for second reading
0.5					EOH @ 0.5m	
1						

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ENVIRONMENTAL BOREHOLE HA07

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.7m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 1.0

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	1.1	HA07_0.1 DUP1 TRIP 1		FILL	SANDY CLAY: not cohesive, slightly plastic, brown, moist, firm	
					SANDY CLAY: slightly cohesive, slightly plastic, red brown, moist - firm (reworked natural)	Sands at 0.3 - 0.4m
0.5				NATURAL	CLAY: yellow orange, plastic, cohesive, firm, moist, w/sands	
	1.0	HA07_0.6				
1					EOH @ 0.7m	

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ENVIRONMENTAL BOREHOLE HA08

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.7m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 1.0

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
		SPACM1		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft	SPACM1 - potential asbestos material found on ground surface
	1.0	HA08_0.1				
0.5				NATURAL	CLAY: yellow orange and blue grey mottling, plastic, cohesive, firm, moist, w/sands	
	1.0	HA08_0.6				
					EOH @ 0.7m	
1						

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ENVIRONMENTAL BOREHOLE HA09

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.5m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.9

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	1.0	HA09_0.1		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft	
	1.0	HA09_0.4				
0.5					Refusal on rock - EOH @ 0.5m	
1						

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ENVIRONMENTAL BOREHOLE HA10

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.7m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.9

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.9	HA10_0.1		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft	
0.5				NATURAL	CLAY: yellow orange and grey blue mottling, plastic, cohesive, firm, moist, w/sands	
	1.0	HA10_0.6				
1					EOH @ 0.7m	

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ENVIRONMENTAL BOREHOLE HA11

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.5m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.5

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.6	HA11_0.1		FILL	SILTY SAND: fine to medium grain, well graded, subrounded, dry, loose, dark brown, trace gravels	
	0.6	HA11_0.4			REWORKED NATURAL: Clay and gravels ~ 10mm, w/ roots	
0.5					Refusal on above - EOH @ 0.5m	
1						

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ENVIRONMENTAL BOREHOLE HA12

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.7m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.9

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.9	HA12_0.1		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft	Glass found in fill
0.5				NATURAL	CLAY: red, brown, plastic, cohesive, firm, moist, w/sands	
	1.0	HA12_0.6				
					EOH @ 0.7m	
1						

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ENVIRONMENTAL BOREHOLE HA13

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 4/5/22
METHOD Hand Auger
TOTAL DEPTH 1.1m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.0

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.2	HA13_0.1		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft	Some reworked clay, orange brown
0.5					SAND: Alluvial filling sands, medium grain, poorly sorted, subrounded gravels	
	0.4	HA13_0.7			SANDY GRAVEL: subangular, poorly sorted, dark brown	
				NATURAL	CLAY: yellow orange, plastic, cohesive, firm, wet, w/sands, w/gravels	
1	0.8	HA13_1.0				
					EOH @ 1.1m	

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ENVIRONMENTAL BOREHOLE HA14

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 3/5/22
METHOD Hand Auger
TOTAL DEPTH 0.6m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.5

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.6	HA14_0.1 DUP2 TRIP2		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft	
0.5	0.6	HA14_0.5		NATURAL	CLAY: brown, orange, plastic, cohesive, firm, moist, w/sands	
1					EOH @ 0.6m	

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ENVIRONMENTAL BOREHOLE HA15

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 4/5/22
METHOD Hand Auger
TOTAL DEPTH 0.7m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.7

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.7	HA15_0.1		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft	
0.5	0.8	HA15_0.6		NATURAL	CLAY: yellow orange, plastic, cohesive, firm, moist, w/sands	
1					EOH @ 0.7m	

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ENVIRONMENTAL BOREHOLE HA16

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 4/5/22
METHOD Hand Auger
TOTAL DEPTH 0.5m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.7

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.8	HA16_0.1		FILL	SANDY CLAYEY SILT: dark brown, not plastic, not cohesive, moist, soft	
	0.8	HA16_0.4		NATURAL	CLAY: grey, yellow, plastic, cohesive, firm, moist, w/sands	
0.5					EOH @ 0.5m	
1						

ENVIRONMENTAL BOREHOLE HA17

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 4/5/22
METHOD Hand Auger
TOTAL DEPTH 0.5m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.7

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.8	HA17_0.1		FILL	CLAYEY SILT: not plastic, slightly plastic, moist, soft, dark brown	Reworked clay
	0.8	HA17_0.4		NATURAL	CLAY: yellow orange, plastic, cohesive, firm, moist, w/sands	
0.5					EOH @ 0.5m	
1						

ENVIRONMENTAL BOREHOLE HA18

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 4/5/22
METHOD Hand Auger
TOTAL DEPTH 0.6m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.7

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.8	HA18_0.1 DUP 3 TRIP 3		FILL	SILTY SAND: fine to medium grain, well graded, subrounded, dry, loose, dark brown, trace gravels	
0.5	0.8	HA18_0.5		NATURAL	CLAY: red, orange, plastic, cohesive, firm, moist, w/sands	
1					EOH @ 0.6m	

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ENVIRONMENTAL BOREHOLE HA19

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 4/5/22
METHOD Hand Auger
TOTAL DEPTH 0.5m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.7

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
		SPACM2		FILL	SILTY SAND: yellow, brown, well sorted, sub rounded	
	0.8	HA19_0.1				
					REWORKED NATURAL: red clay and sands	
				NATURAL	CLAY: red, plastic, cohesive, very firm, dry, w/sands	
	0.7	HA19_0.4				
0.5					EOH @ 0.5m	
1						

Disclaimer This log is intended for environmental not geotechnical purposes.

produced by ESlog.ESdat.net on 12 May 2022

REDITUS

ENVIRONMENTAL BOREHOLE HA20

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 4/5/22
METHOD Hand Auger
TOTAL DEPTH 0.5m

LOGGED BY KS
CHECKED BY GB

COMMENTS AMBIENT PID - 0.0

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.0	HA20_0.1		FILL	SILTY SANDY CLAY: slightly plastic, slightly cohesive, dark brown, orange, poorly sorted, subangular	
	0.1	HA20_0.4		NATURAL	CLAY: red brown, plastic, cohesive, firm, moist, w/sands	
0.5					EOH @ 0.5m	
1						

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produced by ESlog.ESdat.net on 12 May 2022

REDITUS

ENVIRONMENTAL BOREHOLE HA21

PROJECT NUMBER 22065
PROJECT NAME Detailed Site Investigation
CLIENT Asset Geotechnical Engineering Pty Ltd
ADDRESS 222 Waldron Rd, 138 & 140 Campbell Hill Rd, Chester Hill, NSW, 2162

DATE 4/5/22
METHOD Hand Auger
TOTAL DEPTH 0.6m

LOGGED BY K.S.
CHECKED BY J.P.

COMMENTS AMBIENT PID - 0.5

Depth (m)	PID	Sample ID	Graphic Log	Material Type	Material Description	Additional Observations
	0.5	HA21_0.1		FILL	SILTY SAND: fine to medium grain, well graded, subrounded, dry, loose, dark brown, trace gravels	
0.5	0.7	HA21_0.5		NATURAL	CLAY: yellow orange, plastic, cohesive, firm, moist, w/sands	'Organic' odour at 0.5m
1					EOH @ 0.6m	

Disclaimer This log is intended for environmental not geotechnical purposes.

produced by ESlog.ESdat.net on 12 May 2022

Reditus Consulting Pty Ltd
Lvl 1, Suite 1/29-33 Waratah St, Kirrawee NSW 2232, Australia
Phone: (02) 9521 6567

Boring No.: MW05

Easting (MGA56)	**: 314697.169**	**Drill Supplier**	**: Epoca Environmental Pty Ltd**	**Job Number**	**: 22137**
Northing (MGA56)	**: 6249104.825**	**Driller Company**	**: Epoca Environmental Pty Ltd**	**Client**	**: The Abel Tasman Village Association Limited**
Elevation (mAHD)	**: 31.89**	**Logged By**	**: TW**	**Project**	**: Site Hydrology Report**
Total Depth	**: 5.25 m**	**Date**	**: 25/05/2023**	**Location**	**: 222 Waldron Road and 138-140 Campbell Hill Rd, Chester Hill, NSW**

Sheet : 1 OF 1

Depth (m)	Soil Origin	Graphic Log	Moisture	Material Description	Remarks	Well Diagram
0.1	Non-Soil			Concrete 0.1m thick	Concrete 0.1m thick	
0.23	Fill		M	Fill GRAVEL angular (GW) : medium dense, dark brown, fine to coarse sized, moist.	Residual roadbase gravels. Hand Auger from 0.1m - 0.8m	Bentonite
	Fill			Fill Gravelly CLAY (CI) : medium plasticity, stiff, brown with orange grey mottled, coarse sized gravel, inorganic, moist.	Reworked natural, large gravels until 0.3m. No odour, anthropogenic material or staining.	
0.5	Natural			Natural CLAY (CI) : stiff, medium plasticity, brown orange with red grey mottled, inorganic, moist.	No odour, anthropogenic material or staining.	50mm PVC Solid
					SFA drilling from 0.8m	
1						
1.1	Natural		M-D	Natural CLAY (CL) : firm, low plasticity, grey with slight orange mottle, inorganic, moist to dry.	No odour, anthropogenic material, or staining.	
1.6	Rock		D	Rock SILTSTONE: slightly weathered, medium to high strength, dark grey, fine grained, indistinct, dry.		Washed 1-2mm graded sand
2						
3					Becomes highly weathered at 3.2m.	50mm PVC Slotted
4						
5						
				MW05 Terminated at 5.25 m		

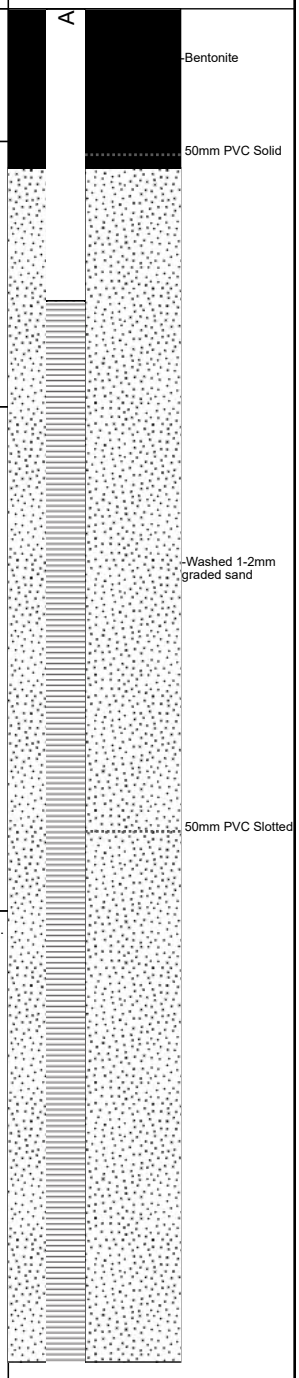
Reditus Consulting Pty Ltd
Lvl 1, Suite 1/29-33 Waratah St, Kirrawee NSW 2232, Australia
Phone: (02) 9521 6567

Boring No.: MW06

Easting (MGA56)	: 314715.666	Drill Supplier	: Epoca Environmental Pty Ltd	Job Number	: 22137
Northing (MGA56)	: 6249136.292	Driller Company	: Epoca Environmental Pty Ltd	Client	: The Abel Tasman Village Association Limited
Elevation (mAHD)	: 33.18	Logged By	: TW	Project	: Site Hydrology Report
Total Depth	: 5.6 m	Date	: 25/05/2023	Location	: 222 Waldron Road and 138-140 Campbell Hill Rd, Chester Hill, NSW

