SEARS 13: GROUNDWATER, SURFACE WATER & SALINITY IMPACT ASSESSMENT

20 October 2025

Prepared for:
Mingara Leisure Group Pty Ltd

Prepared by:
Stantec Australia Pty Ltd

Project Number:
301351398 Tumbi Umbi Retirement Living Project

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
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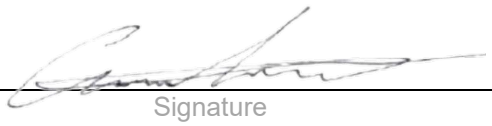
Prepared by: 

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Executive Summary

Stantec have been commissioned by Mingara Leisure Group Pty Ltd to prepare a groundwater and surface water impact assessment report, and a salinity management plan (if deemed to be required, following the outcome of the salinity risk assessment) to address the groundwater, surface water, and salinity elements of the Secretary's Environmental Assessment Requirements (SEARs) (SSD-63475709) for the proposed development.

The study objectives were to assess potential impacts on soil resources, surface water and groundwater resources, saline conditions and risks, develop a salinity management plan (if applicable) and meet the requirements under SEARs number 13.

Stantec's review of available data and impact assessment indicated that:

Surface Water

- No adverse impact by proposed development alterations or derived stormwater on the quantity or quality of receiving downstream surface water is anticipated.
- No surface water management plan is anticipated to be required.

Groundwater

- Construction and operation of the proposed development are not anticipated to interact (dewater) and obstruct water-bearing units of discontinuous and seasonally perched groundwater and shallow alluvial aquifers.
- The proposed development is not anticipated to significantly alter the Site's water balance.
- Currently, the existing Site setting and surrounding area is considered to pose a low risk to groundwater environmental values.
- The proposed development is considered to pose a low risk of impact on groundwater environmental values.
- Potential impact of groundwater on the proposed development is considered low risk, assuming that appropriate mitigation measures are implemented.
- The estimated total project groundwater take during deep pile construction is 0.5 ML. A water supply work approval will be required but a water access license is not anticipated to be required.
- No groundwater management plan or dewatering management plan is anticipated to be required.

Salinity

- Salinity poses a very low to low risk to the proposed development.
- No salinity management plan is required.

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1 Introduction

1.1 Background

Stantec have been commissioned by Mingara Leisure Group Pty Ltd to prepare a Groundwater / Surface Water Impact Assessment Report and a Salinity Management Plan (if deemed to be required) to address the Secretary's Environmental Assessment Requirements (SEARs) (SSD- 63475709) for the proposed development. Specifically, SEARs 13, which pertains to groundwater, surface water, acid sulfate soils, and salinity elements.

1.2 Description of the Site Locality

The site is located at 14 Mingara Drive, Tumbi Umbi, within the Central Coast Local Government Area (LGA). The development site is legally described as Lot 13 DP1204397, which covers approximately 29,958 m^2. The development location is presented on Figure 1-1.

The broader Mingara Club Precinct also encompasses Lot 1 and Lot 2 in DP 1010532 and Lot 71 DP1011971 and currently contains a registered club, health and wellness centre (including aquatics, gym facilities, physio, hairdresser, beautician and martial arts studio), car parking, creche, bowling greens and green space with a regional athletics centre. A hotel is currently under construction.

Immediately surrounding the Mingara Club Precinct are fast food outlets and other restaurants, service station, car wash, retail, medical centre and a retirement village to the south and west. Industrial development is to the north of Wyong Road and residential development to the west. The specific area of the site, the subject of the proposed development, is land located to the west of the Mingara Recreation Club and south of the Athletics field. This development site is currently a vacant grassed area (Figure 1-1). Table 1-1 summarises the key information.

Table 1-1: Key Information

Item	Detail
Site Address	14 Mingara Drive, Tumbi Umbi, NSW 2261
Site	Approximately 29,958 sqm
Title Details	The Site is described as part of Lot 13 in DP 1204397
Municipality	Tumbi Umbi
Planning Zone	RE2: Private Recreation
Current Site Buildings/ Infrastructure	The site is currently vacant land, with existing at-grade parking within the northeastern bounds.
Proposed Dwelling Mix	219 independent living units (ILUs) 39 residential aged care beds
Proposed Car Parks	293 carparking spaces

Figure 1-1: Development Site (red line) & Tumbi Umbi Retirement Village (blue line), Urbis 2023)

Key features of the development site are as follows:

- The topography of the site is generally flat, with some fill historically used to level the site, particularly in the northern portion of the site.
- The development site is vacant grassland with some mature trees located on the eastern boundary.
- The western and southern boundary of the development site has a registered easement following the drainage corridor defining the site boundaries to the west and south.
- Vehicle access will continue to be provided via the existing Wyong Road access to the north and the existing access from Mingara Drive into the broader Mingara Club precinct to the east.
- The development site does not have a direct street frontage and is bounded by the Athletics field to the north, Club access road and Mingara carpark to the east and Glengara Retirement Village to the south and west and low-density residential uses to the north-west. The Mingara Club precinct has frontage to Wyong Road and Mingara Drive.
- Vehicular access to the site from the local road network is available from Wyong Road, via left in and left out and from the signalised intersection at Mingara Drive/Wyong Road and then a roundabout on Mingara Drive.
- Internal pedestrian connectivity within the broader Mingara Precinct site includes pedestrian pathways from the north and west and pedestrian crossings from the car parking area into the main club building.
- A hotel is under construction on the broader Mingara precinct to the east of the development site.
- To the north west of the site is a constructed wetland / gross pollutant trap

The surrounding locality is described as follows:

- **North**: Immediately north of the development site is the athletics track/field, forming part of the broader Mingara Club precinct. Further north on the northern side of Wyong Road is industrial zoned land and the vast majority of the surrounding context comprises low density residential, environmental conservation, living and management.
- **East**: Directly east of the site is a hotel (under construction), the main Club building and car park, accessible from Mingara Drive and Wyong Road. Further east of the site are fast food and commercial land uses on Wyong Road, then low density residential uses. Further east is more residential development with the Bateau Bay Square shopping centre forming the major commercial node for the area.
- **South**: The Glengara Retirement Village is immediately south (and south west) of the site and is one to two storeys in height. Beyond that, the area of Tumbi Umbi is primarily larger environmental living residential lots.
- **West**: A drainage corridor and some taller vegetation is located directly west of the site. Further west is the northern portion of the Glengara Retirement Village

1.3 Project Description

1.3.1 Brief Description

The proposed development comprises subdivision of land and the construction and operation of a seniors housing development. The proposal includes thirteen villa buildings, three multi storey independent living unit (ILU) buildings and one mixed high care and ILU building housing communal facilities together with car parking, open space and associated works including site preparation works and landscaping.

1.3.2 Detailed Description

The proposed SSDA seeks approval to redevelop the site to accommodate a seniors living development inclusive of the following:

- Site establishment works, including minor excavation and tree removal and earthworks.
- Construction and operation of:
  - Thirteen (13) villa buildings, housing four (4) independent living units in each
  - Three (3) multi-storey independent living unit (ILU) buildings of:
    - Building 1 – undercroft car parking, 5 levels of 2-bed and 3-bed ILUs
    - Building 3 - undercroft car parking, 6 levels of 2-bed and 3-bed ILUs
    - Building 4 - undercroft car parking, 5 levels of 2-bed and 3-bed ILUs
  - One (1) mixed high care and ILU building (Building 2) of:
    - Part undercroft car parking, part communal/amenities level at ground with 3 levels of high care suites and 3 levels of ILUs
    - The building will include communal facilities including a café, residential lounge, multi-function spaces, consultation/therapy rooms, library and staff/admin areas.
- Provision of 219 x 2-bed and 3-bed independent living units and 39 high care suites

- Vehicle access will be provided via the existing road access from Wyong Road and via Mingara Drive. The site also accommodates a north-south internal shared access road and dedicated porte cochere in front of Building 2.
- Private, passive and communal open space, landscaping and perimeter and internal pedestrian pathways
- Subdivision of the land and two stage construction.
    1. Stage 1 works:
        - Construction of 119 Independent Living Units (ILUs) across three (3) buildings and six (6) villas), ranging in height from two to seven storeys. Buildings are sitting atop of their own undercroft-carpark or community hub. A 39-unit high care facility is also proposed, covering 3 storeys within Building 2. This stage also includes construction of carparks in the area, providing 109 car parks within the undercroft parking within buildings and 48 parking spaces (on street parking and garage) for villas. This will also include construction of retaining wall within Building 3, a 216 m^3 underground on-site detention (OSD) tank in between Buildings 1 and 2, and proposed 30 kL rainwater tank. Site preparation, roadworks, civil and bulk earthworks, hard and soft landscaping and associated services and infrastructure will be conducted as well.
    2. Stage 2 works:
        - Construction of 100 ILUs across one (1) building and seven (7) villas ranging from 2 storeys to 6 storeys in which the building sitting atop of its own undercroft carpark. This stage includes construction of 80 car parks within the undercroft parking within Building 4 and 56 car spaces, on street or garage, for villas. This will also include construction of retaining wall within Building 4, a 198 m^3 underground OSD tank within the landscape area adjacent to Building 4, and proposed 30 kL rainwater tank. Site preparation, roadworks, civil and bulk earthworks, hard and soft landscaping and associated services and infrastructure will be conducted as well.

Based on the bulk earthworks and demolition plans (Stantec drawing CI-100-001, revision D dated 10 July 2024) for the proposed upgrades within the Site, a total of approximately 5,856 m^3 will be cut and 7,330 m^3 volume of materials will be placed as fill within the area for a net fill placement of approximately 1,474 m^3, at the time of writing this report. The existing at-grade parking northeast of site is to be demolished and some of the existing trees across the site are to be removed. Majority of the earthworks to be conducted on Site is cutting the area into the new proposed ground level (post construction), which is identical to the existing natural ground level preconstruction. There is evident excavation and filling that will occur within the building areas such that building entrances or car park areas are at ground level. There are minimal changes to the topography of the other landscape areas.

The proposed foundation designs include screw piles to 9 m depth and bored piles to 20 m depth. Architectural plans for the proposed development indicate that structures at Site include two-storey independent living villas and six- to seven-storey buildings housing both residential and amenities area. In addition to the proposed buildings, retaining walls and underground on-site detention tanks are also proposed within the site area. Foundation options that may be considered for these structures include high-level foundations and deep foundations.

According to the Integrated Stormwater Management Plan prepared by Stantec (2024d) for the site, there are two (2) proposed underground OSD tanks and two (2) proposed rainwater tanks to be installed to accommodate stormwater flows within the proposed site. Construction of the OSD tanks will entail excavation to approximately 1.2 m below current land surface for the Stage 1 tank and 1.8 m below current land surface for the Stage 2 tank. Additional junction and grated pits are strategically proposed within the site footprint to direct overland flow towards proposed detention basins and/or drainages on

site. It is assumed that the site will utilise the existing stormwater drainages on MRC to eventually direct flows to the existing constructed wetlands, and eventually discharging into Tumbi Umbi Creek.

1.4 Purpose & Objectives

The SEARs for the project set out the following requirements with regards to the assessment of groundwater and surface water.

Specific objectives of this assessment were to collect information that was used to prepare an assessment of groundwater, surface-water, and salinity conditions relevant to interaction with groundwater, surface water, and saline soils within the Site.

The table below outlines the individual SEARs matters relevant to surface water, groundwater and salinity as per requirements under SEAR number 13 (ground and water conditions) and where each of these requirements has been addressed in this report.

Table 1-2: SEARs 13 – Ground and Water Conditions Issues and Requirements Report Section

SEARs Issue and Requirement	Report Reference
13. Ground and Water Conditions	
Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site, including soil erosion, salinity, and acid sulfate soils.	Soil Type: Section 4.4 Soil Salinity: Section 4.6 Soil Erosion: Section 8 Salinity Risk Assessment- Section 10 Acid sulfate soil –Stantec preliminary ASSMP (2024) RCA Preliminary Site Assessment and Geotechnical Assessment (2022, 2024)
Provide a Surface and Groundwater Impact Assessment that assess potential impacts on: - Surface water resources (quantity and quality), including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets, and watercourses. - Groundwater resources in accordance with the Groundwater Guidelines.	Surface Water Resources: Section 4.8 Groundwater Resources: Section 5 Receptors: Section 6 Groundwater Impact Assessment Section 8 Groundwater Resources: Section 9.2 Surface Water Quantity: Section 8.1 Surface Water Quality: Section 8.2

1.5 Scope of Works

Stantec carried out the following tasks to satisfy the purpose and objectives of this assessment:

- Conducted a desktop review of the site, features, and surrounds, including regional and Site (see approximate site boundary, Appendix A) hydrogeology, hydrology, groundwater resource use and land salinity.
- Assessed potential impacts on soil resources and related infrastructure and riparian lands on and near site, including soil erosion, salinity and acid sulfate soils.
- Prepared a Surface and Groundwater Impact Assessment that assesses potential impacts on:

  - Surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourses.
  - Groundwater resources in accordance with the Groundwater Guidelines.
- Preparation of this report to provide findings, conclusions, and recommendations relevant to the objectives of the assessment.

At this stage of the planning process a construction dewatering and a groundwater management plan were not required as these are typically a condition following project approval after the EIS has been issued.

1.6 Legislation and Guidelines

The assessment has been developed in accordance with the following legislation and guidelines:

- NSW (2000) Water Management Act 2000.
- NSW (2012) Aquifer Interference Policy.
- NSW (2022) Guidelines for groundwater documentation for SSD/SSI Projects.
- NSW (2022) Groundwater Impact Assessment Toolbox for Major Projects in NSW – Overview Document.
- NEPC National Environment Protection (Assessment of Site Contamination) Measure 1999. National Environmental Protection Council (NEPC 2013).
- NSW Department of Environment and Conversation (2007) Guidelines for the Assessment and Management of Groundwater Contamination.
- NSW EPA (2020) Consultants Reporting on Contaminated Land: Contaminated Land Guidelines. New South Wales Environment Protection Authority, April 2020, Updated May 2020.

1.7 DCCEWW Comments

Two rounds of comments have been provided by DCCEWW to Pariter and subsequently provided to Stantec. A summary of the relevant sections where updates to this report have been made based on the round 1 and 2 comments, are provided below.

- Round 1: DCCEWW comments dated 29 January 2025. Report updates in section 9.7 and a technical memorandum are provided in Appendix G.
- Round 2: DCCEWW comments dated 18 August 2025. Report updates are provided in:
  - Section 2.1: updated context related to perched groundwater.
  - Section 2.2: updated last dot point, context related to perched groundwater.
  - Section 4.7: Added additional context to the ephemeral concrete-lined drainage
  - Section 5.2: Clarification of the nature of perched groundwater being discontinuous.
  - Section 5.3: Clarification of the depth to groundwater.

- Section 5.5: Concrete-lined drain base RL updated and clarification related to the concrete lined drain.
- Section 7.1: Added a paragraph describing the OSD-1 and 2 construction method and the drainage feature upgrades.
- Section 9.7: Added a paragraph clarifying that the alluvial aquifer will not be intercepted by construction of the OSD and drainage upgrade, and that localised and discontinuous perched groundwater is unlikely to be encountered or dewatered.
- Section 10: removed dot point 5 of the second paragraph. This was a misplaced statement, not directly relevant to the salinity risk assessment. It was related to the general design and drainage considerations across the site (and not related to groundwater management).
- Section 10.4.1: update and clarification of perched groundwater. Removal of last section of paragraph, as this does not apply.
- Appendix G: included RCA test pit logs TP27 to TP36.

1.7.1 Stantec Response to DCCEWW Comments

Stantec have responded to DCCEWW comments, related to round 2 comments, dated 18 August 2025, and specifically for Sections 1 'water supply, take and licencing' and 2 'Groundwater impacts and dewatering requirements'. Stantec's response is provided in Table 1-3 below.

Table 1-3: DCCEWW Comment and Stantec Response

Item	DCCEWW Comment	Stantec Response
1.1	*No assessment has been provided of the water take from the cut excavations*	Locations where cutting is proposed are unlikely to encounter shallow, discontinuous and seasonally perched groundwater, based on the test pit locations where seepage was noted in clays.
1.1	*The proposed cut excavation requirements indicate maximum cuts of up to 2 m within the drainage line and the OSD tanks, and cuts of up to 1 m across other areas of the site.*	The RL of the inferred water-bearing zone of the semi-confined upper alluvial aquifer is deeper than the deepest proposed cuts on site (the OSD tanks) and of the upgraded drainage line depth. The RL of the water-bearing zone is approximately 3.3-3.8 mAHD, and the deepest cut across the site is 5.98 mAHD and at the drainage line is 5.1 mAHD, indicating a reasonable separation between the water-bearing zone of the aquifer and the deepest proposed cut. Regardless dewatering is not anticipated during upgrade of the drainage line.
1.1	*There is also reference to seepage that may require surface and sub-surface drains for ongoing management at the site.* *As shallow groundwater has been identified, likely as perched groundwater at depths ranging from 0.3 and 1.3 mbgl*	Perched groundwater was noted by RCA as seepage at three test pits, between 0.9 and 2.1 m depth, at three locations, TP23, TP 26 and TP 29, out of 36 test pit locations across the site, targeting depths of up to 2.6 m. The reference that DCCEWW has provided is likely related to the standing water depths in groundwater wells deep BH10 (0.35 m depth) and shallow BH13 and BH14 (0.87 and 1.10 m depth, respectively),

Item	DCCEWW Comment	Stantec Response
		which were under pressure. Groundwater-bearing zones (as strikes) were identified at 3.3 to 3.8 m depth. Groundwater seepage that may require sub-surface drains was reported in the salinity risk assessment section and was in the context of general design considerations. This statement was not considered relevant to the risk assessment outcome and has now been removed from the report to avoid confusion, as there are no requirements for sub-surface drains to manage groundwater levels or risk.
1.1	*Further information is requested to quantify the groundwater take for the cut excavations for the construction period and any ongoing take during operations.*	Aside from the previous take (0.5 ML per annum from displaced groundwater in deep pile excavation), no additional take is required or anticipated for the duration of the project, through construction and operation.
2.1	*If the take of groundwater is found to be greater than 3 ML per year, DPHI should seek from* *the proponent an assessment of impacts due to aquifer interference activities in accordance* *with the NSW Aquifer Interference Policy and framework (2012)*	No additional dewatering requirements are required. Hence, take is not anticipated to exceed 3 ML per year.

2 Previous Assessments

2.1 Geotechnical Assessments

2022 RCA Preliminary Geotechnical Investigation (2022a)

Field investigation comprised of ten (10) test pits (TP17-TP26) and ten (10) cone penetration tests (CPT) within the Site bounds. Refer to Figure 2-1 for test location plan.

The general ground conditions encountered across the Site were as follows:

- Fill: 0 to 1.6 m in thickness, predominantly comprised of Silty Clay, Clayey Gravel, Silty Sand, Gravelly Sand, and Sandy Gravel. Likely associated with historical site disturbance or filling works.
- Alluvial Soil: comprised of interlayered Silty Clay, Clay, Silty Sandy Clay, and Clayey Sand encountered from about 0.6 m until 2.6 m/20 m (end of investigation depth).

Perched groundwater was encountered at TP 23 and TP 26 at 2.1 m and 0.9 mbls, respectively. Note that TP26 is positioned within the northwestern bounds of the Site, within the proximity of the watercourse. All CPT soundings, which were advanced up to 20 mbls, reported groundwater at varying depths (0 mbls to 2.5 mbls). Although it should be noted that this is based on interpretation of CPT pore pressure data or limited observation during / after testing. Groundwater conditions may vary with climate and Site conditions.

Table 2-1: General Subsurface Profile

Subsurface Layer	Depth (m)	Material	Description
Fill	0 to 1.6	Silty Clay, Clay, Sandy Gravel, Clayey Gravel, Silty Sand, Gravelly Sand	Assumed to be uncontrolled; associated with historical disturbance or filling within the site.
Alluvial	0.6 to 20	Silty Clay, Clay, Silty Sandy Clay, Clayey Sand	Interlayered and highly variable lenses present at different depths and thicknesses across the Site, very stiff to hard consistency with some stiff bands. Medium to high plasticity with stiff to hard consistency.

Soil aggressivity test results and salinity evaluations are presented in Table 2-2 below. None of the results indicated aggressive classification for steel. Eight results indicated predominantly non-aggressive classification for concrete with two results with mild classification. All eight salinity evaluations indicated non-saline conditions.

Figure 2-1: RCA (2022a) Geotech Test Pit and CPT Location and approximate site boundary.

Table 2-2: Soil Aggressivity & Salinity Tests (RCA 2022a)

Test location	Depth (m)	Soil Type	pH	EC (µS/cm)a	Chloride (mg/kg)	Sulfate (mg/kg)	ECse (dS/m)b	Salinity Classification	Exposure Classification (AS2159-2009)c	
									Concrete	Steel
TP17	1.2-1.3	Silty CLAY	6.0	54	200	50	0.76	Non-saline	Non-aggressive	Non-aggressive
TP18	0.7-0.8	Silty CLAY	6.3	25	60	<10	0.28	Non-saline	Non-aggressive	Non-aggressive
TP19	0.3-0.4	Gravelly CLAY / Clayey GRAVEL	8.9	139	20	40	0.63	Non-saline	Non-aggressive	Non-aggressive
TP21	0.7-0.8	CLAY	5.0	232	230	220	1.51	Non-saline	Mild	Non-aggressive
TP23	1.6-1.7	Silty CLAY	5.7	74	100	20	0.59	Non-saline	Non-aggressive	Non-aggressive
TP24	0.3-0.4	Silty CLAY	7.3	76	60	20	2.00	Non-saline	Non-aggressive	Non-aggressive
TP25	0.6-0.7	Silty CLAY	5.6	285	280	220	0.49	Non-saline	Non-aggressive	Non-aggressive
TP26	0.9-1.0	Sandy GRAVEL	8.2	99	30	<10	0.74	Non-saline	Mild	Non-aggressive

Notes:

a. EC: Electrical conductivity EC 1:5 soil to water as reported.

b. Conversion of EC 1:5 to ECse based on Shaw (1999) and estimates of % clay derived from borehole logs.

c. Exposure classification for buried reinforced concrete based on Tables 4.8.1 and 4.8.2 of AS 3600 (2009). Exposure classification for concrete piles in soil based on Table 6.4.2(C) of AS2159 (2009).

2.2 Contamination Assessment

2022 RCA Preliminary Site (Contamination) Assessment (2022b)

Findings from RCA's 2022 Preliminary Site Assessment for the Site are presented below.

- Based on a desktop review, the majority of Site was used as agricultural or vacant land from before 1966 until 1995, at which construction of MRC commenced and introduced soil disturbance to the site, possibly filling. The site had no formal use aside from being used as an informal car park area (2006 onwards) and existence of gravel tracks looping north-south within site (around 2015).
- Site assessment comprised of historical documentation and photographs, Site inspection, and collection of samples from a total of 36 test pit locations, to approximately 2 m deep, in accordance with NSW EPA guidelines (shown on Figure 2-2 below).
- Fill material is comprised of multiple layers (generally sandy/ silty clay, clayey gravel), with anthropogenic waste encountered approximately a third of the sampling locations. This layer was encountered from surface up to about 2 mbls.
- Natural soils described as sandy/ silty clays up to 2 mbls (investigation extent).
- The potential for contamination is considered to be limited within the fill horizon – likely from leaks and spills from vehicles parking and chemical application to manage vegetation at the Site.
- No visual or olfactory indications of contaminations identified; no chemical contamination was identified in the collected samples.
- Ecological criterion for nickel was exceeded marginally in one sample. However, this concentration is not considered to require further assessment, remediation, or formal management for the purpose of the proposed development.
- No groundwater assessment was undertaken. Perched groundwater was encountered as seepage from overlying clays in test pit locations TP23 and TP29.

Figure 2-2: RCA (2022b) Sampling and Test Pit Locations

3 Soil and Groundwater Investigations

Additional Geotechnical Investigation carried out by RCA (2024) involved drilling of eleven (11) boreholes with three (3) groundwater monitoring bores installed on site from 19 February to 6 March 2024. Boreholes were drilled using Massenza MI2, targeting different proposed structure footprint within the area. Piezometers were constructed through utilising recently drilled geotechnical boreholes. Wherein 50-mm ID PVC is utilised with 3 m slotted screen and solid casing (sump) at the end of the pipe. Sand/gravel pack is used at the bottom of the borehole and used within the depths of the slotted screen. Bentonite seal is added in at the top and base of the slotted screen. Grout is then applied from the top bentonite seal until near surface level. Concrete is then applied at the top of the base and gatic cover is used to seal the piezometer.

Additionally, on 13 March 2024, Stantec conducted a site inspection, groundwater sampling of three piezometers (BH10, BH11 and BH13) and surface water monitoring (3 sites – SW01, SW02 and SW03) and sampling (1 site – SW01) within surface water bodies (constructed wetlands and ephemeral concrete-lined drainage feature) within the proximity of the site .

Findings are summarised in Site subsections below in Section 4 and Section 5.

4 Current Site Setting

Key environmental details defining the Site and regional area are summarised in the subsections below.

4.1 Climate

Based on nearby BOM stations, the Site mean annual rainfall is between 1,177 mm (Norah Heads BOM061366) and 1,328 mm, with February and September recording the highest and lowest rainfall, respectively. December to February are the hottest months, with maximum monthly temperatures of around 27.6°C (January). Meanwhile, June to August is the coolest – with the mean minimum temperature reaching 4.7°C (July) (BOM 2023, Gosford (Narara Research Station) AWS 061087, 1916 to 2013 / 1954 to 2023).

4.2 Topography

RCA (2023b) reported that the Site exhibits relatively flat topography, however slightly raised elevation along most of the western border is observed. Based on the Site Analysis – Topography and Existing Vegetation drawing by Marchese Partners, the site topography varies from 7 mAHD to 9 mAHD (refer to Figure 4-1), with a drop of approximately 2.6m from highest topographical point south of the site and the lowest at the north of the site. Majority of the site area appears to be relatively flat, allowing easy access for the proposed development works.

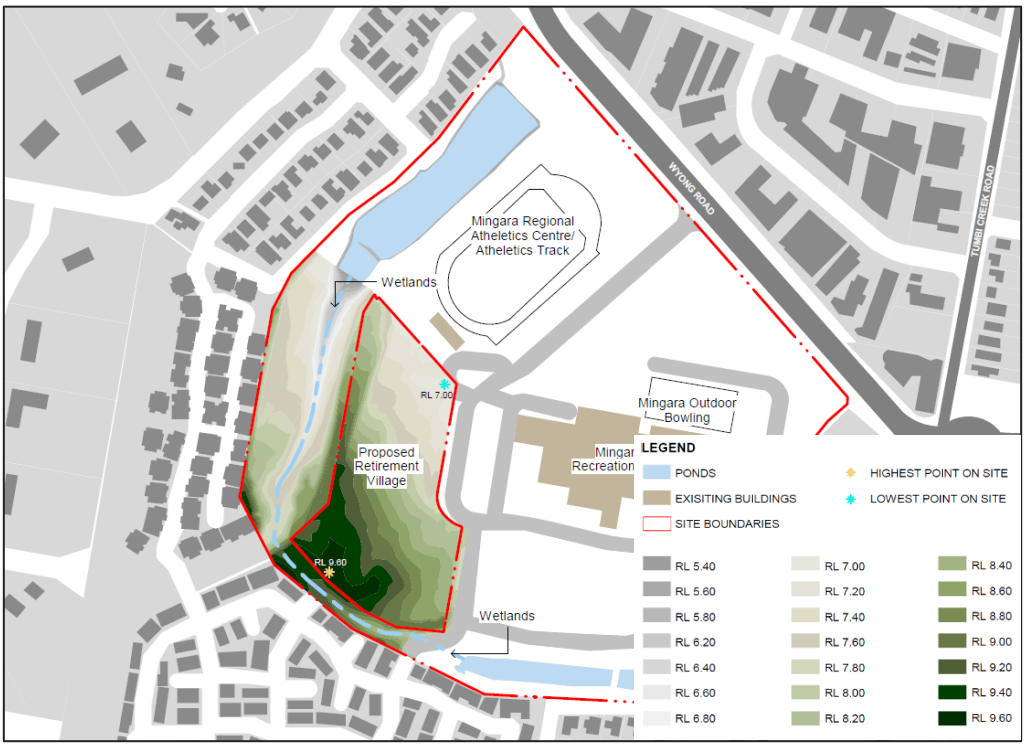

Figure 4-1: Site Topographic Contours (mAHD) (Site Surface Topographic Contours (mAHD) (Marchese Partners, 2024b)

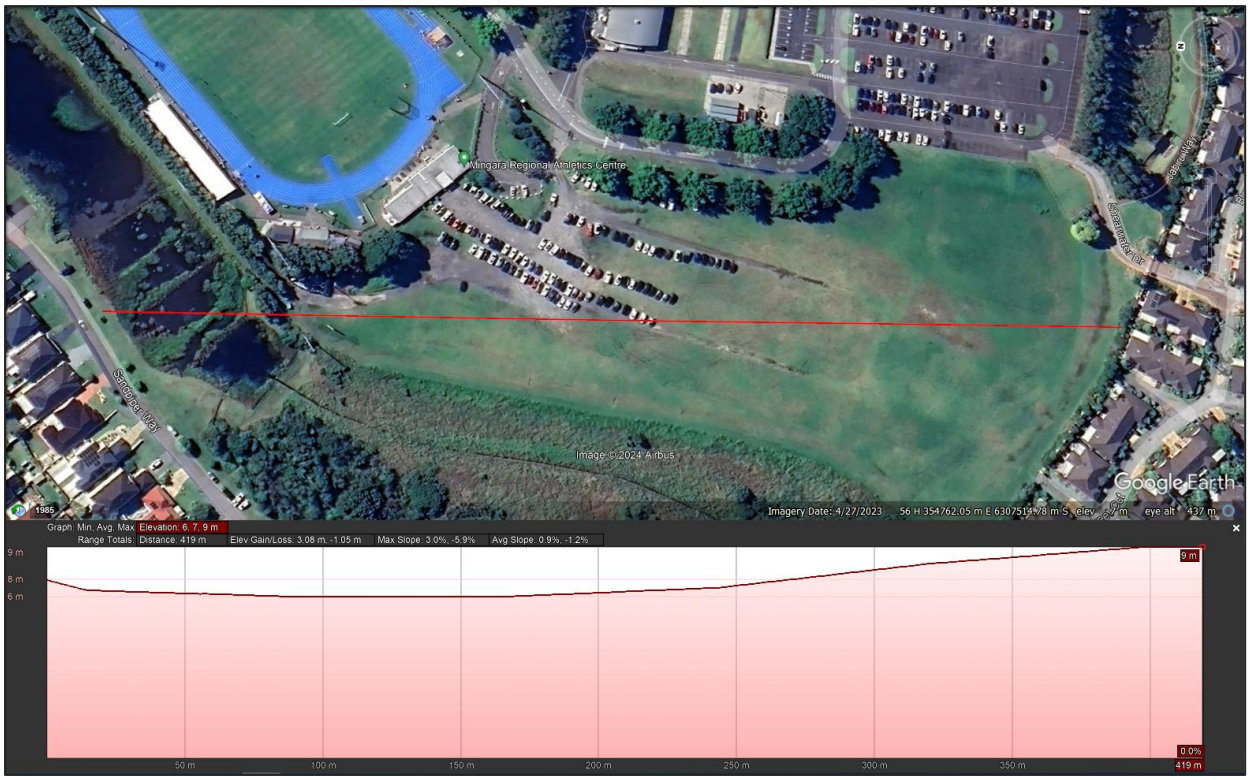

Figure 4-2: Elevation profile across the site, north to south (Google Earth 2024).

Figure 4-3: Elevation profile across the site, west to east (Google Earth 2024).

4.3 Vegetation

Over 90% of the Site is vegetated; predominantly comprised of grass covering the site (vacant land) with several trees present along the site's northern and eastern boundaries, with some trees noted further to the western and southern bounds of the site within the drainage corridor.

Based on Site Analysis – Topography, & Existing Vegetation information (Marchese Partners, 2024), there are twelve identified high significant trees within the precinct, which are proposed to be preserved as they add character and setting of the site. Most trees within the site area are identified as having low to medium significance. Trees that are proposed to be removed are within the proposed new vehicle entry and locations where will impede with the development footprint. Several trees within the northeastern area outside of the project bounds are recommended to be removed to allow construction of future road adjacent to the athletics track for coaches drop off and pick up.

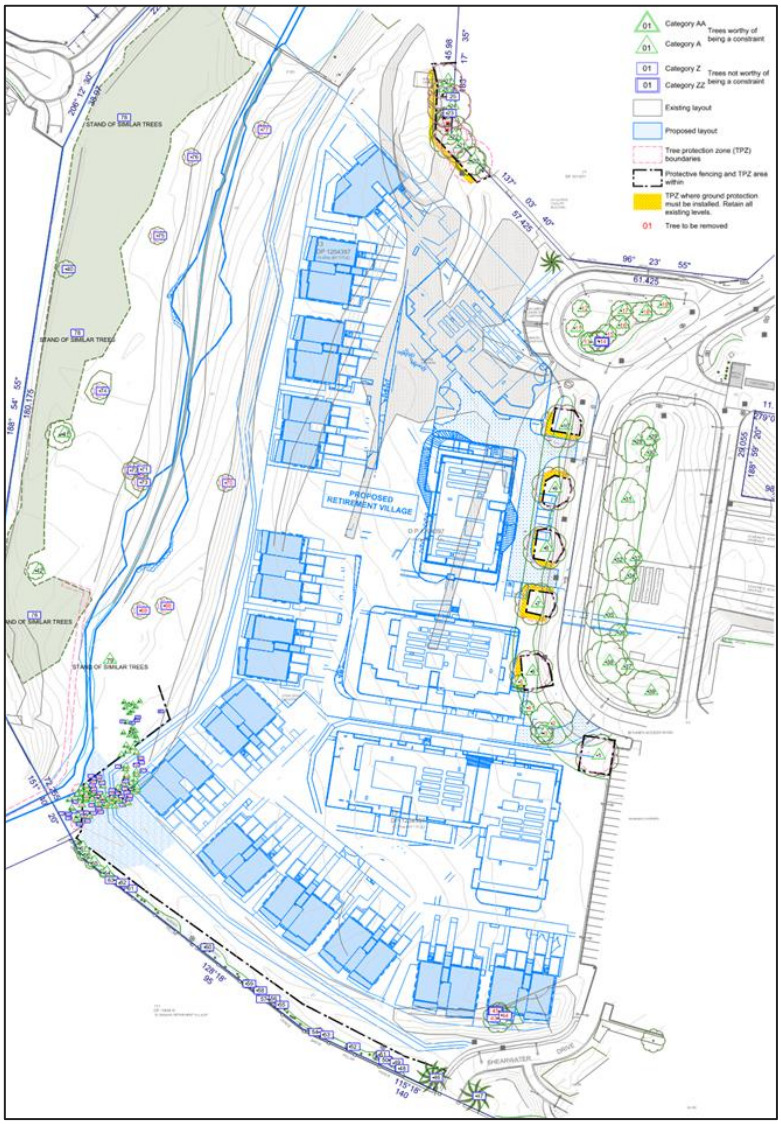

Figure 4-4: Existing vegetation coverage (Naturally Trees, 2024), with existing trees and proposed to be removed as indicated.