Sheet : 1 OF 1

Depth (m)	Soil Origin	Graphic Log	Moisture	Material Description	Remarks
0.5	Fill		M	Fill SAND (SP) : loose to medium dense, dark brown, medium grained, moist.	Grass at surface with underlying topsoil. No odour, anthropogenic material or staining.
1	Natural			Natural CLAY (CL) : stiff, low plasticity, red orange with some grey mottling, inorganic, moist.	No odour, anthropogenic material or staining.
1.2	Natural		M-D	Natural CLAY (CI) : firm, medium plasticity, grey, inorganic, moist to dry.	
1.5	Rock		D	Rock SILTSTONE: slightly weathered, medium strength, dark grey, fine grained, indistinct, dry.	No odour, anthropogenic material, or staining. Increasing weathering until 3.4m where it becomes highly weathered.
2					
3					Decrease in weathering to moderately - slightly weathered.
4					
5					
				MW06 Terminated at 5.6 m	



Reditus Consulting Pty Ltd
Lvl 1, Suite 1/29-33 Waratah St, Kirrawee NSW 2232, Australia
Phone: (02) 9521 6567

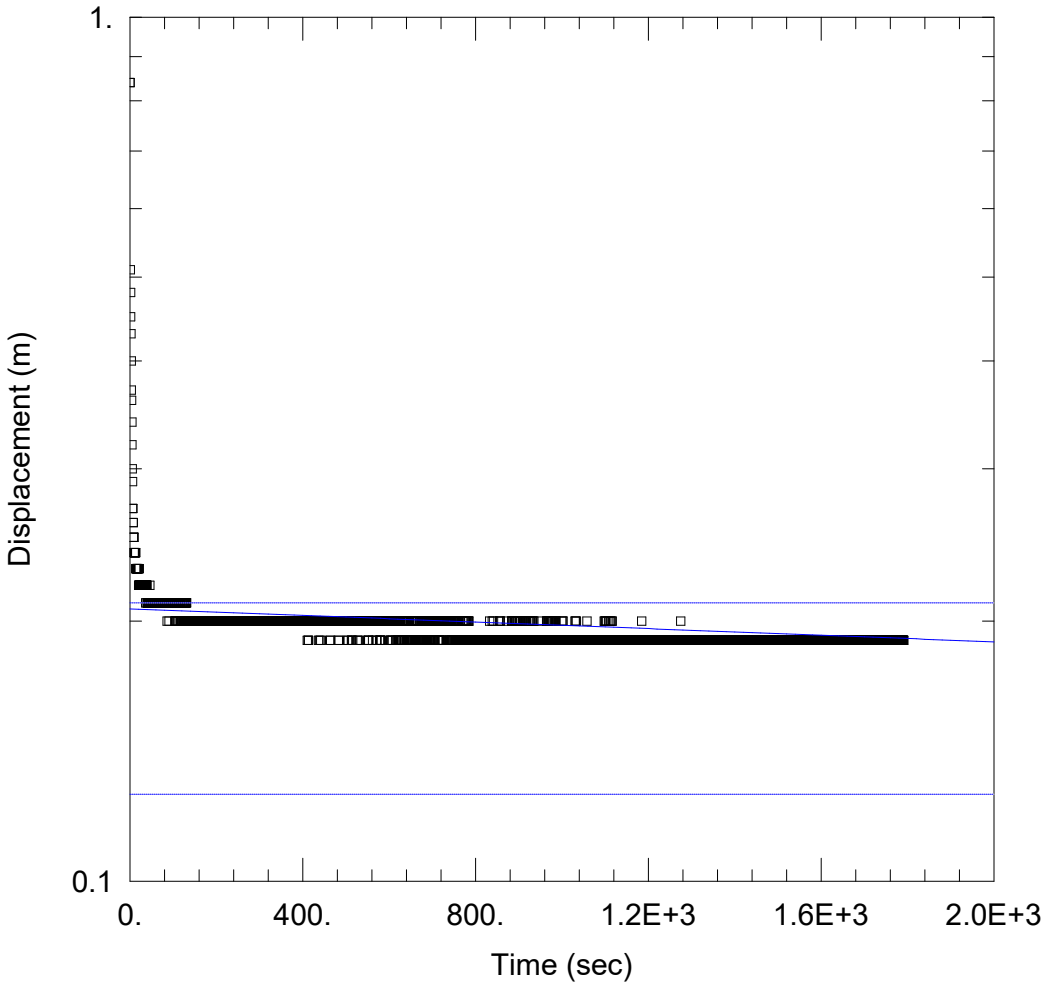
Boring No.: MW07

Easting (MGA56)	: 314722.333	Drill Supplier	: Epoca Environmental Pty Ltd	Job Number	: 22137	Sheet	: 1 OF 1
Northing (MGA56)	: 6249129.025	Driller Company	: Epoca Environmental Pty Ltd	Client	: The Abel Tasman Village Association Limited		
Elevation (mAHD)	: 32.65	Logged By	: TW	Project	: Site Hydrology Report		
Total Depth	: 5.5 m	Date	: 25/05/2023	Location	: 222 Waldron Road and 138-140 Campbell Hill Rd, Chester Hill, NSW		

Depth (m)	Soil Origin	Graphic Log	Moisture	Material Description	Remarks	Well Diagram
0.4	Fill		M	Fill SAND (SP) : loose to medium dense, dark brown, medium grained, moist.	Grass at surface with underlying topsoil. No odour, anthropogenic material or staining.	Bentonite
1.1	Natural			Natural CLAY (CI) : firm, medium plasticity, light grey, inorganic, moist.		50mm PVC Solid
	Rock		D	Rock SILTSTONE: moderately to slightly weathered, medium strength, dark grey, fine grained, indistinct, dry.	No odour, anthropogenic material, or staining. Varying between moderately weathered and not weathered (fresh).	Washed 1-2mm graded sand
						50mm PVC Slotted
				MW07 Terminated at 5.5 m		

D

Rising Head Test Analysis



WELL TEST ANALYSIS

Data Set: G:\...\MW5 rd2.aqt
Date: 11/03/23 Time: 16:26:13

PROJECT INFORMATION

Company: Reditus
Client: CPM
Project: 22137
Location: Chester Hill NSW
Test Well: MW5
Test Date: 13/09/23

AQUIFER DATA

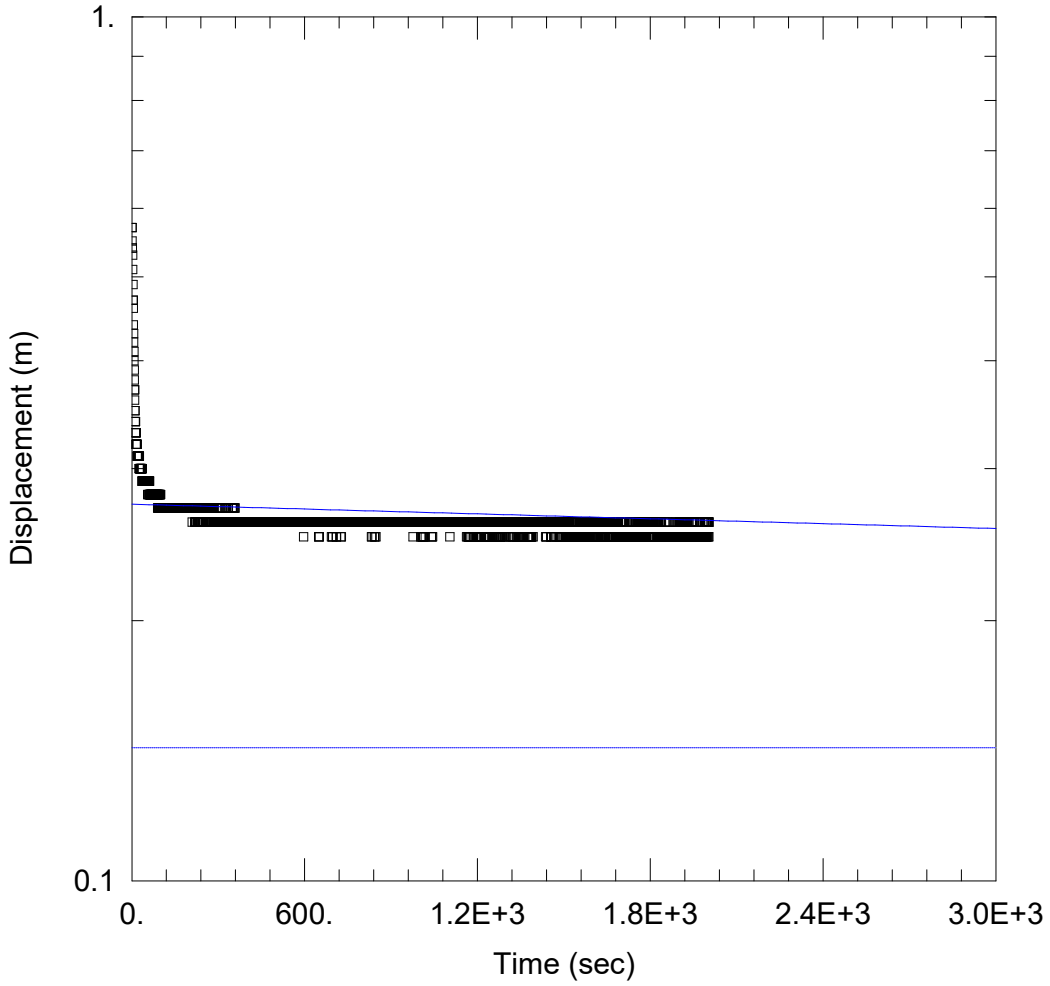
Saturated Thickness: 1.156 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW5)

Initial Displacement: 0.84 m
Total Well Penetration Depth: 1.156 m
Casing Radius: 0.025 m
Static Water Column Height: 1.156 m
Screen Length: 1.156 m
Well Radius: 0.055 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.005447 m/day
y0 = 0.2066 m



SLUG TEST

Data Set: G:\...\MW5 Jan24.aqt
Date: 01/15/24 Time: 14:12:50

PROJECT INFORMATION

Company: Reditus
Client: CPM
Project: 22137
Location: Chester Hill
Test Well: MW5
Test Date: 12/01/2024

AQUIFER DATA

Saturated Thickness: 1.692 m Anisotropy Ratio (Kz/Kr): 1.