4.4 Surface Soils

Soil types are defined within the Wyong Soil Landscape (Marschke, 1989), characterised by deep (>200cm) yellow podzolic soils, brown podzolic soils, soloths, with some humus podzols around lake edges. This landscape is described as being poorly drained floodplains and alluvial flats of Quaternary sediments.

Soil classifications are not provided on logs for Site test pits or boreholes. However, field descriptions on the logs describe most of the soils as grey mottled orange alluvial silty/sandy clay or clayey sand. Alluvial soils are generally classified as “mild” to “non-aggressive” soil types.

Soil profile data available on eSpade (NSW) records a soil test pit north of the Site at the north end of the adjacent athletics field. The log for this test pit records a duplex soil comprising approximately 0.3 m A horizon of sandy loam overlying a B horizon of light medium clay. Subsoil material was moist; pH ranged from 5.5 to 6.0 (slightly acidic).

4.5 Acid Sulfate Soil

Based on Acid sulfate soil risk mapping (eSpade, NSW), the area is within the ‘LAp4’ Landform, which indicates that the area is formed under Lacustrine or Alluvial conditions, within identifiable plain land surface feature with elevations greater than 4 mAHD. Based on the provided ASS probability, there is a low probability of occurrence of acid sulfate soil materials greater than 3 mbls on Site.

Acid sulfate screening tests were undertaken as part of the Preliminary Geotechnical Investigation conducted by RCA (2022a). A total of sixteen samples were tested, and all the field pH results were greater than 4. As such, the soils would not be classified as actual acid sulfate soils. However, positive screening test results were noted, indicative of possible presence of potential acid sulfate soils. This would mean that there appears to be potential for acid forming conditions upon oxidation for soils on site. Further Chromium Reducible Sulfur test noted net acidity that exceeded ASSMAC action criteria.

Additional acid sulfate screening tests were undertaken as part of the Additional Geotechnical Investigation conducted by RCA (2024). A total of thirty samples were tested, and similar to previous investigation results, possible presence of potential acid sulfate soils is noted. Chromium Reducible Sulfur test undertaken indicates three (3) sulfidic soils in three locations, identified as PASS. Although in general, soils in the area are tending towards acidic soils (however, not PASS or ASS).

It is recommended that any disturbance and excavation of fill materials on site should be undertaken in accordance with the Stantec preliminary Acid Sulfate Soil Management Plan (ASSMP).

4.6 Soil Salinity

Review of the NSW State-wide Hydrogeological Landscapes (NSW DCCEEW, 2020) indicates that the site is within Acid Sulfate Potential and Alluvium Hunter Central Rivers Hydrogeological Landscapes. These landscapes indicate low to moderate salinity hazard – in terms of land salinity, salt export, EC, and instream salinity.

Additionally, review of the regional salinity hazard mapping indicates land salinity potential can occur within foot slopes of the low hills, and that minor to severe salt Sites can occur. These mostly occur along drainage depressions or at the foot of hills.

The site is within a higher elevation compared to its surrounding areas to the north and east, indicative of likely good lateral drainage. Water testing (RCA, 2024) and soil testing (RCA, 2022a, 2022b, and 2024) conducted at the Site yielded non-aggressive to mild-aggressive classifications, which suggests minimal risk posed by salinity on proposed site building footprints.

Review of eSpade data and logs for test pits and boreholes (RCA, 2022a, 2022b, and 2024) indicated that the soil profiles are likely to be Podzolic soils being horizon contrast soils (duplex) with often a light textured surface soil (sands) over a heavier B horizon dominated by the accumulation of compounds of organic matter, aluminium and/or iron (noting the presence of coffee rock in the RCA Geotech report).

The drainage status of the B horizon is variable with imperfectly to poorly drained B horizons prone to the development of a perched watertable, which was observed on site. Salinity is unlikely to develop in these soils due to the topography that allows the perched watertable to drain laterally towards lower parts of the landscape. The soil chemistry within the proposed development Site supports the lack of development of saline conditions with ECse (calculated) well below 1.0 dS/m to a depth of 3.45 meters (9 locations and 29 observations). Only one site (BH8) recorded slightly saline conditions with an ECse of 3.0 dS/m at 0.5-0.95 m as reported by RCA (2024). However, this BH8 is located within an area that has previously been disturbed and is therefore considered atypical of the natural conditions of the landscape within the development area.

Table 4-1 presents measured ECs and cation percentages for groundwater collected from wells constructed in BH10, BH13, and BH14. SW1 was collected from the concrete-lined drain located in the western part of the property (west of the proposed development area). Based on USGS (2024) categories, measured EC and converted TDS values were fresh (SW1 and BH14) to slightly brackish (BH10 and BH13). Sodium was the dominant major cation.

Table 4-1: Groundwater EC, Surface Water EC, SAR, and Major Cation Percentages

Bore ID	TDS[a] (mg/L)	EC (mS/cm)	SAR[b]	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	Ca (%)	Mg (%)	Na (%)
BH10	1100	1.72	8.9	21	36	290	6%	10%	84%
BH13	1100	1.72	8.0	15	51	290	4%	14%	81%
BH14	500	0.78	9.0	4.4	10	150	3%	6%	91%
SW1	410	0.64	4.4	22	15	110	15%	10%	75%

[a] TDS = total dissolved solids based on EC (µS/cm) multiplied by 0.65.

[b] SAR = sodium absorption ratio

Soil EC testing results for test pit samples (RCA, 2024) are presented in Table 4-3. EC_{se} was determined using chloride, $EC_{1:5}$ and estimate % clay (Shaw 1999). All results indicated non-saline conditions (that is, less than 2 dS/m EC_{se}) except for one measurement (EC_{se} of 3.0 dS/m at 0.5-0.95 m) that reported 3 dS/m ECse, which falls within the slightly saline classification interval of Hazelton and Murphy (2016).

Table 4-2: Borehole Soil EC and EC_{se}

Depth	0.5-0.95	1.5-1.95	3-3.45	0.5-0.95	1.5-1.95	3-3.45	0.5-0.95	1.5-1.95	3-3.45	0.5-0.95	1.5-1.95	3-3.45
Bore ID	EC uS/cm			% clay			ECse dS/m[a]			pH		
BH1	22	23	49	35	35	35	0.17	0.18	0.38	5.9	6.1	5.8
BH2	19	34	22	25	35	35	0.17	0.26	0.17	6.5	5.9	6.4
BH3	22	49	43	35	35	35	0.17	0.38	0.33	6.8	5.9	5.8
BH4	18	39	53	35	35	35	0.14	0.30	0.41	8.1	7	6.3
BH5	35	17	10	35	45	45	0.27	0.11	0.07	7.8	7.1	6.4
BH6	20	10	22	45	45	35	0.13	0.07	0.17	7	6.6	6.6
BH8	58	65	45	15	35	45	0.59	0.50	0.30	5.3	5.1	4.1
BH10	31	62	30	35	35	45	0.24	0.48	0.20	8	7	7.5
BH12	20	17	10	45	35	35	0.13	0.13	0.08	8.2	7.7	7

[a] Factor from Hazelton and Murphy (2016).

Table 4-3: Test pit Soil EC and EC_{se}

Nearest borehole	Test pit ID	Depth	Soil Type	EC	Cl	pH	% clay	Factor[a]	EC_{se}[a]
BH1	TP17	1.2-1.3	Silty CLAY	54	200	6	45	14	0.76
BH3	TP18	0.7-0.8	Silty CLAY	25	60	6.3	45	11	0.28
BH3&4	TP19	0.3-0.4	gravelly CLAY/clayey GRAVEL	139	20	8.9	35	4.5	0.63
BH4	TP21	0.7-0.8	CLAY	232	230	5	55	6.5	1.51
BH4&5	TP23	1.6-1.7	Silty CLAY	74	100	5.7	45	8	0.59
BH5	TP24	0.6-0.7	Silty CLAY	285	280	5.6	45	7	2.00
BH11	TP25	0.3-0.4	Silty CLAY	76	60	7.3	45	6.5	0.49
BH6	TP26	0.9-1.0	Sandy GRAVEL	99	30	8.2	5	7.5	0.74

[a] Factor from Hazelton and Murphy (2016).

4.7 Drainage

Overland drainage occurs towards northeastern area of the Site (Stantec 2024d). This is expected to consolidate off Site with runoff from the ephemeral concrete-lined drainage located to the west of Site, which drains into a stormwater lagoon that discharges ultimately into Tumbi Umbi Creek.

RCA (2022a) indicated that drainage across Site comprises both surface infiltration and overland flow, which is generally expected to be in the direction of the natural ground surface slopes at the Site (i.e., that is southwest to northeast). Existing stormwater management facility on Site indicates that several constructed wetlands and wetlands exist within the southern, western, and northeastern portion of MRC (refer to Figure 4-5).

Based on the Site constraints drawing (Marchese Partners, 2024), there are existing constructed wetlands and ponds in the Mingara Precinct area to provide potential habitat and maintain stormwater treatment to the Site. The Site does not contain any formalised stormwater drainage. Analysis of survey information and Site information however indicates the presence of existing pits around the Site – particularly five (5) grated inlet pits within the swale along the eastern boundary of the Site. There are also two (2) culverts and three (3) headwalls positioned along the northern boundary of the Site. Overland flow is then collected by the existing Site pit and pipe network to the northern and eastern Site boundaries and assumed that this is eventually discharged to the constructed wetland further north of Site. It is assumed that the collected water within the constructed wetlands will ultimately drain into Tumbi Umbi Creek.

There are existing pits around the Site, with a swale running along the eastern boundary of the Site (with grated inlet pits within the swale) and existing culverts and headwalls positioned along the northern boundary of the Site. There also appears to be a creek/ overland path positioned on the western boundary adjacent to Site. It appears that stormwater collected from these drainages discharge directly into the constructed wetland to the north (refer to Figure 4-6). Under existing conditions, it is assumed that stormwater from the Site is collected by the existing Site pit and pipe network to the northern and eastern boundaries of the Site, then collected into the existing constructed wetland area running parallel with Wyong Road, and eventually discharges into the Tumbi Umbi Creek.

A drainage easement is located adjacent and parrallel to the southern boundary, connecting to the southeastern constructed wetland.

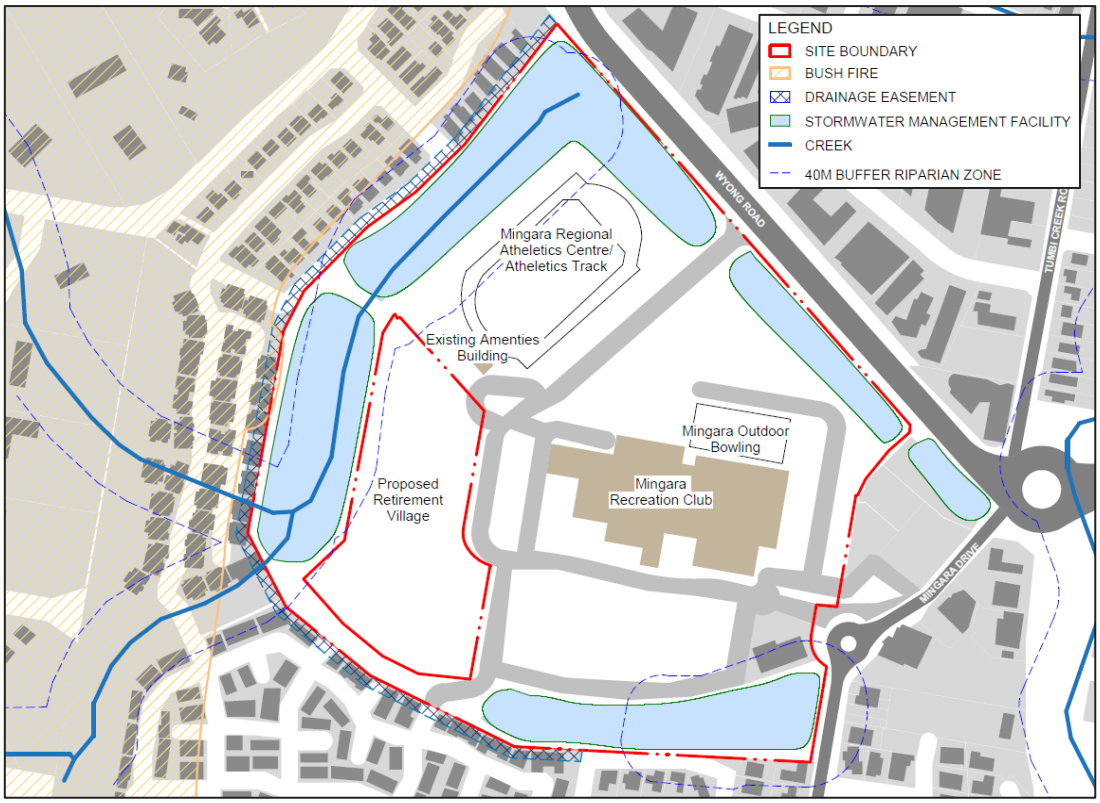

Figure 4-5: Location of the existing constructed wetlands, ponds and drainage lines (Marchese Partners, 2024c)

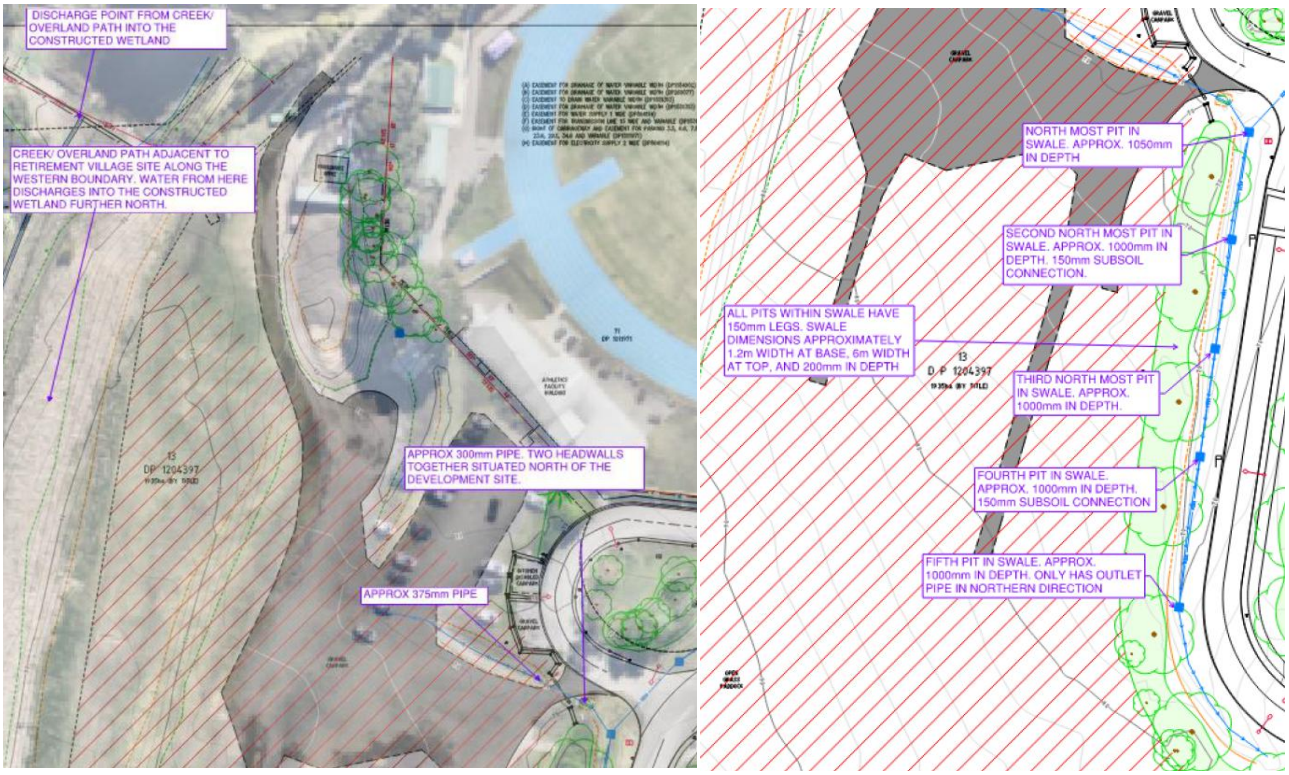

Figure 4-6: Existing Site Stormwater Network (Beveridge Williams, 2023; Stantec, 2024d)

4.8 Hydrology

An unnamed second order ephemeral concrete lined drainage channel is located immediately adjacent to the western development footprint boundary and running southwest to northeast. The unnamed drainage channel discharges into a constructed wetland, to the northwest, which has an overflow discharge drain toward Tumbi Umbi Creek. Several water storage constructed wetlands are also located within the Mingara Precinct. Two constructed wetlands are located south of the recreation club/parking area, and one elongated pond is located west of Mingara Sportsground. These are likely used to store runoff from the concrete-lined drainage channel passing through the area and surface runoff from site and surrounding catchment (see Figure 4-5).

Existing constructed wetlands near the Site may alter groundwater flow to the overall Site area and/or act as a groundwater sink and source.

The Site falls within the Water Sharing Plan for the Central Coast Unregulated Water Resources 2009.

Surface Water Budget - Existing Water Use

Data on water sources and water uses across the Site, particularly for irrigation, would be compiled for comparison with the proposed water use. No information is available regarding wastewater discharge or use of recycled/ grey water in the area. Although it is assumed that water use on site is minimal, given that it is currently a vacant land.

5 Hydrogeological Setting

The Site is located within the Acid Sulfate Potential and Alluvium Hunter Central Rivers Hydrogeological Landscapes (NSW DCCEEW, 2020). Site-specific information was also summarised from RCA (2022a, 2022b and 2024) and Stantec (2024) using available soil, water and groundwater bore data collected within the proposed site area. The Site falls within the Central Coast Unregulated Water Resources (2009) groundwater sharing plan.

5.1 Geology

Based on NSW Seamless Surface Geology (GSNSW, 2023), the area is underlain by alluvial valley deposits. Materials are comprised of fluvially deposited silt, clay, lithic to quartz-lithic sand, and gravel. Immediately to the north and northeast, undifferentiated Pleistocene regolith comprised of fluvial and marine clay, silt, and sand can be encountered. Exposures of Patonga Claystone composed of red-brown claystone and siltstone and light green-grey fine-grained sandstone is noted.

Surface geology at the Site comprises Quaternary-aged valley fill. This unit consists of silt, clay, fluvial sand, and gravel (Central Coast Area, Coastal Quaternary Geomorphology, 1:100,000, 2016).

RCA (2022a, 2022b, and 2024) investigations on site indicate fill materials comprised of generally dark grey/ brown sandy/silty clay and clayey sand with several layers of gravels or sands encountered in some test locations. The locations of RCA bores and wells are presented in Appendix A. Fill materials were encountered at varying depths to about 2.2m below surface, with multiple layers of fill identified on some sites. Natural alluvial materials were encountered as grey mottled orange silty/ sandy clay until about 28 mbls. Pockets of residual soil/ extremely weathered material were also noted in some test location sites, identified as red-brown silty clay from about 28 mbls to 30 mbls. Bedrock comprised of red-brown claystone with sandstone lenses/interbeds were encountered as early as 27.50 mbls to limit of the investigation extent (36.90 mbls).

Previous geotechnical assessment conducted by RCA (2022a, 2022b) of nearby carparking sites support the heterogenous fill mixtures observed on site, which is noted until about 0.5-0.6m in the mounded areas. This is underlain by alluvial deposits of silts, sands, and clays to depths up to 20.6 mbls.

5.2 Principal Aquifers

A regional semi-confined aquifer is developed in the unconsolidated alluvial sediments. A semi-confined to confined aquifer is developed in deeper portions of the alluvium. A fractured-rock aquifer is developed in the bedrock. Local seasonal perched groundwater occurs above shallow clay-rich soil horizons and is likely localised and discontinuous across the site.

Two aquifer units have been identified at the site. A confined deeper alluvial aquifer (between 14.80 mbls and 20 mbls), separated by a clayey aquitard (11.70 mbls to 14.80 mbls) with an overlying semi-confined to unconfined shallow alluvial aquifer (3.00 mbls to 4.30 mbls). The confined aquifer is considered independent from the shallow aquifer due to the different groundwater head levels

observed between bore BH10 (deep) and bores BH13 and BH14 (shallow). Test pits across the site were also noted by RCA to have seepage between 0.9m and 2m below ground level, which may indicate some localised overlying perched groundwater across the site.

5.3 Depth to Groundwater

Based on the location of this region, it is expected that depth to groundwater is shallow, particularly on areas near natural watercourses and towards the coast.

RCA previously encountered perched groundwater, which was observed seeping into test pits TP23 and TP29 (2022b) from 1.8 mbls and TP23 and TP26 (2022a) from underlying clay and gravel layers, 2.1 mbls and 0.9 mbls, respectively. Groundwater was encountered within deep in-situ cone penetrometer tests (CPT); however, depths are unknown, and results were inconclusive. It is noted that the groundwater was confined and exhibited a significant hydrostatic pressure, such that it rose to as shallow as 0.5 mbls within CPT holes. Perched groundwater would be anticipated to move in a northeastern direction towards the lower parts of the landscape and is not expected to cause high groundwater levels, although the presence of the deep confined alluvial aquifer may influence higher groundwater levels due to hydrostatic pressure.

Shallow groundwater was measured at all groundwater wells, from 0.35 m to 1.1 mbls (6.14 mAHD to 6.89 mAHD), although the alluvial aquifers are likely semi-confined sequences, given the water levels were under pressure. A more representative measurement of the top of the shallow aquifer (the actual water-bearing zone) is where the first groundwater strike was measured, which was at approximately 3.3 mbls to 3.8 mbls (3.41 to 3.84 mAHD).

Summary of the gauging information and field parameters is noted in Table 5-1 below, with complete data shown in Appendix B.

Table 5-1: Gauging Information (13 March 2024)

Location	Type / Location	Surface RL* (mAHD)	Groundwater Strike (m bls)	Groundwater Strike (mAHD)	SWL (mbTOC)	SWL RL (mAHD)	Well Depth (mbls)	Well Depth (mAHD)
BH10	Deep	7.24	3.4	3.84	0.35	6.89	19.85	-12.61
BH13	Shallow	7.24	3.3	3.94	1.10	6.14	7.4	-0.16
BH14	Shallow	7.21	3.8	3.41	0.87	6.34	7.2	0.01

* Approximate RL calculated from Survey Plan

5.4 Inferred Groundwater Flow Direction

Based on RCA (2022b), the inferred flow direction likely to be easterly towards the Tuggerah Lake. The topographical gradient indicates that local groundwater flow direction would likely be from the southwest to the northeast, eventually towards Tumbi Umbi Creek.

The estimated inferred groundwater flow direction would likely follow the topographic gradient, from southwest and off Site towards the northeast. Based on the groundwater monitoring conducted on the recently installed piezometers at the site, it is observed that standing water level encountered in the

northern area of the site is indeed deeper compared to the water level noted in the central portion of the site. It should be noted that there are insufficient groundwater data points to generate a groundwater contour plan to illustrate the inferred direction of the groundwater within and outside of the site. However, based on site elevations and proximity to coastal waters, it is inferred that groundwater is flowing generally to the north towards nearby surface water features.

5.5 Groundwater Surface-Water Interaction

Based on the elevations of the inferred hydraulic head and recorded standing water levels on the groundwater bores targeting the shallow alluvial aquifer (BH13, 6.14 mAHD and BH14, 6.34 mAHD) and the groundwater strike of the shallow bores (BH13, 3.94 mAHD and BH14, 3.41 mAHD) and the estimated level of the base of the concrete-lined drain (5.9 mAHD), it is unlikely that the unnamed drainage channel is a gaining system. That is, the drainage channel does not rely on or is influenced by the groundwater encountered in the shallow bores for its water source. Note that the concrete lining will be removed as part of works along the drainage channel.

5.6 Groundwater Flow Systems

Groundwater flow systems in any terrain characterise the occurrence of groundwater and its flow from areas of recharge to areas of discharge, often into surface water bodies. The main influences on groundwater occurrence and flow at the Site are:

- Rainfall (providing maximum recharge to groundwater during cooler periods, when rainfall is expected to exceed evaporation);
- Drainage channels / drains proximal to the Site;
- Low permeability, clayey alluvial layers (which have the potential to slow the percolation of infiltrating water); and
- High permeability, sandy alluvial layers (which have the potential to increase the percolation rate of infiltrating water).

The closest surface water features to the Site are the unnamed concrete-lined drainage channel immediately adjacent to the western boundary of the site and the ephemeral drainage channel to the south of the site, which act as drainage features within MRC. Additionally, other surface water features near the site area are the Tumbi Umbi Creek about 500m west and Quondong Gully about 950 m northwest. Three (3) constructed wetlands are located near the Site (Figure 4-5). Based on the general topography of the area, it is likely that the Site will discharge towards the north/northwest (constructed wetland), then towards the existing wetland overflow drain along Wyong Road, before eventually discharging towards Tumbi Umbi Creek then into Tuggerah Lake.

5.7 Groundwater Water Budget

Recharge

The shallow aquifers and regional aquifers at the site are recharged via infiltration of rainfall and locally by leakage from creeks and constructed wetlands and irrigation through the fill and alluvial soils. Lateral flow enters the perched aquifer from adjacent areas with higher groundwater heads. The regional aquifers are locally recharged via vertical leakage through soils.

Discharge

Discharge occurs from the perched aquifer (where present) occurs via evapotranspiration where the water-bearing zones of the perched aquifer are within approximately 2 m of the unsealed land surface or accessed by vegetation or lateral flow that discharges to surface-water features, such as Tumbi Umbi Creek. The regional aquifer discharges to major rivers and creeks or the sea. Groundwater pumping of the regional aquifer is noted in the region around the site, as evidenced by numerous registered groundwater bores within 2km of site used for irrigation and domestic use.

5.8 Groundwater and Surface Water Chemistry

It is expected that water type gets more saline as the area is closer to the coastal area, whereas it tends to be less saline at higher elevations. Salinity results from one of the registered groundwater bores around the site reported salinity ranging between 2.63 dS/m and 3.60 dS/m, indicating that the water is brackish. No total dissolved solids information is available for any of the registered groundwater bores near the Site.

Groundwater assessment by Stantec from the RCA installed groundwater bores indicates that both shallow and deep groundwaters are indicative of fresh to brackish waters. However, it is anticipated that seawater intrusion is likely to be present in the deepest portion of the deeper alluvial aquifer, which reflects Site proximity to the coast. The surface water collected from the unnamed concrete-lined drain was fresh water.

The Piper plot showing the water types encountered on site as well as the water quality field parameters recorded during the monitoring event are shown in Figure 5-1 and Table 5-2 below, respectively.

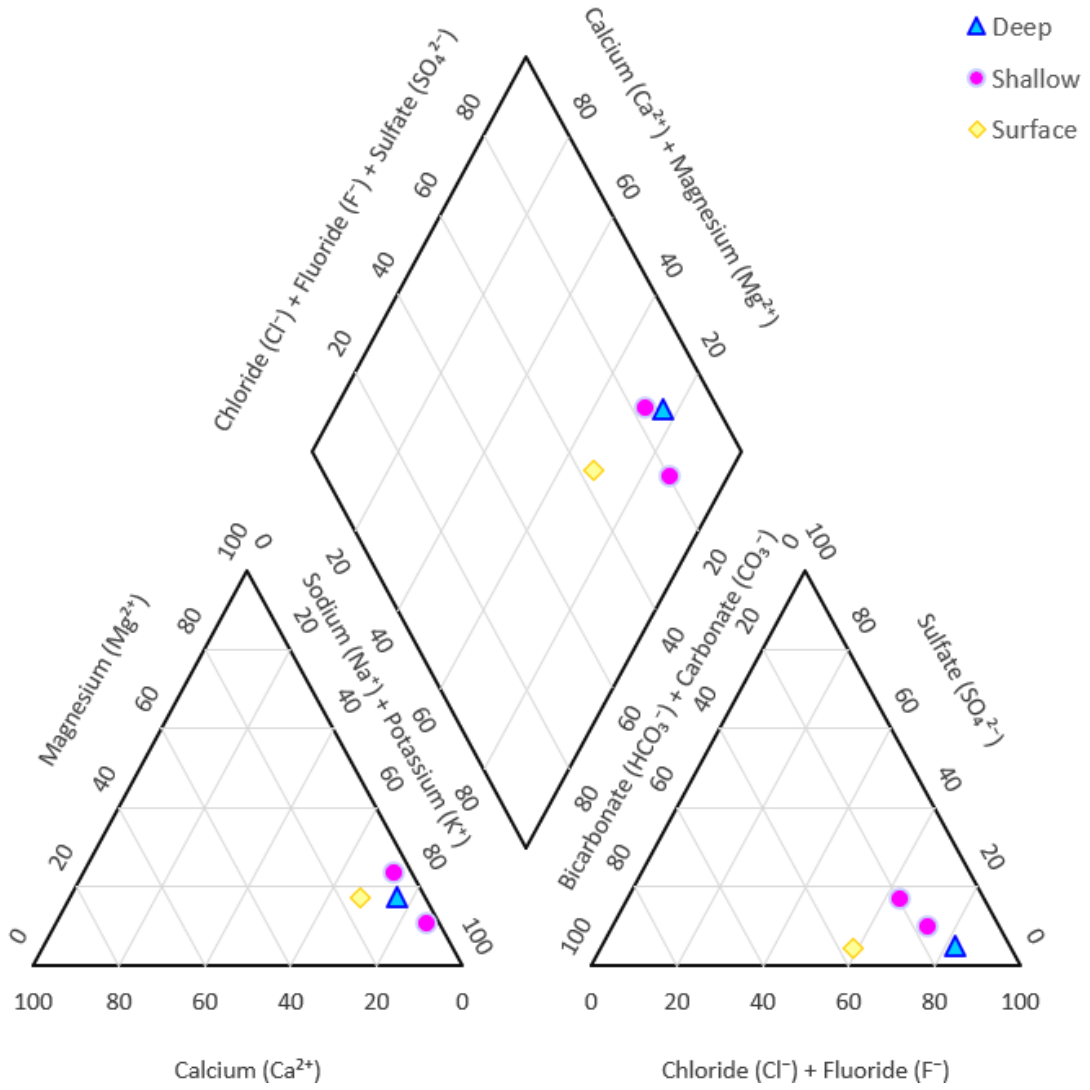

Figure 5-1: Piper plot showing classification based on water chemistry.

Table 5-2: Groundwater Field Parameters (13 March 2024)

Location	Type / Location	pH	DO (mg/L)	EC (µS/cm)	TDS[1] (mg/L)	ORP (mV)
BH10	Deep	5.04	5.06	1757	1142	-96.9
BH13	Shallow	6.17	2.01	1864	1212	-34.0
BH14	Shallow	5.54	6.33	833	542	-67.6
SW01	Surface water/ unnamed creek	6.83	10.26	784	510	-30.4

[1] EC in µS/cm converted to TDS in mg/L by multiplying by 0.65.

6 Receptors

6.1 Nearby Groundwater Users

A search of the boreholes from the Australian Groundwater Explorer (BOM) identified 26 registered bores within 2.0 km of the Site.

There are three registered monitoring wells located 300-400m northwest of the site, generally used for irrigation/ water supply. The next nearest wells are approximately 450m east of the site, identified as monitoring bores for NSW Office of Water and appears to be related to a service station. Based on RCA (2022b), the standing water level at GW201712, GW201713, GW201714, GW201715, GW201716 were recorded at 2.2 mbls. It should be noted that the site of groundwater wells is approximately 3m lower than the site.

Groundwater bores within the area are generally used for water supply (11), irrigation (5), monitoring bores (9), and with unspecified use (1). Depths ranged from 5m to 114m deep, with three bores within 300-400m away from site, six other bores are about 450m away, and all others more than 450m away from site. All bores were considered hydraulically up- or cross-gradient of the locally inferred flow direction of shallow site groundwater and approximately 3 m lower elevation than the site.

Stantec notes that while regional aquifer is likely extracted for consumption within the region, as supported by the presence of registered groundwater bores used for water supply, it is unlikely that the site would be affected by the groundwater taken from the bores located hydraulically up-gradient or cross-gradient from the site.

6.2 Surface Water

There is a second order ephemeral concrete-lined drainage line immediately adjacent to the western boundary and running southwest to northeast, discharging into the constructed wetland. This water feature is not considered to be a sensitive receptor, due to the highly modified feature and that it discharges to a stormwater capturing feature (constructed wetland).