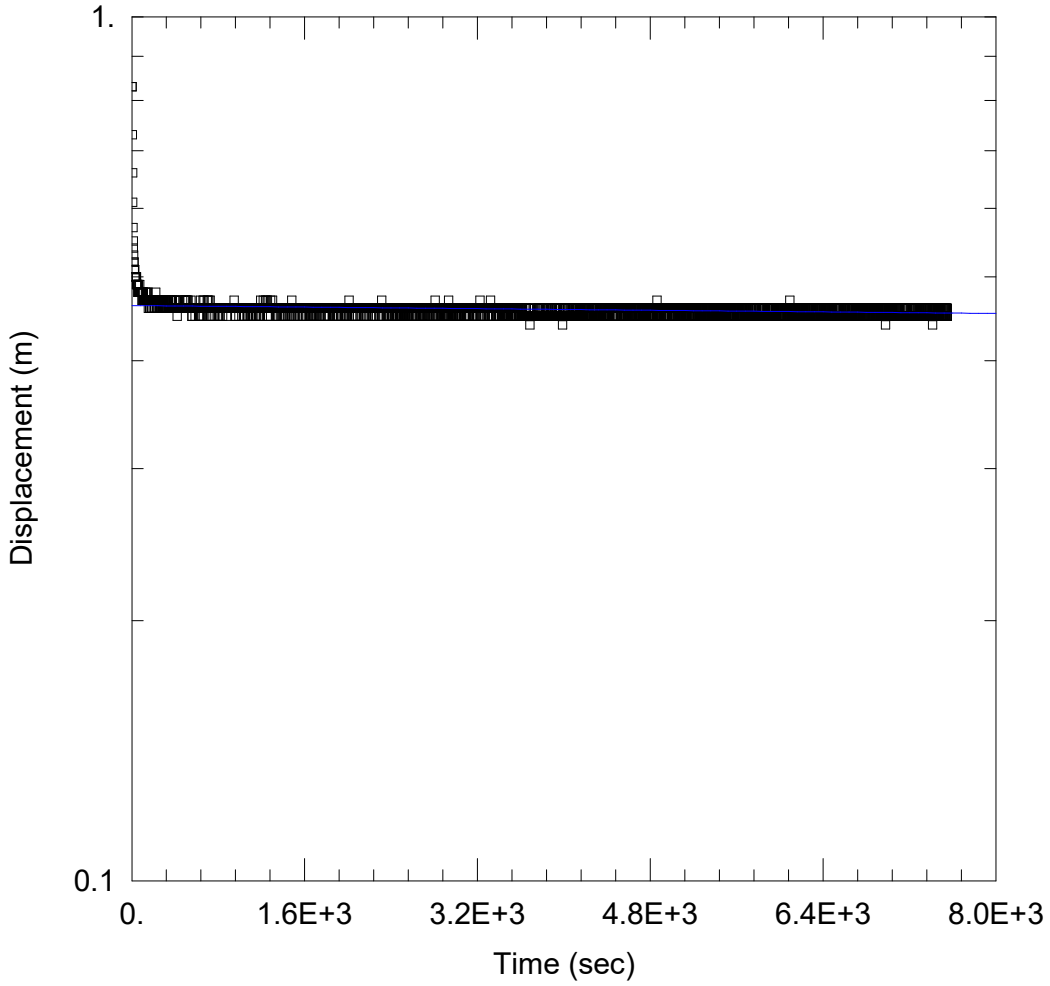
WELL DATA (MW5)

Initial Displacement: 0.57 m
Total Well Penetration Depth: 1.692 m
Casing Radius: 0.025 m
Static Water Column Height: 1.692 m
Screen Length: 1.692 m
Well Radius: 0.055 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 0.001829 m/day y0 = 0.2728 m



RISING HEAD TEST

Data Set:
Date: 10/13/25 Time: 16:39:10

PROJECT INFORMATION

Company: Reditus
Client: Abel Tasman Village
Project: 25254
Location: Chester Hill NSW
Test Well: MW5
Test Date: 10/10/2025

AQUIFER DATA

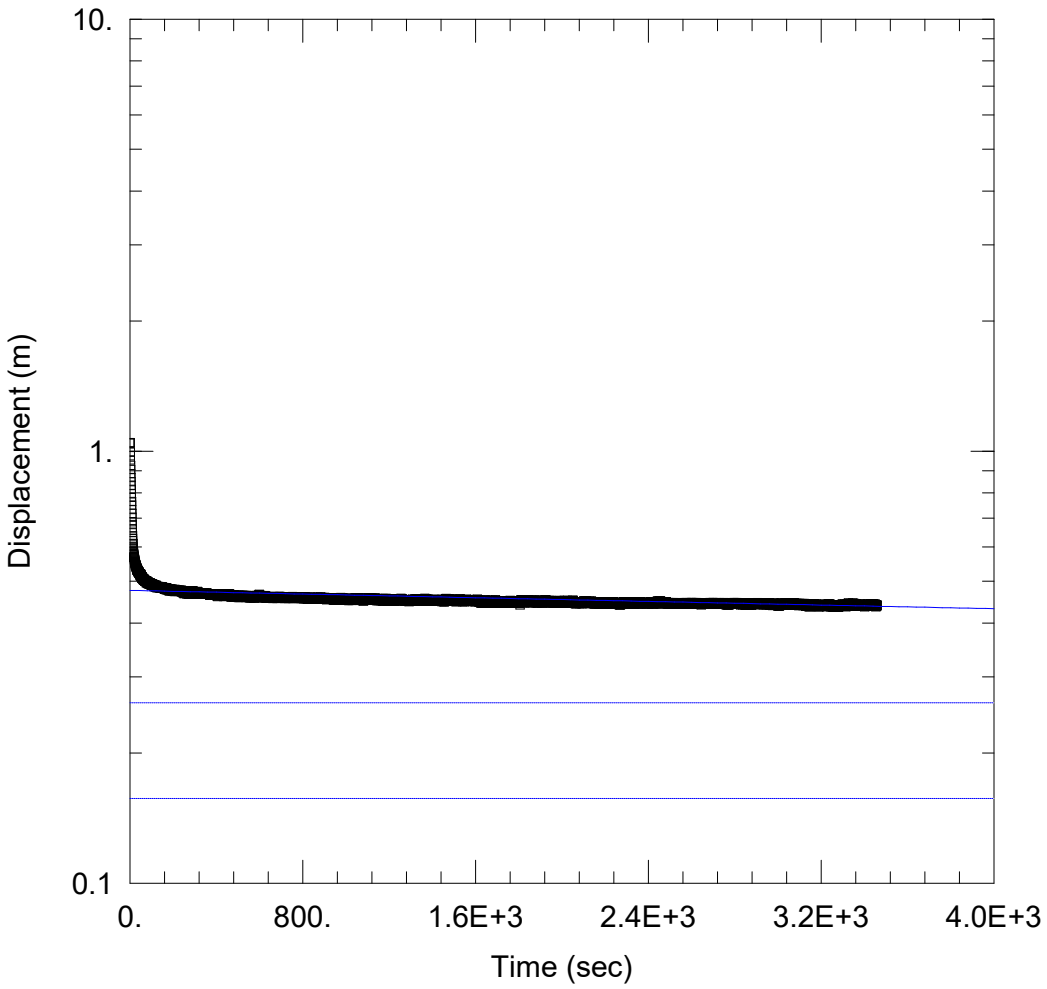
Saturated Thickness: 1.665 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW5)

Initial Displacement: 0.83 m Static Water Column Height: 1.665 m
Total Well Penetration Depth: 1.665 m Screen Length: 1.665 m
Casing Radius: 0.025 m Well Radius: 0.055 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev
K = 0.0002282 m/day y0 = 0.4632 m



WELL TEST ANALYSIS

Data Set: G:\...\MW6 rd2.aqt
Date: 11/03/23 Time: 16:27:16

PROJECT INFORMATION

Company: Reditus
Client: CPM
Project: 22137
Location: Chester Hill NSW
Test Well: MW6
Test Date: 13/09/23

AQUIFER DATA

Saturated Thickness: 2.873 m Anisotropy Ratio (Kz/Kr): 1.

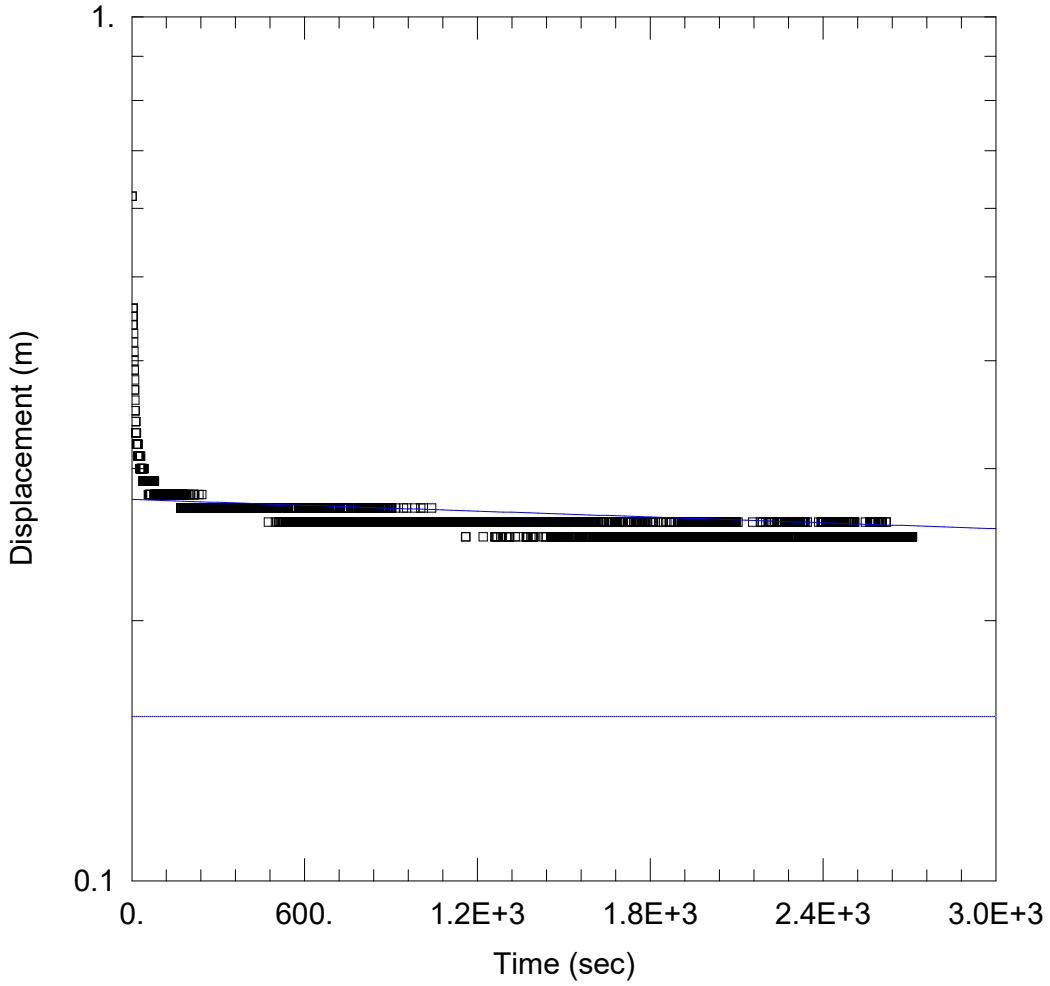
WELL DATA (MW6)

Initial Displacement: 1.046 m
Total Well Penetration Depth: 2.873 m
Casing Radius: 0.025 m
Static Water Column Height: 2.873 m
Screen Length: 2.873 m
Well Radius: 0.055 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 0.001217 m/day y0 = 0.476 m



WELL TEST ANALYSIS

Data Set: G:\...\MW6 Jan24.aqt
Date: 01/15/24 Time: 14:14:58

PROJECT INFORMATION

Company: Reditus
Client: CPM
Project: 22137
Location: Chester Hill
Test Well: MW6
Test Date: 12/01/2024