6.3 Groundwater Dependent Ecosystems

Based on the Groundwater Dependent Ecosystem (GDE) map available (SEED), the closest GDE is about 145 m to the west of site, near an ephemeral watercourse. The next closest GDE are to the east, about 485 m and 700 m away and near Tumbi Umbi Creek (refer to Figure 6-1). GDEs around the Site are exhibited to be of low to medium priority likelihood.

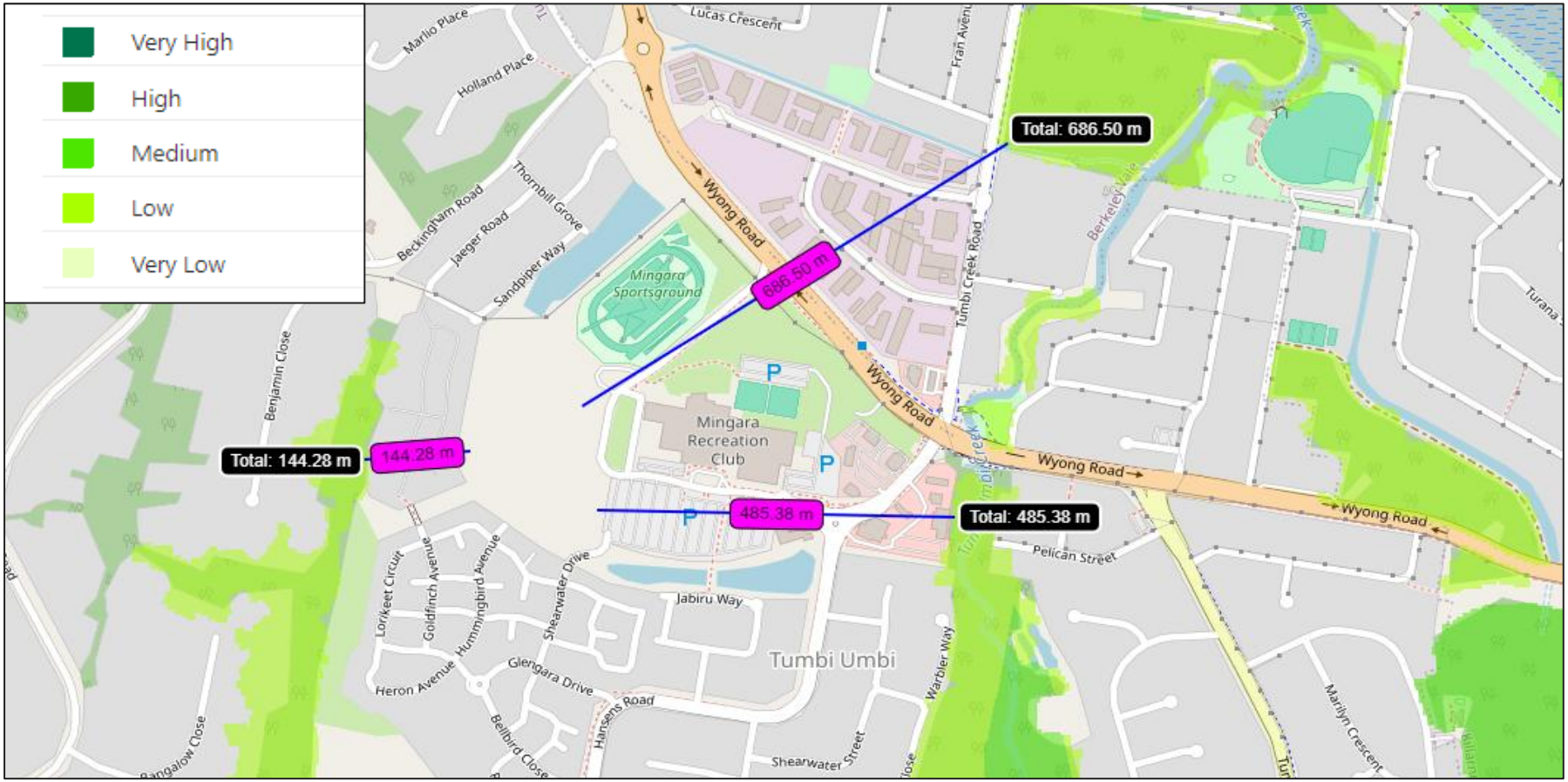

Figure 6-1: Groundwater Dependent Ecosystems within the proximity of the Site area (SEED).

7 Proposed Redevelopment Setting

7.1 Proposed Topographic Changes

Proposed cut and fill plan (CI-100-001, revision D dated 10 July 2024) identified surface elevation topographic changes across the Site. It is noted that the most significant alterations (greater than 1 m deep) are to occur within:

- the northern OSD-1 tank (1.0-1.22 m bls or 6.2-5.98 mAHD),
- the southern OSD-2 tank (1.5-1.79 m bls, or 7.3-7.31 mAHD) and
- the western drainage line (1.0-1.85 m bls, or 5.7-5.1 mAHD) (see Figure 7-1 below).

Construction of the OSD tanks would involve a relatively rapid excavation and installation of a pre-cast structure, therefore the excavation would be kept open and unfilled for a short duration. Landscape changes around the lawn and planting areas are unlikely to significantly alter the natural topographic gradient nor alter the existing drainage regime.

The drainage feature to the west will be restored of riparian corridor and will include removal of the concrete-lined channel, installation of ponds, new landscaping and a walking trail. During construction the existing drainage channel and water will be diverted until restoration upgrades have been completed.

Maximum infilling appears to be minimal, observed along several Villa (1-4) footprints. Fill depth required to achieve nominal pad level for these areas appears to be approximately 1.3m higher compared to the existing surface level.

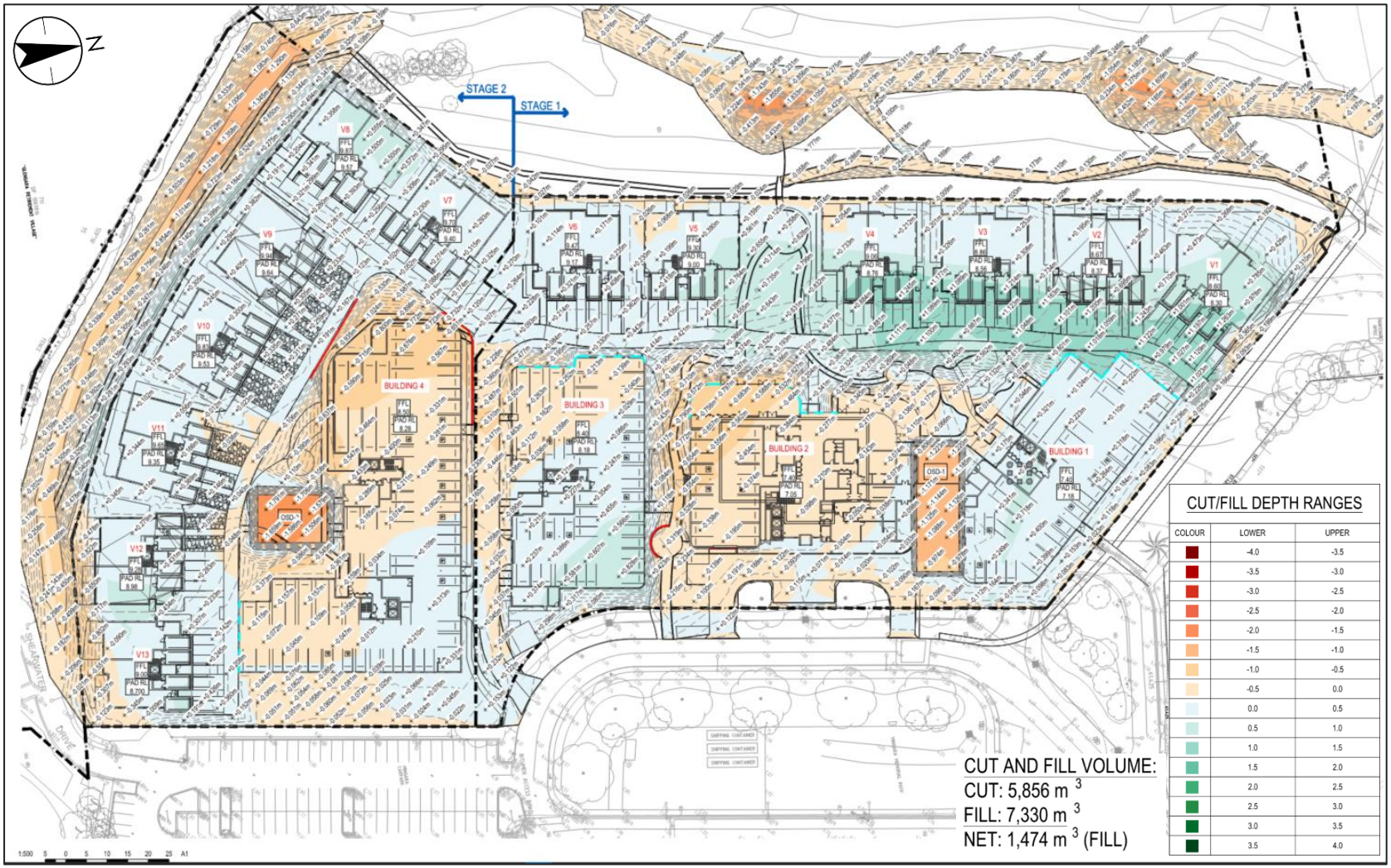

Figure 7-1: Proposed cut (red) and fill (green) areas within the Site (Stantec, 2024a).

7.2 Proposed Vegetation

Based on the arboricultural impact appraisal and method statement (Naturally Trees 2024, see Figure 7-2), there would be a total of 90 trees to be removed based on the proposed upgrades within Site. New building footprint will take up the existing landscape areas.

Additionally, from the Landscape Masterplan provided by Taylor Brammer (LA 100, revision B), areas around the proposed buildings and existing wetlands will be planted with trees, including a dedicated space within the vicinity of Building 1 for the proposed communal vegetable and flower garden. Several passive spaces will also be converted in lawn and planting areas (see **Figure 7-3**).

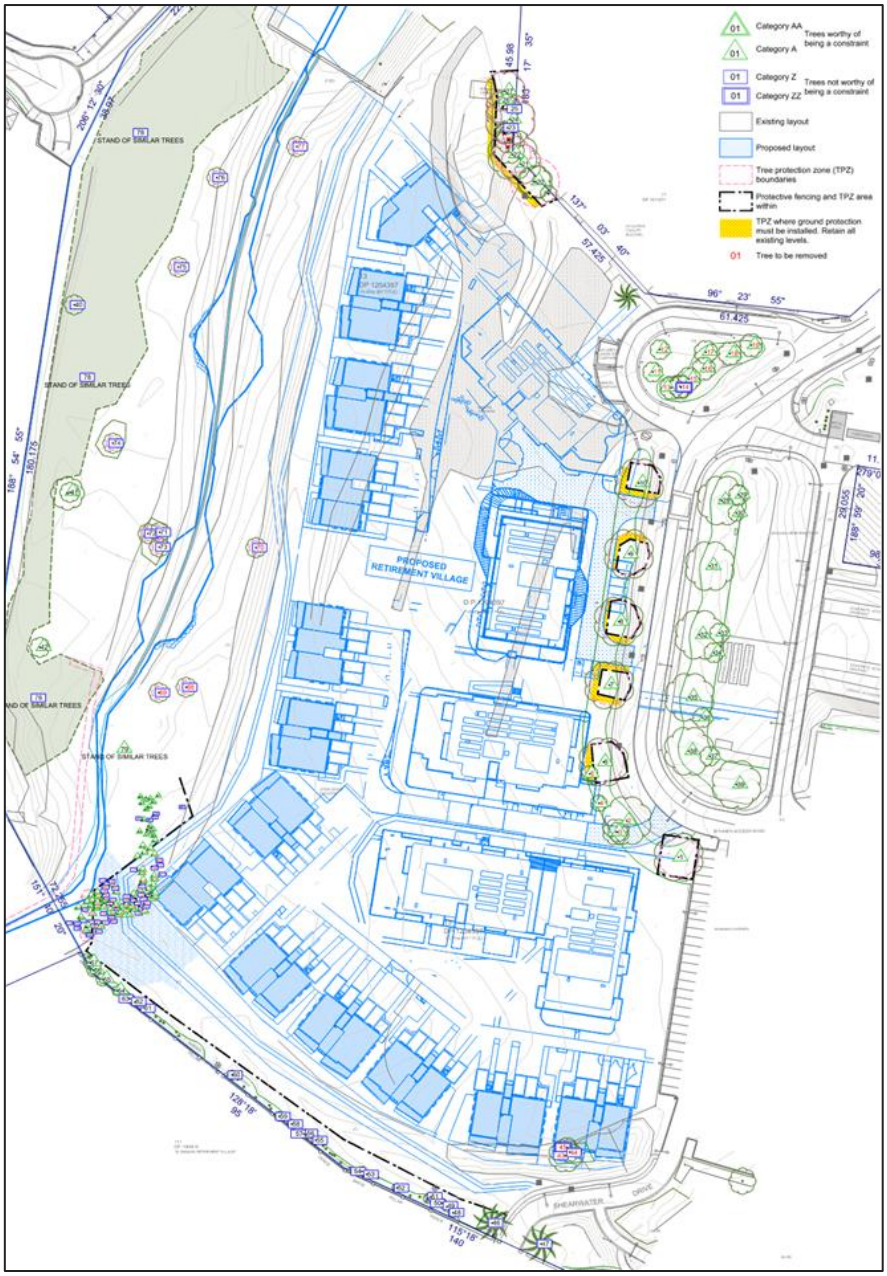

Figure 7-2: Vegetation Clearance Plan (adapted from Naturally Trees, 2024)

Figure 7-3: Landscape Masterplan for the Site (adapted from Taylor Brammer, 2024)

7.3 Hydrologic Regime Change

The existing building roof area and paved/sealed landscape areas varies greatly to the proposed development plans, as shown in and Figure 7-5 below. Hence, the recharge from rainfall may likely be significantly altered due to the proposed development. It is expected that footprints of the new buildings, including additional paved/ pathway areas, would likely minimise rainfall infiltration across these surface areas. However, the proposed landscape areas and proposed/ retained trees are likely to act as rainfall recharge infiltration areas but with the inclusion of the additional irrigation recharge. Therefore, it is likely that the water balance of the Site will encounter minimal change.

The proposed buildings (with partial underground level for parking and community hub), underground detention basins, and retaining walls could potentially intercept seasonally perched groundwater as well as the shallow alluvial aquifer during excavation works. Perched groundwater observed at approximately 0.9-2.1 mbls may be locally seasonally encountered.

The overall drainage features could be altered by changes to impervious areas and landscape (stormwater runoff flow change) and implementation of the proposed stormwater drainage plan as

runoff are to be diverted to onsite detention basins to cater flows generated from the development or into existing stormwater drainage directed towards existing constructed wetlands within MRC vicinity (outside of Site bounds). Runoff collection is proposed to continue consolidating into the existing public stormwater drainage by following the natural topography and therefore is unlikely to be significantly altered. Within the existing western drainage area, this feature will be renaturalised into a rock lined swale and two basins constructed with permanent pool and pumped reticulation system.