AQUIFER DATA

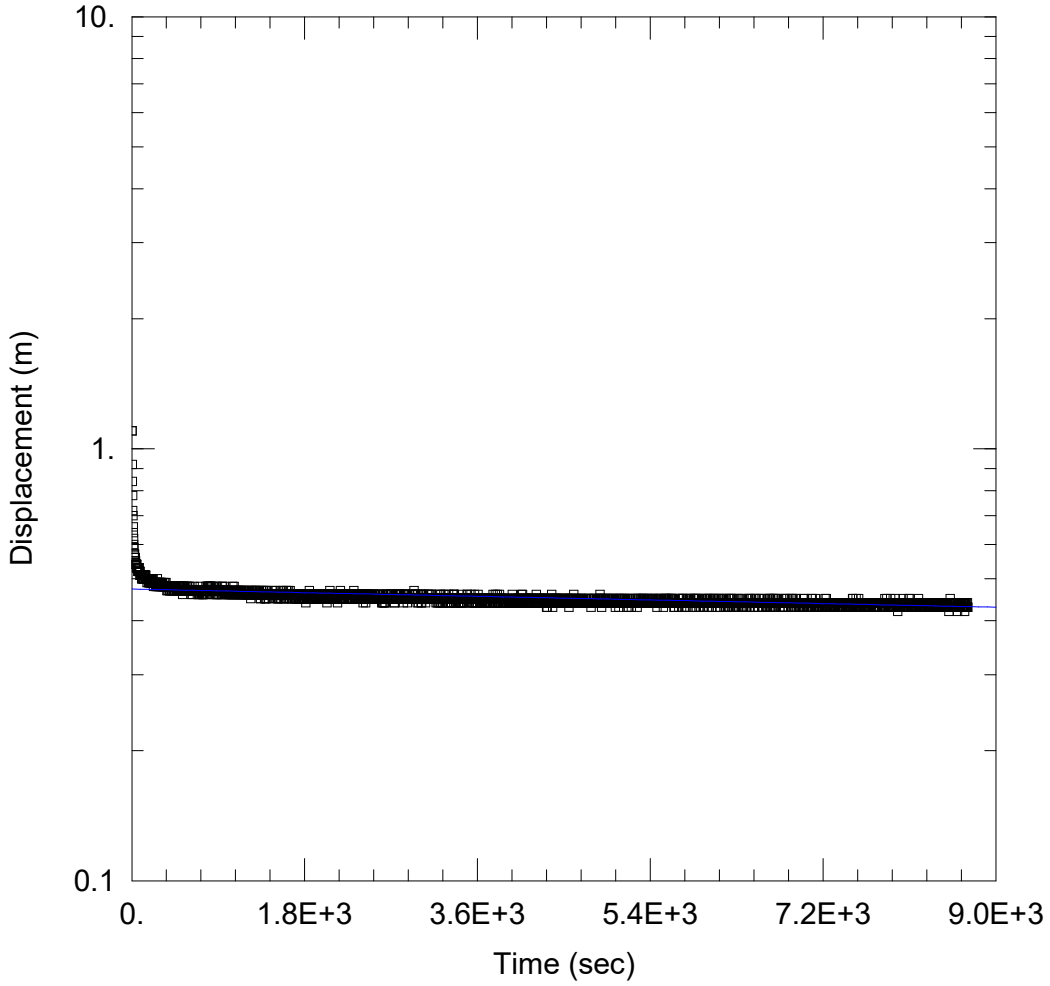
Saturated Thickness: 3.295 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW6)

Initial Displacement: 0.62 m
Total Well Penetration Depth: 3.295 m
Casing Radius: 0.025 m
Static Water Column Height: 3.295 m
Screen Length: 3.295 m
Well Radius: 0.055 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.001125 m/day
y0 = 0.2763 m



RISING HEAD TEST

Data Set:
Date: 10/13/25 Time: 16:44:28

PROJECT INFORMATION

Company: Reditus
Client: Abel Tasman Village
Project: 25254
Location: Chester Hill NSW
Test Well: MW6
Test Date: 10/10/2025

AQUIFER DATA

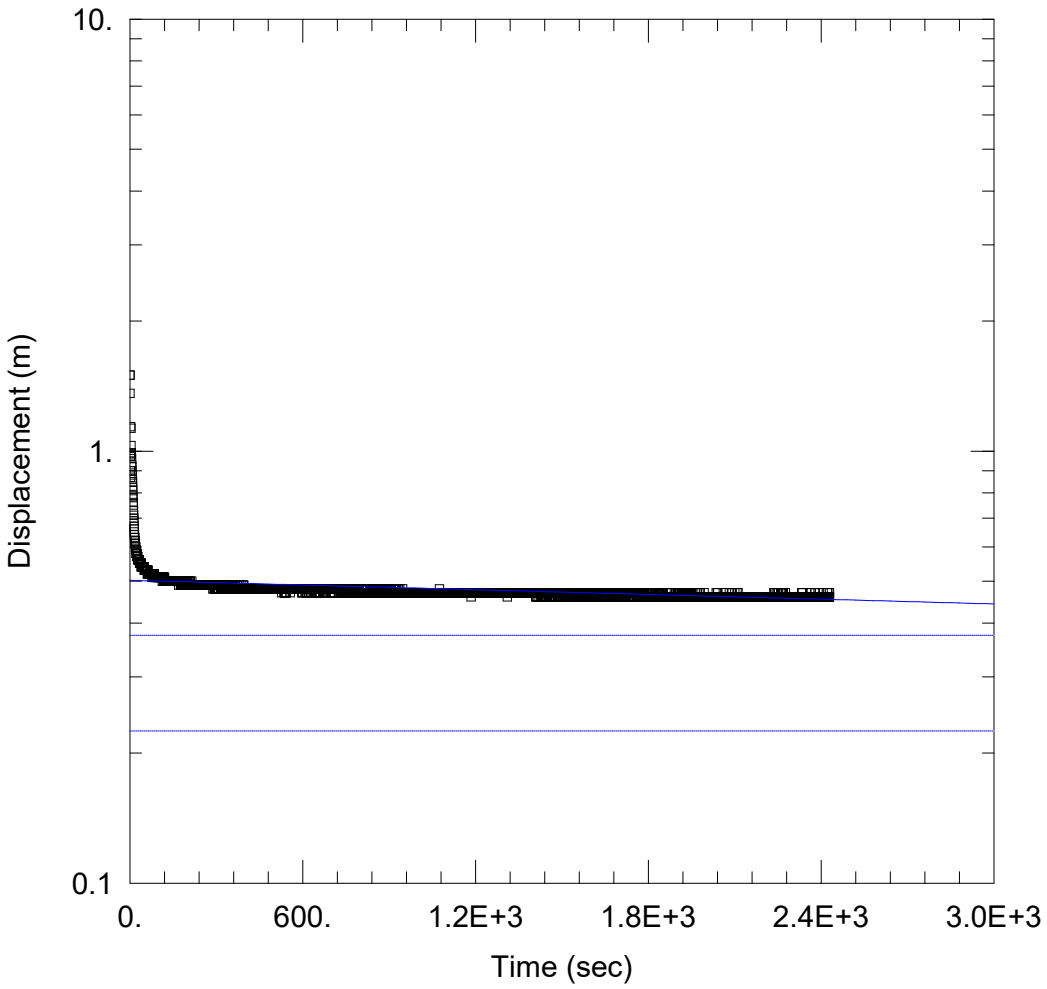
Saturated Thickness: 3.55 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW6)

Initial Displacement: 1.1 m
Total Well Penetration Depth: 3.55 m
Casing Radius: 0.025 m
Static Water Column Height: 3.55 m
Screen Length: 3.55 m
Well Radius: 0.055 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.0004336 m/day
y0 = 0.4735 m



WELL TEST ANALYSIS

Data Set: G:\...\MW7 rd2.aqt
Date: 11/03/23 Time: 16:27:52

PROJECT INFORMATION

Company: Reditus
Client: CPM
Project: 22137
Location: Chester Hill NSW
Test Well: MW7
Test Date: 13/09/23

AQUIFER DATA

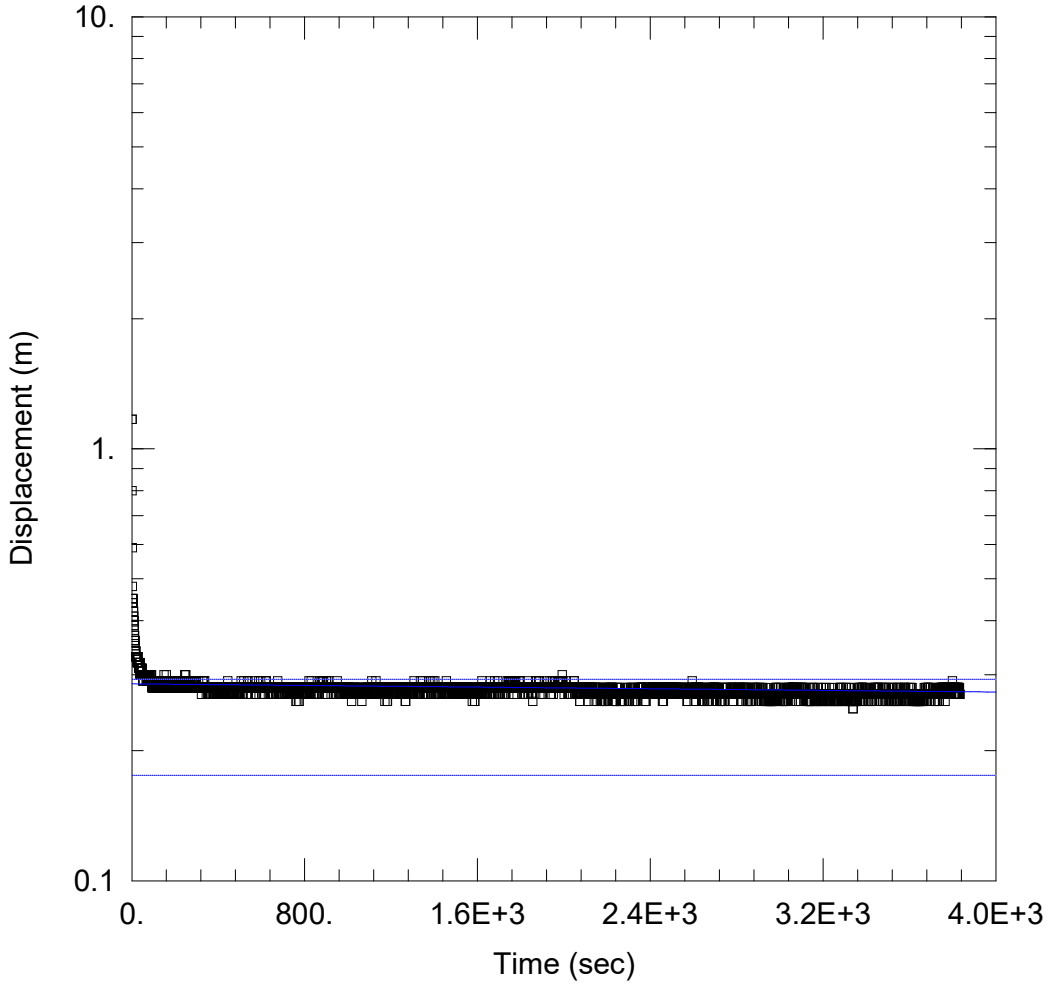
Saturated Thickness: 3.495 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW7)

Initial Displacement: 1.5 m
Static Water Column Height: 3.495 m
Total Well Penetration Depth: 3.495 m
Screen Length: 3.495 m
Casing Radius: 0.025 m
Well Radius: 0.055 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.001722 m/day
y0 = 0.5024 m



WELL TEST ANALYSIS

Data Set: G:\...\MW7 Jan24.aqt
Date: 01/15/24 Time: 14:16:07

PROJECT INFORMATION

Company: Reditus
Client: CPM
Project: 22137
Location: Chester Hill
Test Well: MW7
Test Date: 12/01/2024