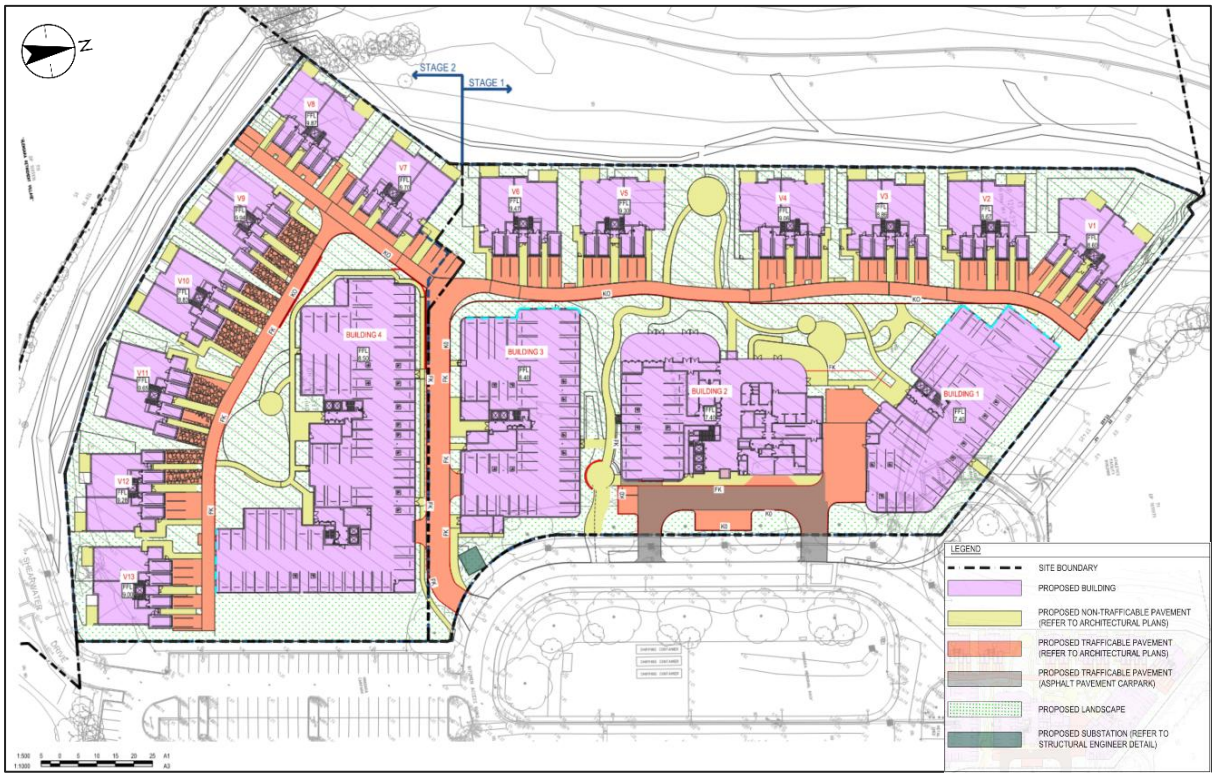

Figure 7-4: Pavement Plan (Stantec, 2024c)

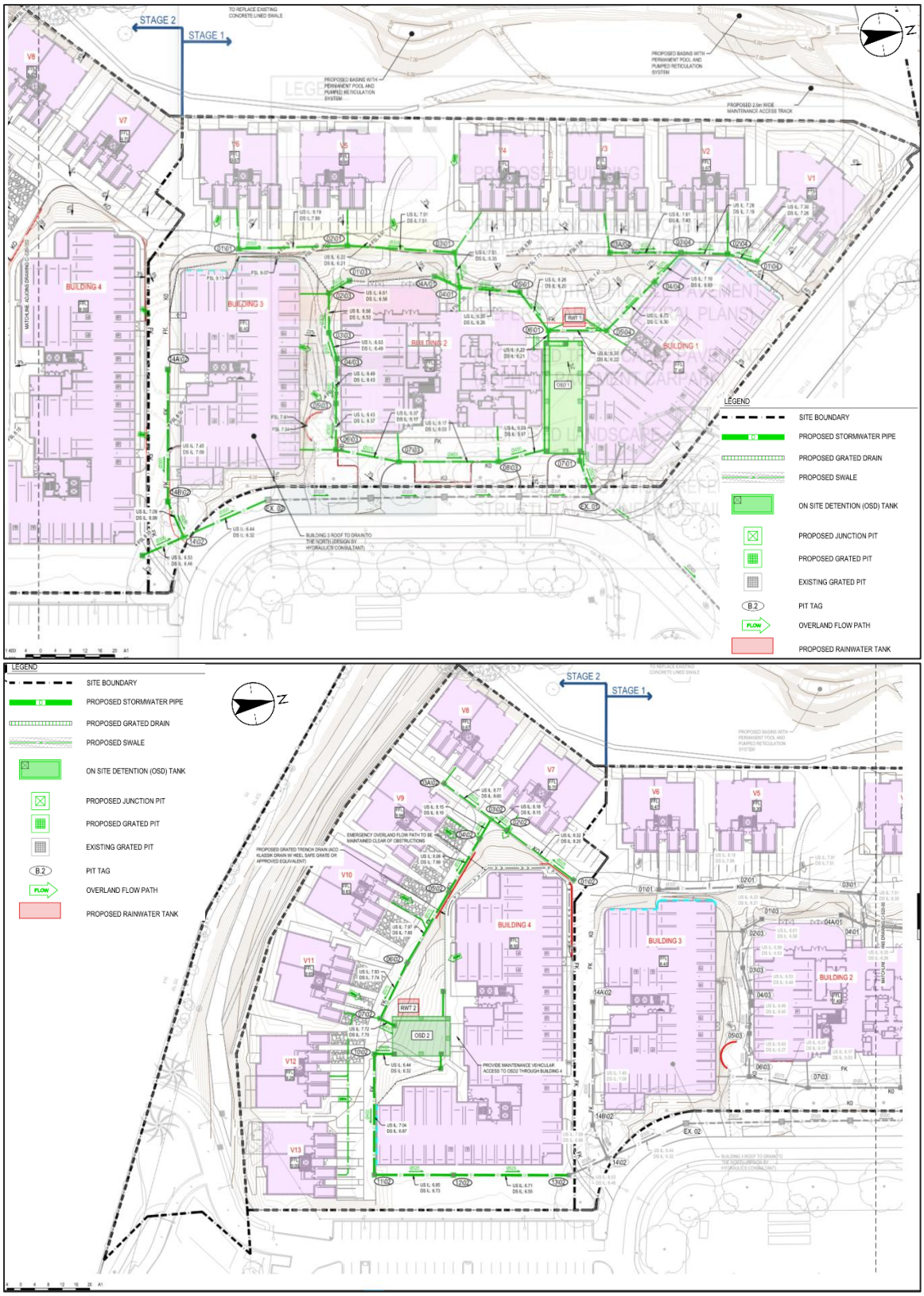

Figure 7-5: Stormwater Drainage Plan showing proposed rainwater tanks, on-site detention basins, pipes, and pits within the Stage 1 and Stage 2 bounds (Stantec, 2024b)

7.4 Proposed Water Use

Mains water will be used to supply the proposed development. Irrigation is proposed to all planting on grade and on slab adjacent to new buildings, typically using 25 mm per week to maintain planting. Turf or riparian zones are excluded from proposed irrigation on Site. Irrigation supply is understood to be from harvested stormwater, collected from rainfall building roof runoff, that will be stored in the proposed storages (rainwater tanks) on Site or from potable water sources.

It is anticipated that the distribution of recharge across the Site will change due to the proposed works on Site. The variation in topography will be minor in nature but recharge will be reduced at the building and paved areas. However, irrigation at the Site is anticipated to increase recharge. Therefore, on balance the recharge would be similar to current conditions.

8 Surface Water Impact Assessment

SEARs number 13 sets out the SSDA physical works for assessing impact on surface waters:

- Surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourses.
- Potential adverse impacts by the Site-derived surface water on the quantity or quality of surface water resources near the Site were assessed by evaluating whether significant changes in either discharge rates or stormwater quality were likely to occur compared to current conditions.

As noted in Section 4.8, no natural surface water features were identified on Site. However, there is a highly modified natural unnamed concrete-lined drainage feature immediately adjacent to the western boundary of the proposed development and running southwest to northeast, discharging into the constructed wetland (drainage basin). Several wetlands that have been constructed to manage stormwater exist within the MRC bounds. Drainage on site is likely to comprise of surface infiltration and overland flow, with flow direction generally according to the topographic gradient of the site (southwest to northeast) or diverted into existing stormwater drainages to the north or east of site. Post-development erosion at the Site is not anticipated in light of the proposed stormwater drainage system and landscaping. Within the existing western drainage area, this feature will be developed into a rock-lined swale and two basins constructed with permanent pool and pumped reticulation system with much of the surrounding vegetation retained.

8.1 Potential Impact of the Proposed Development on Surface Water Quantity

Based on the Existing Wetlands and Ponds diagram from Marchese Partners (2024) (refer to Figure 4-5) and Integrated Stormwater Management Plan by Stantec (2024) (refer to Figure 7-5), the Site stormwater runoff from the Retirement Village area will be diverted into proposed detention basins. Stormwater in the proposed western wetlands and excess stormwater from the Retirement Village area will eventually enter Tumbi Umbi Creek.

The Site stormwater system and proposed drainage system upgrades is designed to generally mimic the existing conditions. Therefore, adverse impact by Site-derived stormwater on the quantity of surface water downstream of the Site is not anticipated.

8.2 Potential Impact of the Proposed Development on Surface Water Quality

With regards to stormwater quality, modelling of the proposed stormwater management system's treatment train by Stantec (2024) indicates that the reduction of pollutants exceeds the target percentage set by Council's guidelines considered on water discharged into the public stormwater network.

Therefore, no adverse impacts by Site-derived stormwater on the quality of water in downstream receiving waters are anticipated.

9 Groundwater Impact Assessment

9.1 Hydrogeological Characteristics of the Site

The hydrogeology at the Site is characterised by a shallow unconfined to semi-confined aquifer and a confined deeper aquifer hosted by clayey sand to sand alluvial materials. Overlying perched groundwater across site may also be present, hosted within alluvial materials or a mix of clayey/ gravelly/ sandy fill. Testing points marks area of lower topography on site and may be within shallower depths to groundwater in the site. The alluvial aquifers present on site were not investigated extensively during the fieldworks (RCA 2022a, 2022b, and 2024) conducted on site. However, it is expected that it would likely form the shallowest regional aquifer in the area.

Groundwater bores were installed on site (BH10, BH13 and BH14) and subsequent laboratory results for samples obtained from these bores were used to assess water properties related surface water-groundwater interactions.

It is expected that groundwater from the site will likely discharge towards the Tumbi Umbi Creek to the east before eventually draining into Tuggerah Lake located to the north. This is consistent with the local topography and drainage pattern noted on the site area. Regional groundwater flow within the alluvial aquifer is expected to be in a northeasterly direction, generally consistent with the regional topography and drainage pattern in the area.

9.2 Environmental Values

An assessment of the applicability of groundwater environmental values, both on Site and off Site, is provided in Table 9-1 below.

Table 9-1: Assessment of Groundwater Environmental Values

Environmental Value	Applicable	Comment
Protecting aquatic ecosystems	**Yes**	The nearest surface water systems to the site are the highly modified unnamed second order stream drainage line immediately to the west of site, unnamed likely tributary of Tumbi Umbi Creek (approximately 200m west) and Tumbi Umbi Creek (approximately 550m east). Potential (low to medium likelihood) groundwater dependent ecosystems are located within the vicinity of these surface water systems. The site area is generally unused plot of land likely been reworked throughout the years. Surface water flows and potential groundwater migration is inferred to flow towards the northeastern/ east surface water drainage systems.
Groundwater used for drinking water	No	The site is located within an urban setting that is supplied with a municipal potable water supply. Several registered groundwater bores within the proximity are listed for domestic supply were identified, although not all bores notes if most are still functioning or had been decommissioned. Laboratory testing done on water samples collected indicates that water is fresh enough to be used potentially for drinking water, although no intensive assessment has been conducted to confirm this.

Environmental Value	Applicable	Comment
		Based on above, it is likely that groundwater can be used for drinking water, but the environmental value is not considered to be relevant.
Groundwater used for Irrigation	No	No registered groundwater bore is present on-site, with the nearest extraction bores near the site is about 300-400m away. Therefore, groundwater extraction for irrigation purposes is unlikely to occur.
Groundwater used for Stock Watering	No	The site is situated within a disturbed and urbanised setting. As such use of groundwater for stock watering purposes is unlikely.
Groundwater used for Industrial Use	No	On-Site use of groundwater for industrial purposes is unlikely to be practiced within a 500-m radius of the Site.
Groundwater used for Aquaculture and human consumption of aquatic foods	No	A review of the NSW Department of Primary Industries NSW Aquaculture Industry Directory 2019 did not list an aquaculture producer on or near the site. This environmental value is not considered relevant.
Groundwater used for Recreational Use	No	Groundwater on the site is not likely to be used for recreational purposes. Tumbi Umbi Creek, approximately 550m east is the likely major receiving surface water system. However, it is unlikely to be used for recreational purposes and is situated further away from the site.
Groundwater impact on Visual amenity of surface water	No	Tumbi Umbi Creek is the likely major receiving surface water systems. This is unlikely be impacted by potential groundwater impact from the Site.
Groundwater in non-use scenarios (i.e., vapour inhalation and intrusion)	No	The potential for inhalation of vapours via vapour intrusion emanating from contaminated groundwater was unlikely. No identified sources on or near the Site.
Groundwater impact on Buildings and Structures	**Yes**	Future and current building foundations and infrastructure could intercept perched groundwater within the fill/alluvial material layers or semi-confined/confined groundwater within the alluvial aquifer. These waters were assessed and discussed in Section 9.4 below.

Based on the above assessment, the relevant environmental values (REVs) to be considered are:

- Aquatic ecosystems.
- Groundwater impact on Buildings and Structures.

9.3 Potential Groundwater Contamination

No groundwater contamination assessment has been undertaken on site. Groundwater bores were installed within the site during RCA's investigation in 2024 although water testing did not include any contamination assessment. Hence, the potential groundwater contamination in the area is unknown.

Review of the previous reports, current site land use and surrounding land use did not identify any significant sources of potential groundwater contamination.

A service station is located approximately 420 m east of the site. However, it was not considered to be a risk, as it was located downgradient of the site and inferred groundwater flow from the service station would likely discharge into Tumbi Umbi Creek, to the east.

Hence, based on the results of this assessment, potential groundwater contamination at the site is considered unlikely.

9.4 Potential Impact of the Proposed Development on Groundwater Environmental Values

Considerations of impact of the proposed development on the groundwater quality at the site are as follows:

- It is not anticipated that the proposed excavations, detention basins, and building/structure will intercept the shallow alluvial aquifers or potentially generate pathways into the aquifers.
- Several new buildings and villas are to be constructed and could minimise recharge potential across the building footprint area. This minimised recharge could result in localised alterations to the physicochemical nature of the locally perched and shallow/deep alluvial aquifers and the underlying regional aquifer. However, it is unlikely to adversely impact the broader extent of the local or regional aquifers.

In summary, the proposed development is considered a low risk of impact on groundwater environmental values.

9.5 Potential Impact on Current Groundwater Environmental Values

Based on previous investigations completed by RCA (2022a, 2022b, 2024), groundwater at site and downgradient off site (potential receptors such as Tumbi Umbi Creek) were unlikely to be impacted by the current site uses. No potential groundwater contamination sources were identified or known, as no sources were identified at the site or within its proximity.

In summary, it is considered that there is currently a low risk of impact on the current groundwater environmental values.

9.6 Potential Impact of The Groundwater on the Proposed Development

A potential risk is that shallow groundwater can potentially cause water-logging and/or salinisation of the soil, leading to impacts on landscape and plants. The groundwater risk to buildings can cause corrosion of concrete and metal components of infrastructure, particularly when the water is saline or corrosive. Shallow groundwater at the site indicated:

- In-situ electrical conductivity (EC) and laboratory salinity water is fresh to slightly brackish and showing minimal to mild corrosivity properties.
- Compared to soil results collected from the same soil profile expected to yield water (3m to 4m) the results indicated low soil aggressivity (high pH and low salts).

- Shallow water table or mounding conditions can impact road/footpath pavements due to uplift pressures, erosion, differential moisture conditions and corrosive effects.

The risk of shallow groundwater effects are unlikely to occur across the majority of the site, however, may be localised to deep structures (such as deep foundations) and within vicinity of the existing surface water features (such as the existing drainage west of site). With adequate design measures these potential effects can be mitigated.

In summary, the potential impact of groundwater on the development is considered a low risk, assuming appropriate mitigation measures are implemented.

9.7 Aquifer Interference Assessment

As set out in the 2012 NSW Aquifer Interference Policy (AIP), an aquifer is considered a material that is or has the potential to be saturated with water. The AIP defines aquifer interference activities relevant to the proposed works at the Site area includes:

- Penetration of an aquifer.
- Interference with water in an aquifer.
- Obstruction of the flow of water in an aquifer.
- Disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

Other activities set out in the AIP, such as mining activities, are not relevant to the proposed works at the Site and are not considered further.

Importantly, excavations at the proposed northern OSD-1 tank, the southern OSD-2 tank and within the western drainage line upgrade will not intercept the shallow alluvial aquifer water-bearing zone.

Further to this, localised and seasonally perched groundwater will not be encountered during the construction of the OSD-1 and OSD-2, based on absence of perched water in nearby test pits (TP2, TP6, TP7, and TP10; and TP25, TP30 and TP32).

The drainage line upgrade will also not interfere with the regional unconfined alluvial aquifer due to the proposed drainage RL depths being higher than the inferred alluvial aquifer water-bearing zone RL.

Based on the construction methods and depths of the excavations for the two OSD tanks and the drainage line, groundwater is not anticipated to be intercepted and therefore a negligible consideration for any potential dewatering activities during these works. No dewatering activities are anticipated during construction along the drainage line.

The development will include a construction activity that intercepts the water table through dewatering or take that includes:

- Deep continuous flight auger (CFA) piles will intercept water-bearing alluvial aquifer intervals, and groundwater displacement, as dewatering or disposal, will occur.

A detailed review and response to the Department of Climate Change, Energy, Environment and Water's (DCCEEW) letter, dated 11 December 2024, *Attachment A, Section 1.0, Water Take and Licensing* and Department of Planning Housing and Infrastructure's (DPHI) letter dated 29 January 2025, R*equest for Additional Information*, *item 30,* queries are provided in Appendix G. Based on the review of the 40 proposed CFA piling bore holes (Dunnings 2024), the estimated total groundwater take is approximately 0.5 ML. This estimated volume is not a continuous annual take to be consumed or used for supply but is considered the maximum take for the duration of the project. The estimated take volume is also less than the 3 ML take threshold volume requirement under NSW Department of Planning, Infrastructure and Environment[2]. A water supply work approval will be required for the duration of the construction dewatering works; however, a water access license is not anticipated to be required (an exemption[3]) for groundwater taken during CFA piling for the building cores.

An evaluation of compliance with minimal impact is summarised in Table 9-2 below.

9.8 Evaluation of Compliance with Minimal Impact

Table 9-2: Productive Alluvial Aquifer: Assessment of Minimal Impact Consideration

Minimal Impact Considerations	Assessment	Impact Outcome
Water Table		
1. Less than or equal to ten percent cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: **a. High priority groundwater dependent ecosystem; or** **b. High priority culturally significant Site;** **listed in the schedule of the relevant water sharing plan.** **A maximum of a 2-m decline cumulatively at any water supply work.**	The shallow groundwater table, which is likely unconfined or semi-confined with the water-bearing zone around 3m-4.30 mbls is not anticipated to be actively dewatered. During CFA pile construction, some groundwater will be displaced, however this will unlikely result in significant water table variations. Localised perched aquifer may be present, wherein a seasonal and localised water-bearing zone seems to be within 0.9m-2 mbls layer, although was identified in areas where filling is to occur. Therefore, this consideration for a water table may be relevant, however no active dewatering[4] is anticipated. Potential sensitive receptors are not anticipated to be at risk from the construction or operation of the	No Impact

[2] https://water.dpie.nsw.gov.au/our-work/licensing-and-trade/water-access-licences-and-approvals/exemptions-for-water-licences-and-works-and-or-use-approvals/groundwater-wal-exemptions

[3] https://www.waternsw.com.au/__data/assets/pdf_file/0006/160953/Water-access-licence-exemption-for-aquifer-up-to-3ML.pdf; https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0009/386181/wal-exemption-up-to-3ML-information-sheet.pdf, accessed 31 March 2025

[4] Active dewatering is defined by Stantec as dewatering with pumping and drawdown effects.

Minimal Impact Considerations	Assessment	Impact Outcome
	development, due to no active dewatering[4] requirements.	
2. If more than ten percent cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: **a. High priority groundwater dependent ecosystem; or** **b. High priority culturally significant Site listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation would not prevent the long-term viability of the dependent ecosystem or significant Site.** **If more than a 2-m decline cumulatively at any water supply work, then make good provisions should apply.**	See above point.	No Impact
Water Pressure		
1. A cumulative pressure head decline of not more than a 2-m decline, at any water supply work.	See above point	No Impact
2. If the predicted pressure head decline is greater than consideration (1) above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline would not prevent the long-term viability of the affected water supply works unless make good provisions apply.	'Consideration 1' is considered met.	No Impact
Water Quality		
1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	The development is not anticipated to significantly alter the Site's water balance. The rate of local recharge is more sensitive to seasonal variations compared to the proposed changes in landscape and building footprints. Therefore, potential sensitive receptors are not considered to be at risk.	No Impact

Minimal Impact Considerations	Assessment	Impact Outcome
2. If consideration (1) is not met then appropriate studies would need to demonstrate to the Minister's satisfaction that the change in groundwater quality would not prevent the long-term viability of the dependent ecosystem, significant Site or affected water supply works.	'Consideration 1' is considered met.	No Impact

10 Salinity Risk Assessment

The following information was reviewed to assess salinity risk associated at the Tumbi Umbi development:

- Topography changes (based on cut/fill plan).
- Soil profile characteristics, mainly texture (based on the geotechnical bore logs and PSD data from the RCA 2022a, 2022b, and 2024 geotechnical investigations).
- Soil profile chemistry, mainly EC, pH, Cl (from field sampling and laboratory analysis – EC, CL. and pH).
- Any changes in water balance to the site (based on current use and development plans).
- Depth to groundwater (from field measurements in Site wells).
- Quality of the groundwater, EC (from field measurements and laboratory results).
- Quality of the water used for irrigation and/or in storages (provided by the client team).

The review of the documents and the findings on salinity presented in Section 4.6 along with the following assumptions were used to evaluate salinity risk:

- It is assumed that the current landscape is not irrigated based on google historical images. Irrigation of the landscaped area (approximately 40% of the total proposed development area) of up to 25 mm per week, or approximately 450 mm per year, will be applied to maintain healthy landscape plant growth.
- Irrigation water will be supplied by recycled water which is likely to have a TDS near 800 mg/L, within the TDS levels observed (500 mg/L to 1100 mg/L) in the shallow bores (BH13 and BH14).
- The high average rainfall for the site (1177 mm annual average rainfall reported for the open BOM station located closest to the Site at Norah Head BOM station 061366) provides the necessary leaching of the additional salts applied through irrigation of recycled water.
- The light surface soils (predominantly sands) allow for high lateral transmission of perched water to the northeast.
- Depth to the watertable (free water) was at approximately 1 mbls (BH13) and of low salinity (TDS 1100 mg/L). The nature of the topography and low salinity level suggests that the hydraulic gradient to the north towards Tuggerah Lake with no evidence of saltwater intrusion in the water-table aquifer. There were observations of perched water conditions 0.9-2.1 mbls, again showing non-saline conditions. Surface water sampled from the surrounding drain was also non-saline.

10.1 Potential Contribution of the Proposed Development on Salinity Risk

Factors that impact salinity risk of the proposed development within the Site are as follows:

- Site is currently used as vacant lot area. Proposed construction works will introduce major redevelopment at site, in accordance with the provided development drawings.
- Two stormwater detention basins, and deep footings (that is, piles) are proposed. The piles are likely to intercept perched groundwater, water-table aquifer, and the regional confined groundwater or potentially generate hydraulic connections between these Site aquifers.
- Building foundations, retaining walls, or underground infrastructure are likely to intercept perched groundwater and shallow alluvial aquifer at some locations. However, this may only occur seasonally and would be managed by intercepting groundwater and disposing such as by conveying to the stormwater system.
- Several new buildings are to be constructed and paved areas proposed that could reduce Site aquifer recharge. This reduced recharge could result in localised alterations to the physicochemical nature of the shallow aquifers and the underlying regional aquifer. However, it is unlikely to adversely impact the broader extent of the local or regional aquifers.
- Irrigation with recycled water, which is typically more saline than mains water or rainfall, may alter the quality of shallow Site groundwater.

In summary, the proposed development may affect the interaction between soil moisture and salt stored in the soils across the Site.

10.2 Risk Posed by Salinity on the Proposed Development

If present, saline soils, surface water, and groundwater could have deleterious effects on the proposed development. Examples of adverse impact include:

- Perched or shallow groundwater can cause waterlogging and/or salinisation of the soil, leading to impacts on buildings, infrastructure, landscape, and vegetation.
- Saline perched or shallow groundwater can cause corrosion of concrete and metal components of infrastructure.

However, soil results reported for shallow soils indicate low soil aggressivity (high pH and low salts) and non-saline soils (low EC_{se}). Furthermore, tests conducted on water sampled from Site wells and the adjacent drain (groundwater and surface water) indicated low to mild aggressivity and fresh to slightly brackish salinity results.

10.3 Risk Assessment Approach

The risk posed by salinity on the proposed development at the Site reflects the combination of the adverse consequence of salinity (such as salt damage to foundations or stressed/death of vegetation)

and the likelihood of this consequence occurring. A matrix can be used to illustrate the interaction between consequence and likelihood, as shown on the following table.

Risk Matrix		Consequence			
		Acceptable	*Tolerable*	*Unacceptable*	*Intolerable*
Likelihood	*Improbable*				
	Possible				
	Probable				

Descriptions of the consequence and Likelihood categories are as follows:

Consequence:

- *Acceptable* *No measurable salinity risk impact.*
- *Tolerable* *Salinity impact manageable with minor intervention.*
- *Unacceptable* *Salinity impact requires a significant intervention and cost.*
- *Intolerable* *Salinity impacts causes unavoidable damage to infrastructure and vegetation.*

Likelihood

- *Improbable* *unlikely to occur over the design life.*
- *Possible* *could occur over the design life.*
- *Probable* *Likely to occur over the design life.*

The cells coloured:

- *Green reflects very low risk.*
- *Yellow reflects low risk.*
- *Orange reflects moderate risk.*
- *Red reflects high risk.*

10.4 Evaluation of Salinity Risk

The salinity risk assessment considered the following factors:

- Depth to groundwater.
- Changes in recharge and discharge potential.
- Changes in water quality infiltrated across the Site.
- Spatial variation of potential salinity risk.

These factors are not mutually exclusive and have a high degree of interdependence. Nevertheless, each factor is assessed in independently.

Depth to Groundwater

The water-bearing zone of the regional confined aquifer is anticipated to be several metres below the proposed cuts, and it is not anticipated to be encountered during construction nor have a direct impact on surface soil salinisation.

Potential groundwater interference is only relevant to the shallow alluvial aquifers, which may be semi-confined within the water-bearing zone deeper from 3 mbls. However, discontinuous and seasonally perched groundwater seepage may be possible locally within the Site (encountered around 0.9 mbls to 2 mbls), although where this has been identified, none of the cuttings, such as for the OSD tanks, are not anticipated to intercept perched groundwater. The salinity level of the perched groundwater was mostly non-saline and is not expected to become saline due to the development.

Recharge and Discharge

Changes in the recharge regime in response to the proposed development can alter the depth of the perched and shallow alluvial aquifer and its interaction with a potential salt bulge and potential discharge points within the Site.

Overall, there is minimal change in recharge anticipated withing the retirement village footprint due to the deep drainage associated with Site irrigation compensating for reduced recharge where buildings and paved area intercept rainfall. Further, the soil profiles showed no salt bulge development suggesting low salt influx and sufficient leaching. Therefore, the anticipated changes in the water balance are not anticipated to mobilise the low levels of profile salt within the retirement village footprint. Similarly, the modified and renaturalised drainage line along the site boundary to the west and south will likely see an increase in recharge from stormwater which poses no additional risk to salinity development within and surround the modified and renaturalised drainage line.

Water Quality

Proposed irrigation water is assumed to be from recycled water or utilising potable water sources should recycled water not be available. Hence, when recycled water is used, the impact of salinity in the irrigation water, which is higher than rainfall or mains water, is still likely to be low due to sufficient

soil profile leaching from rainfall and is sufficient to maintain salt sensitive plant species within the landscaped areas.

Spatial Variation of Risk

The risk posed by salinity is low across most of the Site based on topography, depth to the water table, groundwater quality, water balance changes and expected water quality used for irrigation.

Risk Evaluation Summary

Observed soil profile conditions along with topography and groundwater conditions do not indicate that saline soil conditions will develop naturally or as a result of this proposed Site development. Recharge of the shallow aquifer throughout the proposed development will be lower due to the stormwater capture from buildings but higher in the landscaped areas, particularly in the modified drainage line to the west. The change in net recharge across the proposed development is not anticipated to increase the risk of saline conditions developing. As a result, the salinity risk is low to very low across the development site and, therefore, there is no requirement for a Salinity Management plan.

The water used for irrigation and in the stormwater management facilities poses little risk to the development of salinity through leakage and irrigation. Soil profile EC and chloride measurements do not indicate development of saline soil conditions naturally or as a result of the development. Groundwater EC indicates fresh to slightly saline conditions. Perched and shallow groundwaters and application of low EC water also does not pose a risk to the development of salinity.

The salinity risk assessment is summarised in Table 10-1. Salinity is anticipated to pose low to very low risk to the proposed development. Hence, no Salinity Management Plan is required for the proposed development.

Table 10-1: Salinity Risk Assessment

Salinity Risk Factor	Likelihood	Consequence	Risk
Changes in Groundwater Depth	Possible	Acceptable	Very Low
Changes to Recharge and Discharge	Possible	Acceptable	Very Low
Changes in Water Quality	Improbable	Acceptable	Very Low
Spatial Variation of Salinity Risk	Possible	Tolerable	Low

11 Conclusion

Stantec has been engaged to prepare a Groundwater and Surface Water Impact Assessment and Salinity Management Plan to support a State Significant Development Application (SSD- 63475709) for the proposed development at Tumbi Umbi Retirement Village.

The study objectives were to assess potential impacts on soil resources, surface and groundwater resources, saline conditions and risks, develop a salinity management plan (if applicable) and meet the requirements under SEARs number 13.

The assessment indicated the following:

- The proposed development is not anticipated to develop or increase erosion, considering the proposed stormwater management, drainage system and landscaping.
- The proposed development is not anticipated to significantly alter the Site's water balance.
- No adverse impact by proposed development-derived stormwater or alterations on the quantity and quality of receiving downstream surface water is anticipated.
- No surface water management plan is anticipated to be required.
- Construction and operation of the proposed development is not anticipated to interact (dewater) and obstruct groundwater-bearing units of discontinuous and seasonally perched groundwater and shallow alluvial aquifers. Building foundations (that is, piles), are likely to intercept these units but no impact to the aquifer is anticipated.
- Currently, the existing Site setting and surrounding area is considered to pose a low risk on groundwater environmental values.
- The proposed development is considered unlikely to impact on groundwater environmental values.
- Potential impact of groundwater on the proposed development is a low risk, assuming that appropriate mitigation measures are implemented.
- The estimated total project groundwater take during deep pile construction is 0.5 ML. A water supply work approval will be required but a water access license is not anticipated to be required.
- No groundwater management or dewatering management plan is anticipated to be required.
- Construction of proposed structures with stormwater diversion to the existing stormwater network is likely to lead to a reduction in recharge at the Site. However, irrigation of Site landscaping is likely to increase Site recharge. Hence, on a Site-wide basis, no significant change in recharge is anticipated.
- Salinity poses a very low to low risk to the proposed development, therefore no Salinity Management Plan is required.

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13 Limitations

This assessment has been undertaken in general accordance with the current "industry standards" for a water and salinity impact assessment for the purpose and objectives identified in this report. These standards are set out in:

- National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999 (NEPC, 1999) as varied May 2013 (the 'NEPM 2013').
- Western Sydney Regional Organisation of Councils (2003; amended 2004) Western Sydney Salinity Code of Practice.
- NSW Department of Infrastructure, Planning and Natural Resources (2005)
- NSW Department of Land and Water Conservation (2002) Site Investigations for Urban Salinity.
- NSW (2022) Guidelines for groundwater documentation for SSD/SSI Projects.
- NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination. Department of Environment and Conservation NSW. DEC 2007/144. March 2007.

The agreed scope of works has been limited for the current purposes of the Client. The assessment may not identify contamination occurring in all areas of the Site or occurring after sampling was conducted. Subsurface conditions may vary considerably away from the sample locations where information has been obtained.

This Document has been provided by Stantec subject to the following limitations:

- This Document has been prepared for the particular purpose outlined in Stantec's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.
- The scope of work and the period of Stantec's services are as described in Stantec's proposal and are subject to restrictions and limitations. Stantec did not perform a complete assessment of all possible conditions or circumstances that may exist at the Site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Stantec in regard to it.
- Conditions may exist which were undetectable given the limited nature of the enquiry Stantec was retained to undertake with respect to the Site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the Site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.
- In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Stantec's opinions are based upon information that existed at the

time of the production of the Document. It is understood that the services provided allowed Stantec to form no more than an opinion of the actual conditions of the Site at the time this Document was prepared and cannot be used to assess the effect of any subsequent changes in the quality of the Site, or its surroundings, or any laws or regulations.

- Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.
- Where data supplied by the client or other external sources, including previous Site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Stantec for incomplete or inaccurate data supplied by others.
- Stantec may have retained sub consultants affiliated with Stantec to provide services for the benefit of Stantec. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any direct legal recourse to, and waives any claim, demand, or cause of action against, Stantec's affiliated companies, and their employees, officers and directors.
- Salinity assessments were based solely on available information that included topography changes, soil profile characteristics and chemistry, changes in water balance, groundwater (regional and perched) and its quality, water used for irrigation and knowledge of the regional and local landscape of the Site.

This assessment report is not any of the following:

- A Site Audit Report or Site Audit Statement as defined under the Contaminated Land Management Act, 1997.
- A Detailed ESA or Environmental Site Investigation sufficient for an Environmental Auditor to be able to conclude a Site Audit Report and Site Audit Statement.
- A geotechnical report and the bore logs or test pit logs may not be sufficient as the basis for geotechnical advice.
- A detailed hydrogeological assessment in conformance with NSW DEC (2007) Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination.
- A construction dewatering management plan.
- A groundwater management and monitoring plan.
- An assessment of groundwater contaminants potentially arising from other Sites or sources nearby.
- A total assessment of the Site to determine suitability of the entire parcel of land at the Site for one or more beneficial uses of land.