AQUIFER DATA

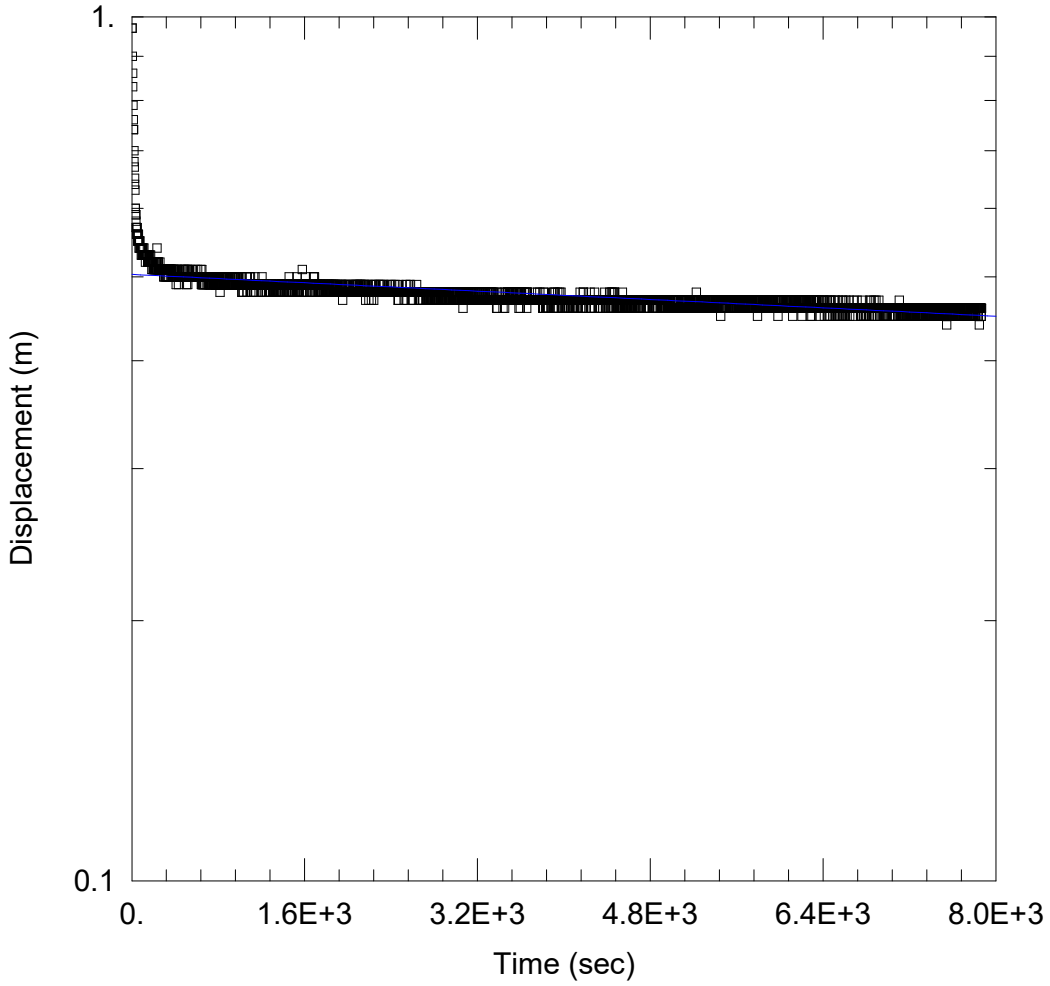
Saturated Thickness: 3.962 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW7)

Initial Displacement: 1.17 m
Total Well Penetration Depth: 3.962 m
Casing Radius: 0.025 m
Static Water Column Height: 3.962 m
Screen Length: 3.962 m
Well Radius: 0.055 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.0003942 m/day
y0 = 0.2857 m



WELL TEST ANALYSIS

Data Set:
Date: 10/13/25 Time: 16:48:37

PROJECT INFORMATION

Company: Reditus
Client: Abel Tasman Village
Project: 25254
Location: Chester Hill NSW
Test Well: MW7
Test Date: 10/10/2025

AQUIFER DATA

Saturated Thickness: 4.135 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW7)

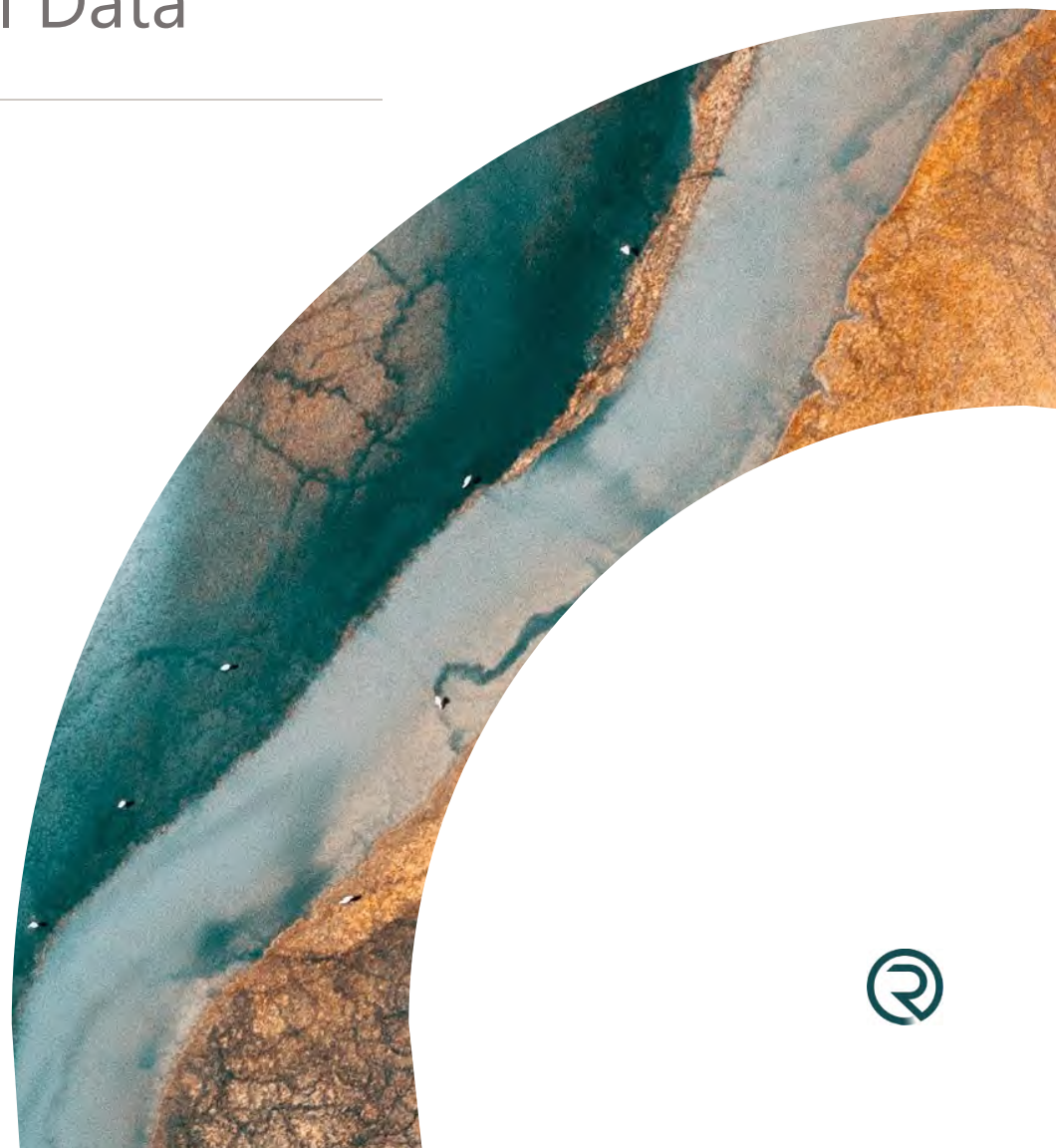
Initial Displacement: 0.97 m
Total Well Penetration Depth: 4.135 m
Casing Radius: 0.025 m
Static Water Column Height: 4.135 m
Screen Length: 4.135 m
Well Radius: 0.055 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.0004815 m/day
y0 = 0.5033 m

E

Tabulated Groundwater Analytical Data



Dewatering Management Plan
222 Waldron Rd, 138 140 Campbell Hill Rd,
Chester Hill NSW
25254RP01_v2

Table 1A

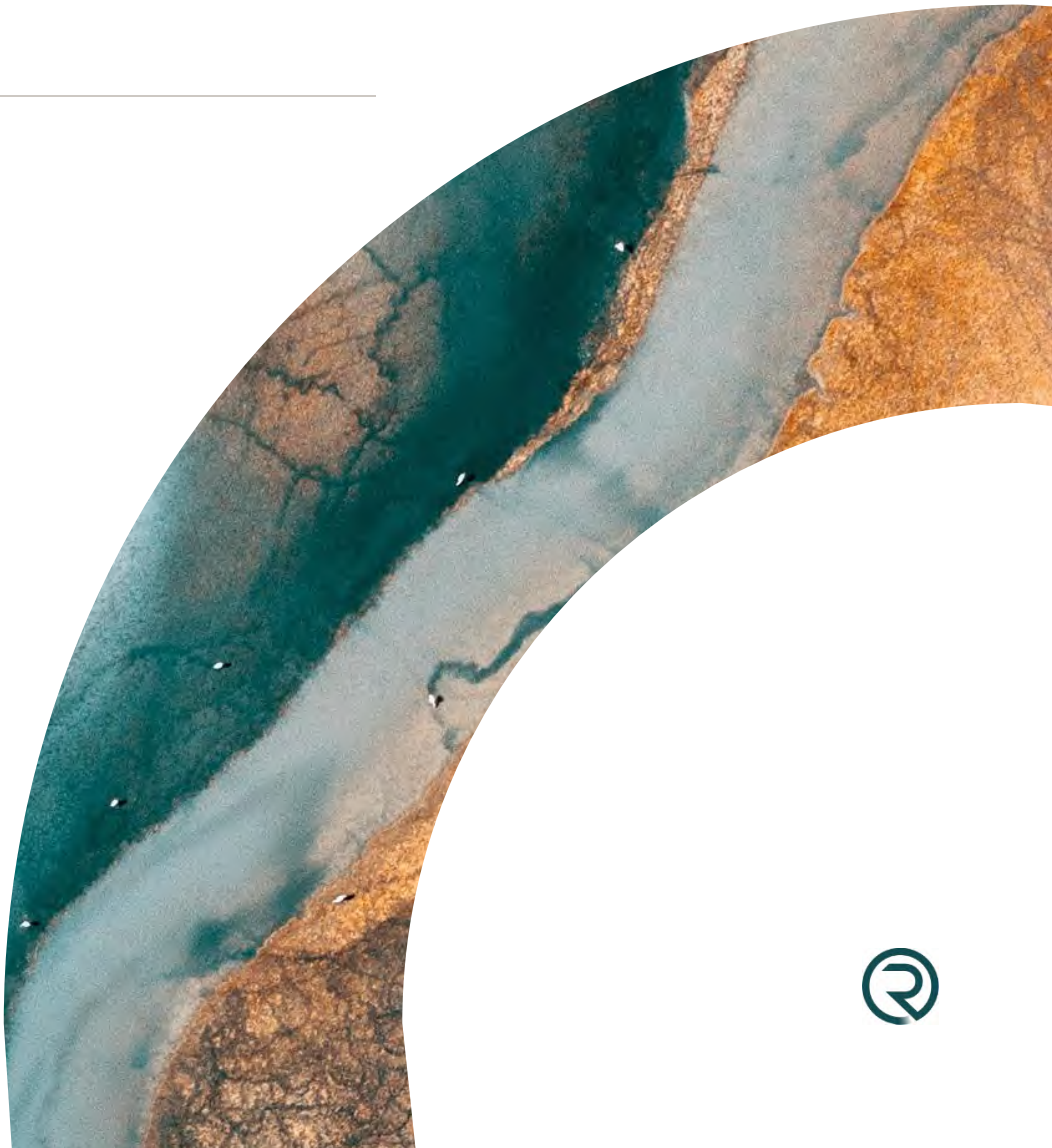
Groundwater Analytical Results

					Field ID	MW4	MW5	MW6	MW7	DUP1	TRIP 1
					Date	07 Jun 2023	07 Jun 2023	07 Jun 2023	07 Jun 2023	07 Jun 2023	07 Jun 2023
					Matrix Type	Water	Water	Water	Water	Water	Water
					Lab Report Number	325231	325231	325231	325231	325231	ES2319421
	Unit	EQL	ANZG 95% Freshwater	ANZG 95% Marine							
BTEX											
Naphthalene (BTEX)	ug/L	1	16	70	<1	<1	<1	<1	<1	<5
Benzene	ug/L	1	950	700	<1	<1	<1	<1	<1	<1
Toluene	ug/L	1	180	180	<1	<1	<1	<1	<1	<2
Ethylbenzene	ug/L	1	80	80	<1	<1	<1	<1	<1	<2
Xylene (m & p)	ug/L	2			<2	<2	<2	<2	<2	<2
Xylene (o)	ug/L	1	350		<1	<1	<1	<1	<1	<2
Xylene Total	ug/L	2								<2
Total BTEX	ug/L	1								<1
TRH										
C6-C10 Fraction (F1)	ug/L	10			<10	<10	<10	<10	<10	<20
C6-C10 (F1 minus BTEX)	ug/L	10			<10	<10	<10	<10	<10	<20
>C10-C16 Fraction (F2)	ug/L	50			<50	<50	<50	<50	<50	<100
>C10-C16 Fraction (F2 minus Naphthalene)	ug/L	50			<50	<50	<50	<50	<50	<100
>C16-C34 Fraction (F3)	ug/L	100			<100	<100	<100	<100	<100	<100
>C34-C40 Fraction (F4)	ug/L	100			<100	<100	<100	<100	<100	<100
>C10-C40 Fraction (Sum)	ug/L	50			<50	<50	<50	<50	<50	<100
TPH										
C6-C9 Fraction	ug/L	10			<10	<10	<10	<10	<10	<20
C10-C14 Fraction	ug/L	50			<50	<50	<50	<50	<50	<50
C15-C28 Fraction	ug/L	100			<100	<100	<100	<100	<100	<100
C29-C36 Fraction	ug/L	50			<100	<100	<100	<100	<100	<50
C10-C36 Fraction (Sum)	ug/L	50			<50	<50	<50	<50	<50	<50
PAH										
Benzo(b+j+k)fluoranthene	ug/L	0.2			<0.2	<0.2	<0.2	<0.2	<0.2	
Acenaphthene	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Acenaphthylene	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Anthracene	ug/L	0.1	0.4	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Benz(a)anthracene	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Benzo(a) pyrene	ug/L	0.1	0.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5
Benzo(b+j)fluoranthene	ug/L	1								<1.0
Benzo(g,h,i)perylene	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Benzo(k)fluoranthene	ug/L	1								<1.0
Chrysene	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Dibenz(a,h)anthracene	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Fluoranthene	ug/L	0.1	1.4	1.4	<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Fluorene	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Indeno(1,2,3-c,d)pyrene	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Naphthalene	ug/L	0.2	16	70	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
Phenanthrene	ug/L	0.1	2	2	<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Pyrene	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<1.0
Benzo(a)pyrene TEQ	ug/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	
PAHs (Sum of total)	ug/L	0.5								<0.5
PAHs (Sum of positives)	ug/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	
Inorganics										
Hardness (filtered)	mgCaCO3/L	3			1,300	960	1,700	1,500	1,300	
Total Phosphorus as P (Organic Phosphate as P)	ug/L	10								20
Sulfate as SO4 - Turbidimetric (filtered)	ug/L	1,000								500,000
Nitrite + Nitrate as N	ug/L	10								<10
Alkalinity (Bicarbonate as CaCO3)	ug/L	1,000			1,400,000	1,300,000	1,100,000	1,300,000	1,300,000	1,370,000
Alkalinity (Carbonate as CaCO3)	ug/L	1,000			<5,000	<5,000	<5,000	<5,000	<5,000	<1,000
Alkalinity (Hydroxide) as CaCO3	ug/L	1,000			<5,000	<5,000	<5,000	<5,000	<5,000	<1,000
Alkalinity (total) as CaCO3	ug/L	1,000			1,400,000	1,300,000	1,100,000	1,300,000	1,300,000	1,370,000
Ammonia as N	ug/L	5	900	910						200
Ammonia as N (filtered)	ug/L	5	900	910	40	320	190	240	39	
Anions Total	meq/L	0.01								119
Cations Total	meq/L	0.01								116
Chloride	ug/L	1,000			3,000,000	2,400,000	3,300,000	2,900,000	3,000,000	2,870,000
Ionic Balance	%	0.01			-4.0	-6.0	-3.0	-4.0	-3.0	1.02
Kjeldahl Nitrogen Total	ug/L	100			<100	600	400	500	<100	200
Nitrate (as N)	ug/L	5	2,400	2,400	<5	100	130	180	<5	<10
Nitrite (as N)	ug/L	5			<5	18	20	21	<5	<10
Organic Nitrogen as N	ug/L	200			<200	300	<200	200	<200	
Nitrogen (Total Oxidised)	ug/L	5			<5	100	200	200	<5	
Nitrogen (Total)	ug/L	100			<100	700	500	700	<100	200
Total Phosphorus (Organic Phosphate)	ug/L	50			<50	200	<50	50	<50	
Reactive Phosphorus as P (Orthophosphate as P)	ug/L	5			<5	110	20	50	<5	<10
Sodium (filtered)	ug/L	500			2,000,000	1,700,000	1,900,000	1,800,000	2,100,000	2,030,000
Sulphate	ug/L	1,000			540,000	550,000	500,000	470,000	560,000	
Metals										
Arsenic (filtered)	ug/L	1			<1	<1	1	<1	<1	<1
Cadmium (filtered)	ug/L	0.1	0.2	5.5	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Calcium (filtered)	ug/L	500			94,000	57,000	98,000	87,000	96,000	114,000
Chromium (III+VI) (filtered)	ug/L	1			<1	<1	<1	<1	<1	<1
Copper (filtered)	ug/L	1	1.4	1.3	<1	4	3	3	<1	<1
Lead (filtered)	ug/L	1	3.4	4.4	<1	<1	<1	<1	<1	<1
Magnesium (filtered)	ug/L	500			260,000	200,000	360,000	310,000	260,000	267,000
Mercury (filtered)	ug/L	0.05	0.6	0.4	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Nickel (filtered)	ug/L	1	11	70	1	4	4	2	1	<1
Potassium (filtered)	ug/L	500			18,000	21,000	24,000	24,000	18,000	15,000
Zinc (filtered)	ug/L	1	8	8	4	27	19	14	4	<5
Biological										
Total Coliforms by MF	CFU/100mL	1							<1,000.0	

Environmental Standards
ANZG, July 2023, ANZG Freshwater Toxicant DGVs LOSP 95% (July 2023)
ANZG, July 2023, ANZG Marine Water Toxicant DGVs LOSP 95% (July 2023)

F

Groundwater Sample Laboratory Reports



Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 325231

Client Details

Client	Reditus Consulting
Attention	Greg Bartlett
Address	Shop 1, 29-33 Waratah St, KIRRAWEE, NSW, 2232

Sample Details

Your Reference	**22137**
Number of Samples	5 Water
Date samples received	08/06/2023
Date completed instructions received	08/06/2023

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	16/06/2023
Date of Issue	16/06/2023

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Results Approved By
Dragana Tomas, Senior Chemist
Giovanni Agosti, Group Technical Manager
Hannah Nguyen, Metals Supervisor
Liam Timmins, Organics Supervisor
Nick Sarlamis, Assistant Operation Manager
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Water						
Our Reference		325231-1	325231-2	325231-3	325231-4	325231-5
Your Reference	UNITS	MW4	MW5	MW6	MW7	DUP1
Date Sampled		07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	15/06/2023	15/06/2023	15/06/2023	15/06/2023	15/06/2023
Date analysed	-	16/06/2023	16/06/2023	16/06/2023	16/06/2023	16/06/2023
TRH C_6 - C_9	µg/L	<10	<10	<10	<10	<10
TRH C_6 - C_{10}	µg/L	<10	<10	<10	<10	<10
TRH C_6 - C_{10} less BTEX (F1)	µg/L	<10	<10	<10	<10	<10
Benzene	µg/L	<1	<1	<1	<1	<1
Toluene	µg/L	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	<1	<1	<1	<1	<1
m+p-xylene	µg/L	<2	<2	<2	<2	<2
o-xylene	µg/L	<1	<1	<1	<1	<1
Naphthalene	µg/L	<1	<1	<1	<1	<1
Surrogate Dibromofluoromethane	%	96	96	99	97	96
Surrogate toluene-d8	%	98	98	98	100	101
Surrogate 4-BFB	%	105	105	106	104	103

svTRH (C10-C40) in Water						
Our Reference		325231-1	325231-2	325231-3	325231-4	325231-5
Your Reference	UNITS	MW4	MW5	MW6	MW7	DUP1
Date Sampled		07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	09/06/2023	09/06/2023	09/06/2023	09/06/2023	09/06/2023
Date analysed	-	10/06/2023	10/06/2023	10/06/2023	10/06/2023	10/06/2023
TRH C_{10} - C_{14}	µg/L	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	µg/L	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	µg/L	<100	<100	<100	<100	<100
Total +ve TRH (C10-C36)	µg/L	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16}	µg/L	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	µg/L	<50	<50	<50	<50	<50
TRH >C_{16} - C_{34}	µg/L	<100	<100	<100	<100	<100
TRH >C_{34} - C_{40}	µg/L	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	µg/L	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	72	68	79	79	74

PAHs in Water						
Our Reference		325231-1	325231-2	325231-3	325231-4	325231-5
Your Reference	UNITS	MW4	MW5	MW6	MW7	DUP1
Date Sampled		07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	09/06/2023	09/06/2023	09/06/2023	09/06/2023	09/06/2023
Date analysed	-	13/06/2023	13/06/2023	13/06/2023	13/06/2023	13/06/2023
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	80	89	87	92	81

HM in water - dissolved						
Our Reference		325231-1	325231-2	325231-3	325231-4	325231-5
Your Reference	UNITS	MW4	MW5	MW6	MW7	DUP1
Date Sampled		07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/06/2023	09/06/2023	09/06/2023	09/06/2023	09/06/2023
Date analysed	-	09/06/2023	09/06/2023	09/06/2023	09/06/2023	09/06/2023
Arsenic-Dissolved	µg/L	<1	<1	1	<1	<1
Cadmium-Dissolved	µg/L	<0.1	<0.1	0.1	<0.1	<0.1
Chromium-Dissolved	µg/L	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	<1	4	3	3	<1
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	1	4	4	2	1
Zinc-Dissolved	µg/L	4	27	19	14	4

Metals in Waters - Total						
Our Reference		325231-1	325231-2	325231-3	325231-4	325231-5
Your Reference	UNITS	MW4	MW5	MW6	MW7	DUP1
Date Sampled		07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/06/2023	09/06/2023	09/06/2023	09/06/2023	09/06/2023
Date analysed	-	09/06/2023	09/06/2023	09/06/2023	09/06/2023	09/06/2023
Phosphorus - Total	mg/L	<0.05	0.2	<0.05	0.05	<0.05

Miscellaneous Inorganics						
Our Reference		325231-1	325231-2	325231-3	325231-4	325231-5
Your Reference	UNITS	MW4	MW5	MW6	MW7	DUP1
Date Sampled		07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	08/06/2023	08/06/2023	08/06/2023	08/06/2023	08/06/2023
Date analysed	-	08/06/2023	08/06/2023	08/06/2023	08/06/2023	08/06/2023
Ammonia as N in water	mg/L	0.040	0.32	0.19	0.24	0.039
Nitrate as N in water	mg/L	<0.005	0.10	0.13	0.18	<0.005
Nitrite as N in water	mg/L	<0.005	0.018	0.020	0.021	<0.005
NOx as N in water	mg/L	<0.005	0.1	0.2	0.2	<0.005
Total Nitrogen in water	mg/L	<0.1	0.7	0.5	0.7	<0.1
Phosphate as P in water	mg/L	<0.005	0.11	0.02	0.05	<0.005
TKN in water	mg/L	<0.1	0.6	0.4	0.5	<0.1
Organic Nitrogen as N	mg/L	<0.2	0.3	<0.2	0.2	<0.2

Ion Balance						
Our Reference		325231-1	325231-2	325231-3	325231-4	325231-5
Your Reference	UNITS	MW4	MW5	MW6	MW7	DUP1
Date Sampled		07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	08/06/2023	08/06/2023	08/06/2023	08/06/2023	08/06/2023
Date analysed	-	08/06/2023	08/06/2023	08/06/2023	08/06/2023	08/06/2023
Calcium - Dissolved	mg/L	94	57	98	87	96
Potassium - Dissolved	mg/L	18	21	24	24	18
Sodium - Dissolved	mg/L	2,000	1,700	1,900	1,800	2,100
Magnesium - Dissolved	mg/L	260	200	360	310	260
Hardness	mgCaCO 3 /L	1,300	960	1,700	1,500	1,300
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1,400	1,300	1,100	1,300	1,300
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	1,400	1,300	1,100	1,300	1,300
Sulphate, SO4	mg/L	540	550	500	470	560
Chloride, Cl	mg/L	3,000	2,400	3,300	2,900	3,000
Ionic Balance	%	-4.0	-6.0	-3.0	-4.0	-3.0

Microbiologocal Testing						
Our Reference		325231-1	325231-2	325231-3	325231-4	325231-5
Your Reference	UNITS	MW4	MW5	MW6	MW7	DUP1
Date Sampled		07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Type of sample		Water	Water	Water	Water	Water
Date of testing	-	09/06/2023	09/06/2023	09/06/2023	09/06/2023	09/06/2023
Total Coliforms	cfu/100mL	<100&>10	<1,000 NBO	<100&>10	<1,000 NBO	<1,000

Method ID	Methodology Summary
Ext-008	Subcontracted to Sonic Food & Water Testing. NATA Accreditation No. 4034.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-040	The concentrations of the major ions (mg/L) are converted to milliequivalents and summed. The ionic balance should be within +/- 15% ie total anions = total cations +/-15%.
Inorg-055	Nitrate - determined colourimetrically. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction.
Inorg-055	Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction.
Inorg-055/062/127	Total Nitrogen - Calculation sum of TKN and oxidised Nitrogen. Alternatively analysed by combustion and chemiluminescence.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction.
Inorg-060	Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction.
Inorg-062	TKN - determined colourimetrically based on APHA latest edition 4500 Norg. Alternatively, TKN can be derived from calculation (Total N - NOx).
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS. Please note for Bromine and Iodine, any forms of these elements that are present are included together in the one result reported for each of these two elements.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-023	Water samples are analysed directly by purge and trap GC-MS.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			15/06/2023	[NT]	[NT]	[NT]	[NT]	15/06/2023	[NT]
Date analysed	-			16/06/2023	[NT]	[NT]	[NT]	[NT]	16/06/2023	[NT]
TRH C_6 - C_9	µg/L	10	Org-023	<10	[NT]	[NT]	[NT]	[NT]	109	[NT]
TRH C_6 - C_{10}	µg/L	10	Org-023	<10	[NT]	[NT]	[NT]	[NT]	109	[NT]
Benzene	µg/L	1	Org-023	<1	[NT]	[NT]	[NT]	[NT]	93	[NT]
Toluene	µg/L	1	Org-023	<1	[NT]	[NT]	[NT]	[NT]	108	[NT]
Ethylbenzene	µg/L	1	Org-023	<1	[NT]	[NT]	[NT]	[NT]	112	[NT]
m+p-xylene	µg/L	2	Org-023	<2	[NT]	[NT]	[NT]	[NT]	116	[NT]
o-xylene	µg/L	1	Org-023	<1	[NT]	[NT]	[NT]	[NT]	115	[NT]
Naphthalene	µg/L	1	Org-023	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate Dibromofluoromethane	%		Org-023	96	[NT]	[NT]	[NT]	[NT]	95	[NT]
Surrogate toluene-d8	%		Org-023	98	[NT]	[NT]	[NT]	[NT]	99	[NT]
Surrogate 4-BFB	%		Org-023	105	[NT]	[NT]	[NT]	[NT]	102	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date extracted	-			09/06/2023	2	09/06/2023	09/06/2023		09/06/2023	[NT]
Date analysed	-			10/06/2023	2	10/06/2023	10/06/2023		10/06/2023	[NT]
TRH C_{10} - C_{14}	µg/L	50	Org-020	<50	2	<50	<50	0	109	[NT]
TRH C_{15} - C_{28}	µg/L	100	Org-020	<100	2	<100	<100	0	110	[NT]
TRH C_{29} - C_{36}	µg/L	100	Org-020	<100	2	<100	<100	0	100	[NT]
TRH >C_{10} - C_{16}	µg/L	50	Org-020	<50	2	<50	<50	0	109	[NT]
TRH >C_{16} - C_{34}	µg/L	100	Org-020	<100	2	<100	<100	0	110	[NT]
TRH >C_{34} - C_{40}	µg/L	100	Org-020	<100	2	<100	<100	0	100	[NT]
Surrogate o-Terphenyl	%		Org-020	70	2	68	76	11	85	[NT]

QUALITY CONTROL: PAHs in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	325231-1
Date extracted	-			09/06/2023	2	09/06/2023	09/06/2023		09/06/2023	09/06/2023
Date analysed	-			13/06/2023	2	13/06/2023	13/06/2023		13/06/2023	13/06/2023
Naphthalene	µg/L	0.2	Org-022/025	<0.2	2	<0.2	<0.2	0	60	63
Acenaphthylene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	62	63
Fluorene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	60	60
Phenanthrene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	64	64
Anthracene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	64	63
Pyrene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	65	62
Benzo(a)anthracene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Chrysene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	64	67
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-022/025	<0.2	2	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	119	103
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-022/025	<0.1	2	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	66	2	89	92	3	82	77

QUALITY CONTROL: HM in water - dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	325231-2
Date prepared	-			09/06/2023	1	09/06/2023	09/06/2023		09/06/2023	09/06/2023
Date analysed	-			09/06/2023	1	09/06/2023	09/06/2023		09/06/2023	09/06/2023
Arsenic-Dissolved	µg/L	1	Metals-022	<1	1	<1	[NT]		100	[NT]
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	1	<0.1	[NT]		97	[NT]
Chromium-Dissolved	µg/L	1	Metals-022	<1	1	<1	[NT]		97	[NT]
Copper-Dissolved	µg/L	1	Metals-022	<1	1	<1	[NT]		95	[NT]
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	[NT]		101	[NT]
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	1	<0.05	<0.05	0	110	113
Nickel-Dissolved	µg/L	1	Metals-022	<1	1	1	[NT]		96	[NT]
Zinc-Dissolved	µg/L	1	Metals-022	<1	1	4	[NT]		96	[NT]

QUALITY CONTROL: Metals in Waters - Total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			09/06/2023	[NT]	[NT]	[NT]	[NT]	09/06/2023	[NT]
Date analysed	-			09/06/2023	[NT]	[NT]	[NT]	[NT]	09/06/2023	[NT]
Phosphorus - Total	mg/L	0.05	Metals-020	<0.05	[NT]	[NT]	[NT]	[NT]	104	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			08/06/2023	[NT]	[NT]	[NT]	[NT]	08/06/2023	[NT]
Date analysed	-			08/06/2023	[NT]	[NT]	[NT]	[NT]	08/06/2023	[NT]
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	[NT]	[NT]	[NT]	[NT]	90	[NT]
Nitrate as N in water	mg/L	0.005	Inorg-055	<0.005	[NT]	[NT]	[NT]	[NT]	91	[NT]
Nitrite as N in water	mg/L	0.005	Inorg-055	<0.005	[NT]	[NT]	[NT]	[NT]	100	[NT]
NOx as N in water	mg/L	0.005	Inorg-055	<0.005	[NT]	[NT]	[NT]	[NT]	91	[NT]
Total Nitrogen in water	mg/L	0.1	Inorg-055/062/127	<0.1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Phosphate as P in water	mg/L	0.005	Inorg-060	<0.005	[NT]	[NT]	[NT]	[NT]	91	[NT]
TKN in water	mg/L	0.1	Inorg-062	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Organic Nitrogen as N	mg/L	0.2	Inorg-055/062/127	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: Ion Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			08/06/2023	1	08/06/2023	08/06/2023		08/06/2023	[NT]
Date analysed	-			08/06/2023	1	08/06/2023	08/06/2023		08/06/2023	[NT]
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	94	[NT]		87	[NT]
Potassium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	18	[NT]		95	[NT]
Sodium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	2000	[NT]		91	[NT]
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	260	[NT]		98	[NT]
Hardness	mgCaCO 3 /L	3	Metals-020	[NT]	1	1300	[NT]		[NT]	[NT]
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	[NT]		[NT]	[NT]
Bicarbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	1400	[NT]		[NT]	[NT]
Carbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	1400	[NT]		97	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	1	540	560	4	117	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	1	3000	3000	0	113	[NT]
Ionic Balance	%		Inorg-040	[NT]	1	-4.0	[NT]		[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Total Coliform analysed by Sonic Food & Water Testing. Report No. W2313523
NBO: the presence of competing background organisms in the sample may have reduced the count.

CERTIFICATE OF ANALYSIS

Work Order	: **ES2319421**	Page	: 1 of 6
Client	: **REDITUS CONSULTING PTY LTD.**	Laboratory	: Environmental Division Sydney
Contact	: GREG BARTLETT	Contact	: Customer Services ES
Address	: 1A/29-33 Waratah Street KIRRAWEE	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 22137	Date Samples Received	: 09-Jun-2023 15:36
Order number	: ----	Date Analysis Commenced	: 09-Jun-2023
C-O-C number	: ----	Issue Date	: 19-Jun-2023 18:16
Sampler	: TIARNI WIERSMA		
Site	:		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

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 Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Sanjeshni Jyoti	Senior Chemist Volatiles	Sydney Organics, 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.

- 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), Dibenz(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.
- 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.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	TRIP 1	----	----	----	----
				Sampling date / time	07-Jun-2023 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2319421-001	--------	--------	--------	--------
					Result	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**1370**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**1370**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**500**	----	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**2870**	----	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**114**	----	----	----	----
Magnesium	7439-95-4	1	mg/L		**267**	----	----	----	----
Sodium	7440-23-5	1	mg/L		**2030**	----	----	----	----
Potassium	7440-09-7	1	mg/L		**15**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.20**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**0.2**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	TRIP 1	----	----	----	----
				Sampling date / time	07-Jun-2023 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2319421-001	--------	--------	--------	--------
					Result	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**0.2**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.02**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**119**	----	----	----	----
ø Total Cations	----	0.01	meq/L		**116**	----	----	----	----
ø Ionic Balance	----	0.01	%		**1.02**	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L		<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L		<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L		<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L		<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L		<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L		<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L		<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L		<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L		<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	TRIP 1	----	----	----	----
				Sampling date / time	07-Jun-2023 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2319421-001	--------	--------	--------	--------
					Result	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		<100	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	----	----	----
^ **Total Xylenes**	----	2	µg/L		<2	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L		<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1.0	%		**24.4**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%		**48.2**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%		**63.2**	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1.0	%		**64.6**	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%		**79.4**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%		**95.7**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**106**	----	----	----	----
Toluene-D8	2037-26-5	2	%		**108**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		**101**	----	----	----	----

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	: **ES2319421**	Page	: 1 of 8
Client	: **REDITUS CONSULTING PTY LTD.**	Laboratory	: Environmental Division Sydney
Contact	: GREG BARTLETT	Contact	: Customer Services ES
Address	: 1A/29-33 Waratah Street KIRRAWEE	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 22137	Date Samples Received	: 09-Jun-2023
Order number	: ----	Date Analysis Commenced	: 09-Jun-2023
C-O-C number	: ----	Issue Date	: 19-Jun-2023
Sampler	: TIARNI WIERSMA		
Site	:		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

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
Sanjeshni Jyoti	Senior Chemist Volatiles	Sydney Organics, 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**

				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: 5116763)									
ES2319714-002	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	53	53	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	53	53	0.0	0% - 20%
ES2319472-001	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	186	186	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	186	186	0.0	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 5104101)									
ES2319320-023	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	2	1	0.0	No Limit
ES2319320-032	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	12	12	0.0	0% - 50%
ED045G: Chloride by Discrete Analyser (QC Lot: 5104100)									
ES2319294-002	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	10	10	0.0	No Limit
ED093F: Dissolved Major Cations (QC Lot: 5113766)									
ES2319787-005	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	5	5	0.0	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit
ES2319515-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	1260	1230	2.2	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	212	203	4.1	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	10700	10400	2.8	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	88	86	2.1	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5113765)									

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: 5113765) - continued									
ES2319787-005	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	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
		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	<0.005	<0.005	0.0	No Limit
ES2319515-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.010	<0.010	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.010	<0.010	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.010	<0.010	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.050	<0.050	0.0	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 5113767)									
ES2319698-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
ES2319787-007	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: 5112112)									
ES2319407-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
ES2319437-004	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	376	384	2.3	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 5104097)									
ES2319294-002	Anonymous	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: 5112111)									
ES2319407-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	6.03	6.03	0.0	0% - 20%
ES2319437-004	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	240	236	1.5	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 5112107)									
ES2319407-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.1	2.5	17.4	No Limit
ES2319437-004	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	447	402	10.5	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 5112108)									
ES2319407-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	1.03	0.98	5.6	0% - 50%
ES2319437-004	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	3.10	3.55	13.7	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 5104098)									
ES2319294-002	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.46	0.46	0.0	0% - 20%
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5110070)									
ES2319189-029	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
ES2319538-002	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	30	30	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5110070)									
ES2319189-029	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	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 (%)*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5110070) - continued									
ES2319538-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	50	50	0.0	No Limit
EP080: BTEXN (QC Lot: 5110070)									
ES2319189-029	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	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		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
ES2319538-002	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	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		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**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 5116763)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	99.0	81.0	115
				----	50 mg/L	107	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5104101)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	103	82.0	122
				<1	500 mg/L	100	82.0	122
ED045G: Chloride by Discrete Analyser (QCLot: 5104100)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	50 mg/L	95.7	80.9	127
				<1	1000 mg/L	99.0	80.9	127
ED093F: Dissolved Major Cations (QCLot: 5113766)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	92.4	80.0	114
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	98.6	90.0	116
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	101	82.0	120
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	97.0	85.0	113
EG020F: Dissolved Metals by ICP-MS (QCLot: 5113765)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	95.1	85.0	114
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	95.9	84.0	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	94.6	85.0	111
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	91.2	81.0	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	94.8	83.0	111
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	90.6	82.0	112
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	93.2	81.0	117
EG035F: Dissolved Mercury by FIMS (QCLot: 5113767)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	92.3	83.0	105
EK055G: Ammonia as N by Discrete Analyser (QCLot: 5112112)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	100	90.0	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5104097)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	106	82.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5112111)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	102	91.0	113
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 5112107)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 5112107) - continued								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	101	69.0	101
				<0.1	1 mg/L	85.6	70.0	118
				<0.1	5 mg/L	103	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5112108)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	97.0	71.3	126
				<0.01	0.442 mg/L	92.1	71.3	126
				<0.01	1 mg/L	105	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5104098)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	101	85.0	117
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 5107236)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	67.2	50.0	94.0
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	89.2	63.6	114
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	97.2	62.2	113
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	90.0	63.9	115
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	79.4	62.6	116
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	74.2	64.3	116
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	67.2	63.6	118
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	68.6	63.1	118
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	68.6	64.1	117
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	72.2	62.5	116
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	5 µg/L	69.0	61.7	119
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	86.4	63.0	115
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	81.2	63.3	117
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	71.1	59.9	118
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	69.3	61.2	117
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	70.2	59.1	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5107237)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	400 µg/L	79.8	53.7	97.0
EP071: C15 - C28 Fraction	----	100	µg/L	<100	600 µg/L	75.5	63.3	107
EP071: C29 - C36 Fraction	----	50	µg/L	<50	400 µg/L	97.6	58.3	120
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5110070)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	93.4	75.0	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5107237)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	500 µg/L	69.9	53.9	95.5

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5107237) - continued								
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	700 µg/L	88.6	57.8	110
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	300 µg/L	94.7	50.5	115
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5110070)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	96.1	75.0	127
EP080: BTEXN (QCLot: 5110070)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	90.1	68.3	119
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	95.2	73.5	120
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	100	73.8	122
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	100	73.0	122
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	99.0	76.4	123
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	103	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**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 5104101)							
ES2319320-023	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	105	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 5104100)							
ES2319294-002	Anonymous	ED045G: Chloride	16887-00-6	50 mg/L	96.4	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5113765)							
ES2319775-001	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	100	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	97.4	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	111	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	114	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	97.9	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	102	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 5113767)							
ES2319421-001	TRIP 1	EG035F: Mercury	7439-97-6	0.01 mg/L	92.2	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 5112112)							
ES2319407-001	Anonymous	EK055G: Ammonia as N	7664-41-7	1 mg/L	84.2	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EK057G: Nitrite as N by Discrete Analyser (QCLot: 5104097)							
ES2319294-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	104	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 5112111)							
ES2319407-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	# Not Determined	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 5112107)							
ES2319407-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	25 mg/L	114	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 5112108)							
ES2319407-002	Anonymous	EK067G: Total Phosphorus as P	----	5 mg/L	103	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 5104098)							
ES2319294-002	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	92.8	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5110070)							
ES2319189-029	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	104	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5110070)							
ES2319189-029	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	103	70.0	130
EP080: BTEXN (QCLot: 5110070)							
ES2319189-029	Anonymous	EP080: Benzene	71-43-2	25 µg/L	100	70.0	130
		EP080: Toluene	108-88-3	25 µg/L	100	70.0	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	102	70.0	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	97.9	70.0	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	98.8	70.0	130
		EP080: Naphthalene	91-20-3	25 µg/L	98.5	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES2319421**	Page	: 1 of 7
Client	: **REDITUS CONSULTING PTY LTD.**	Laboratory	: Environmental Division Sydney
Contact	: GREG BARTLETT	Telephone	: +61-2-8784 8555
Project	: 22137	Date Samples Received	: 09-Jun-2023
Site	:	Issue Date	: 19-Jun-2023
Sampler	: TIARNI WIERSMA	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1

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.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

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

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Ar	ES2319407--001	Anonymous	**Nitrite + Nitrate as N**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC 0	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	5	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	4	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	5	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	4	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 / *Container* / Client Sample ID(s)	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
TRIP 1	**07-Jun-2023**	**----**	----	**----**	**16-Jun-2023**	21-Jun-2023	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
TRIP 1	**07-Jun-2023**	**----**	----	**----**	**09-Jun-2023**	05-Jul-2023	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
TRIP 1	**07-Jun-2023**	**----**	----	**----**	**09-Jun-2023**	05-Jul-2023	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
TRIP 1	**07-Jun-2023**	**----**	----	**----**	**15-Jun-2023**	05-Jul-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
TRIP 1	07-Jun-2023	----	----	----	15-Jun-2023	04-Dec-2023	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
TRIP 1	07-Jun-2023	----	----	----	19-Jun-2023	05-Jul-2023	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
TRIP 1	07-Jun-2023	----	----	----	16-Jun-2023	05-Jul-2023	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
TRIP 1	07-Jun-2023	----	----	----	09-Jun-2023	09-Jun-2023	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
TRIP 1	07-Jun-2023	----	----	----	16-Jun-2023	05-Jul-2023	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
TRIP 1	07-Jun-2023	15-Jun-2023	05-Jul-2023	✓	16-Jun-2023	05-Jul-2023	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
TRIP 1	07-Jun-2023	15-Jun-2023	05-Jul-2023	✓	16-Jun-2023	05-Jul-2023	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
TRIP 1	07-Jun-2023	----	----	----	09-Jun-2023	09-Jun-2023	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM))							
TRIP 1	07-Jun-2023	14-Jun-2023	14-Jun-2023	✓	18-Jun-2023	24-Jul-2023	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
TRIP 1	07-Jun-2023	14-Jun-2023	14-Jun-2023	✓	19-Jun-2023	24-Jul-2023	✓
Clear glass VOC vial - HCl (EP080)							
TRIP 1	07-Jun-2023	15-Jun-2023	21-Jun-2023	✓	15-Jun-2023	21-Jun-2023	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071)							
TRIP 1	07-Jun-2023	14-Jun-2023	14-Jun-2023	✓	19-Jun-2023	24-Jul-2023	✓
Clear glass VOC vial - HCl (EP080)							
TRIP 1	07-Jun-2023	15-Jun-2023	21-Jun-2023	✓	15-Jun-2023	21-Jun-2023	✓
EP080: BTEXN							
Clear glass VOC vial - HCl (EP080)							
TRIP 1	07-Jun-2023	15-Jun-2023	21-Jun-2023	✓	15-Jun-2023	21-Jun-2023	✓

Quality Control Parameter Frequency Compliance

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.

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*	
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	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	18	**11.11**	**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	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	5	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	4	**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	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	5	**40.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	18	**5.56**	**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	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	3	20	**15.00**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	3	20	**15.00**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

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							
Major Cations - Dissolved	ED093F	1	18	**5.56**	**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	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**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	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	5	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	4	**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)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 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 thiocynate forms highly-coloured ferric thiocynate 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 Mercury by FIMS	EG035F	WATER	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(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 SnCl2 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-NH3 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-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
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 seperately 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)

Analytical Methods	Method	Matrix	Method Descriptions
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 othophosphate 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 1030F. 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)

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)
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.

REDITUS

02 9521 6567
admin@reditusconsulting.com

Unit 1A, 29-33 Waratah Street,
Kirrawee NSW 2232

reditus.com.au