APPENDICES

Appendix A Sampling Location Plan

Note: Aerial image taken from Nearmap, 29 October 2023 (used in accordance with commercial licence)
Drawing adapted from plan supplied by Partier (drawn by Marchese Partners International Pty Ltd, Job No. 16072, Drawings DA2.01 and DA2.02, Revision 2, dated 4 July 2024)

LEGEND

- Approximate site boundary
- Approximate stage boundary
- Approximate borehole location
- Approximate test pit location (RCA Report 15660a-602/1)
- Approximate CPT location (RCA Report 15660a-602/1)

0 5 10 20 30 40
metres

N

Draft

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

SITE AND BOREHOLE LOCATION PLAN
MINGARA RECREATION CLUB
TUMBI UMBI

CLIENT	Pariter			RCA Ref	15660b-201/3
DRAWN BY	CD	SCALE	1:1,250 (A3)	DRAWING No 1	REV 2
APPROVED BY	MA	DATE	10/07/2024	OFFICE	NEWCASTLE

Tumbi Umbi Retirement Living

Sample Location Plan

Project Code: 301351398
Drawn By: GC, Checked By: CL
Figure No: 1 | Rev: 01
Date: 2024-03-28

Stantec

Legend

- Approximate Site Boundary

Stantec Test Locations (2024)

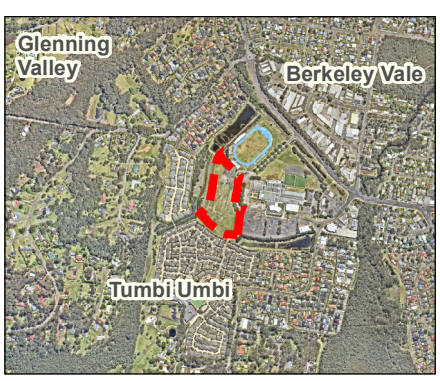
- Surface Water (Sampled)
- Surface Water (Not sampled)
- Photo Location
- Cadastre (DCS, 2024)
- Map Extent

Notes:
1. Coordinate System: GDA 1994 MGA Zone 56

References:
1. Aerial imagery supplied by Nearmap (October 2023)

0 10 20 30 40 Metres

Scale at A3 1:1,250



Appendix B Field and Laboratory Data Tables

Water Type	Location	Approx surface RL* (m AHD)	Additional RL (m AHD)	SWL (mbTOC)	Well Depth	Well Depth (mAHD)	Screened Interval	Screened Interval (mAHD)	SWL RL (m AHD)	Total Dissolved Solids Dried at 180 °C ± 2 °C (mg/L)	Strike (m bgl)	Strike (m AHD)	Temp (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)
Groundwater (Deep)	BH10	7.24		0.35	19.85	-12.61	15.65-18.65	-8.41 to -11.41	6.89	1100	3.4	3.84	24.3	1757	5.04	5.06	-96.9
Groundwater (Shallow)	BH13	7.24		1.1	7.4	-0.16	2.90-5.90	4.34 to 1.34	6.14	1100	3.3	3.94	23.4	1864	6.17	2.01	-34
Groundwater (Shallow)	BH14	7.21		0.87	7.2	0.01	2.70-5.70	4.51 to 1.51	6.34	500	3.8	3.41	25.7	833	5.54	6.33	-67.6
Surface Water	SW1	6.95[1.]	6.85[2.]						6.91	410			23.1	784	6.83	10.26	-30.4
Surface Water	SW2	7.6											27.3	1055	7.1	10.07	-9.9
Surface Water	SW3	5.58											25.8	746	6.43	11.12	10.4

* Approx RL calculated from Survey plan

[1.] RL Reference to top of concrete drain.

[2.] RL Reference to bottom of concrete drain.

				Inorganics	Acid Sulphate Soils		
				Conductivity (1:5 aqueous extract)	pH (F)	pH (Fox)	Reaction Rate_
				US/CM	pH Unit	pH Unit	-
EQL				10	0.1	0.1	0
Field ID	**Matrix Description**	**Date**	**Lab Report Number**				
BH1 0.5-0.95m		**19 Feb 2024**	**1076721**	22	5.9	2.8	3.0
BH1 1.5-1.95m		**19 Feb 2024**	**1076721**	23	6.1	4.4	1.0
BH1 3.0-3.45m		**19 Feb 2024**	**1076721**	49	5.8	4.6	1.0
BH1 4.5-4.95m		**19 Feb 2024**	**1076721**		5.8	4.3	1.0
BH1 6.0-6.45m		**19 Feb 2024**	**1076721**		6.0	4.6	1.0
BH2 0.5-0.95m		**19 Feb 2024**	**1076721**	19	6.5	3.2	1.0
BH2 1.5-1.95m		**19 Feb 2024**	**1076721**	34	5.9	4.2	1.0
BH2 3.0-3.45m		**19 Feb 2024**	**1076721**	22	6.4	3.6	1.0
BH2 4.5-4.95m		**19 Feb 2024**	**1076721**		6.0	4.8	1.0
BH2 6.0-6.45m		**19 Feb 2024**	**1076721**		6.1	4.9	1.0
BH3 0.5-0.95m		**19 Feb 2024**	**1076721**	22	6.8	3.0	3.0
BH3 1.5-1.95m		**19 Feb 2024**	**1076721**	49	5.9	4.4	1.0
BH3 3.0-3.45m		**19 Feb 2024**	**1076721**	43	5.8	4.5	1.0
BH3 4.5-4.95m		**19 Feb 2024**	**1076721**		6.4	4.8	1.0
BH3 6.0-6.45m		**19 Feb 2024**	**1076721**		6.2	4.9	1.0
BH4 0.5-0.95m		**20 Feb 2024**	**1076721**	18	8.1	4.5	1.0
BH4 1.5-1.95m		**20 Feb 2024**	**1076721**	39	7.0	3.9	4.0
BH4 3.0-3.45m		**20 Feb 2024**	**1076721**	53	6.3	4.3	2.0
BH4 4.5-4.95m		**20 Feb 2024**	**1076721**		6.5	5.1	1.0
BH4 6.0-6.45m		**20 Feb 2024**	**1076721**		6.7	4.1	1.0
BH5 0.5-0.95m		**20 Feb 2024**	**1076721**	35	7.8	4.8	1.0
BH5 1.5-1.95m		**20 Feb 2024**	**1076721**	17	7.1	4.3	4.0
BH5 3.0-3.45m		**20 Feb 2024**	**1076721**	<10	6.4	4.5	1.0
BH5 4.5-4.95m		**20 Feb 2024**	**1076721**		6.7	5.1	2.0
BH5 6.0-6.45m		**20 Feb 2024**	**1076721**		6.8	4.5	1.0
BH6 0.5-0.95m		**20 Feb 2024**	**1076721**	20	7.0	6.3	1.0
BH6 1.5-1.95m		**20 Feb 2024**	**1076721**	10	6.6	4.5	1.0
BH6 3.0-3.45m		**20 Feb 2024**	**1076721**	22	6.6	5.2	1.0
BH6 4.5-4.95m		**20 Feb 2024**	**1076721**		6.5	4.8	1.0
BH6 6.0-6.45m		**20 Feb 2024**	**1076721**		6.5	4.5	1.0
BH8 0.5-0.95m		**20 Feb 2024**	**1076721**	58	5.3	3.0	1.0
BH8 1.0-1.45m		**20 Feb 2024**	**1076721**	63	5.8	4.2	1.0
BH8 1.5-1.95m		**20 Feb 2024**	**1076721**	65	5.1	3.9	1.0
BH8 2.0-2.45m		**20 Feb 2024**	**1076721**	41	5.6	3.9	1.0
BH8 2.5-2.95m		**20 Feb 2024**	**1076721**	49	5.8	4.1	1.0
BH8 3.0-3.45m		**20 Feb 2024**	**1076721**	45	5.7	4.1	1.0
BH8 3.5-3.95m		**20 Feb 2024**	**1076721**		5.9	4.2	1.0
BH8 4.0-4.45m		**20 Feb 2024**	**1076721**		5.8	4.1	1.0
BH8 4.5-4.95m		**20 Feb 2024**	**1076721**		5.9	4.2	1.0
BH8 5.0-5.45m		**20 Feb 2024**	**1076721**		5.9	4.1	1.0
BH8 6.0-6.45m		**20 Feb 2024**	**1076721**		5.4	3.9	1.0
BH10 0.5-0.95m		**26 Feb 2024**	**1076721**	31	8.0	4.2	1.0
BH10 1.0-1.45m		**26 Feb 2024**	**1076721**	62	7.2	4.2	1.0
BH10 1.5-1.95m		**26 Feb 2024**	**1076721**		7.0	4.6	1.0
BH10 2.0-2.45m		**26 Feb 2024**	**1076721**	35	7.3	5.8	1.0
BH10 2.5-2.95m		**26 Feb 2024**	**1076721**	38	7.2	5.3	1.0
BH10 3.0-3.45m		**26 Feb 2024**	**1076721**	30	7.5	5.2	1.0
BH10 3.5-3.95m		**26 Feb 2024**	**1076721**		6.8	4.8	1.0
BH10 4.0-4.45m		**26 Feb 2024**	**1076721**		6.9	3.9	1.0
BH10 4.5-4.95m		**26 Feb 2024**	**1076721**		6.9	4.1	1.0
BH10 5.0-5.45m		**26 Feb 2024**	**1076721**		6.8	4.9	1.0
BH10 5.5-5.95m		**26 Feb 2024**	**1076721**		7.1	5.1	1.0
BH10 6.0-6.45m		**26 Feb 2024**	**1076721**		7.1	5.3	1.0
BH10 8.0-8.45m		**26 Feb 2024**	**1076721**		7.4	4.1	1.0
BH10 9.0-9.45m		**26 Feb 2024**	**1076721**		7.2	4.1	1.0
BH12 0.5-0.95m Silty CLAY		**04 Mar 2024**	**1076721**	20	8.2	5.8	1.0
BH12 1.0-1.45m Sandy CLAY		**04 Mar 2024**	**1076721**	22	8.8	5.9	1.0
BH12 1.5-1.95m Sandy CLAY		**04 Mar 2024**	**1076721**	17	7.7	5.0	1.0
BH12 2.0-2.45m Sandy CLAY		**04 Mar 2024**	**1076721**	<10	7.0	4.7	1.0
BH12 2.5-2.95m Sandy CLAY		**04 Mar 2024**	**1076721**	17	7.2	4.7	1.0
BH12 3.0-3.45m Sandy CLAY / Clayey SAND		**04 Mar 2024**	**1076721**	<10	7.0	4.8	1.0
BH12 3.5-3.95m Sandy CLAY / Clayey SAND		**04 Mar 2024**	**1076721**		6.2	3.5	1.0
BH12 4.0-4.45m Clayey SAND / SAND		**04 Mar 2024**	**1076721**		6.6	3.3	1.0
BH12 4.5-4.95m SAND		**04 Mar 2024**	**1076721**		6.2	3.4	1.0
BH12 5.0-5.45m SAND		**04 Mar 2024**	**1076721**		6.4	3.8	1.0
BH12 5.5-5.95m SAND / Clayey SAND		**04 Mar 2024**	**1076721**		6.6	3.8	1.0
BH12 6.0-6.45m Silty CLAY		**04 Mar 2024**	**1076721**		6.9	4.5	1.0
BH8 11.0-11.45m		**22 Feb 2024**	**1076721**		6.9	5.1	1.0
BH8 16.0-16.45m		**22 Feb 2024**	**1076721**		7.1	4.0	1.0
BH8 20.0-20.45m		**22 Feb 2024**	**1076721**		7.1	4.9	1.0
BH8 25.0-25.45m		**22 Feb 2024**	**1076721**		7.7	3.9	1.0
BH10 10.0-10.45m		**27 Feb 2024**	**1076721**		7.5	4.7	1.0
BH10 11.0-11.45m		**27 Feb 2024**	**1076721**		6.9	4.7	1.0
BH10 12.0-12.45m		**27 Feb 2024**	**1076721**		7.2	5.3	1.0
BH10 13.0-13.45m		**27 Feb 2024**	**1076721**		6.9	5.5	1.0
BH10 14.0-14.45m		**27 Feb 2024**	**1076721**		7.4	5.8	1.0
BH10 15.0-15.45m		**27 Feb 2024**	**1076721**		6.8	3.9	1.0
BH10 17.0-17.45m		**27 Feb 2024**	**1076721**		6.8	4.7	1.0
BH10 18.0-18.45m		**27 Feb 2024**	**1076721**		7.1	4.3	1.0
BH10 19.0-19.45m		**27 Feb 2024**	**1076721**		6.7	3.7	1.0
BH10 20.0-20.45m		**27 Feb 2024**	**1076721**		7.1	5.3	1.0
BH10 25.0-25.45m		**28 Feb 2024**	**1076721**		6.9	4.0	1.0
BH12 11.0-11.45m Sandy CLAY		**04 Mar 2024**	**1076721**		6.4	4.2	1.0
BH12 16.0-16.45m Sandy CLAY		**04 Mar 2024**	**1076721**		6.3	4.9	1.0
BH12 21.0-21.45m SAND / Clayey SAND		**06 Mar 2024**	**1076721**		6.7	4.3	1.0
BH12 26.0-26.45m Sandy CLAY		**06 Mar 2024**	**1076721**		6.3	4.8	1.0

Statistics

Maximum Concentration	**65**	**8.8**	**6.3**	**4**
Average Concentration *	**32**	**6.7**	**4.5**	**1.1**
Standard Deviation *	**17**	**0.69**	**0.67**	**0.56**
% of Detects	**91**	**100**	**100**	**100**
% of Non-Detects	**9**	**0**	**0**	**0**

* A Non Detect Multiplier of 0.5 has been applied.

			Metals												Inorganics							
			Aluminium (filtered)	Arsenic (filtered)	Cadmium (filtered)	Calcium	Chromium (III+VI) (filtered)	Copper (filtered)	Lead (filtered)	Magnesium	Mercury (filtered)	Nickel (filtered)	Potassium	Sodium	Zinc (filtered)	Alkalinity (Bicarbonate as CaCO3)	Carbonate Alkalinity (as CaCO3)	Alkalinity (Hydroxide) as CaCO3	Alkalinity (total) as CaCO3	Chloride	pH (Lab)	Sulfate	TDS
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH_Units	mg/L	mg/L
EQL			0.05	0.001	0.0002	0.5	0.001	0.001	0.001	0.5	0.0001	0.001	0.5	0.5	0.005	20	20	20	20	1	0.1	2	10
Field ID	**Date**	**Lab Report No.**																					
BH10	**13 Mar 2024**	**1077863**	<0.05	0.003	<0.0002	21	0.001	<0.001	<0.001	36	<0.0001	0.085	7.1	290	0.35	110	<20	<20	110	500	5.3	41	1,100
BH13	**13 Mar 2024**	**1077863**	<0.05	<0.001	<0.0002	15	<0.001	0.006	<0.001	51	<0.0001	0.048	5.0	290	0.091	170	<20	<20	170	530	6.4	98	1,100
BH14	**13 Mar 2024**	**1077863**	<0.05	0.006	<0.0002	4.4	0.001	<0.001	<0.001	10	<0.0001	0.062	3.1	150	0.11	83	<20	<20	83	190	5.2	69	500
DUP1	**13 Mar 2024**	**1077863**	<0.05	0.006	<0.0002	4.5	0.001	<0.001	<0.001	10	<0.0001	0.055	3.1	150	0.096	82	<20	<20	82	190	5.3	70	600
RIN01	**13 Mar 2024**	**1077863**				<0.5				<0.5			<0.5	<0.5		<20	<20	<20	<20	<1		<2	
SW1	**13 Mar 2024**	**1077863**	<0.05	<0.001	<0.0002	22	<0.001	0.006	<0.001	15	<0.0001	0.004	5.4	110	0.017	150	<20	<20	150	170	7.6	17	410
Statistics																							
Maximum Concentration			**<0.05**	**0.006**	**<0.0002**	**22**	**0.001**	**0.006**	**<0.001**	**51**	**<0.0001**	**0.085**	**7.1**	**290**	**0.35**	**170**	**<20**	**<20**	**170**	**530**	**7.6**	**98**	**1,100**
Average Concentration *			**0.025**	**0.0032**	**0.0001**	**11**	**0.0008**	**0.0027**	**0.0005**	**20**	**0.00005**	**0.051**	**4**	**165**	**0.13**	**101**	**10**	**10**	**101**	**263**	**6**	**49**	**742**
Standard Deviation *			**0**	**0.0028**	**0**	**9.4**	**0.00027**	**0.003**	**0**	**19**	**0**	**0.03**	**2.4**	**111**	**0.13**	**57**	**0**	**0**	**57**	**208**	**1**	**36**	**334**
% of Detects			**0**	**60**	**0**	**83**	**60**	**40**	**0**	**83**	**0**	**100**	**83**	**83**	**100**	**83**	**0**	**0**	**83**	**83**	**100**	**83**	**100**
% of Non-Detects			**100**	**40**	**100**	**17**	**40**	**60**	**100**	**17**	**100**	**0**	**17**	**17**	**0**	**17**	**100**	**100**	**17**	**17**	**0**	**17**	**0**

* A Non Detect Multiplier of 0.5 has been applied.

Appendix C RCA Borehole & Test Pit Logs

GEOTECHNICAL BOREHOLE LOG
BH1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 19/02/2024
DATE COMPLETED: 19/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T				0.0		SC-SM	FILL/TOPSOIL, Clayey Silty SAND, fine grained, brown	M		FILL / TOPSOIL Grass root mattress to ~0.05m
		0.50m	0.50m	0.5						
				0.60		ML	FILL, Clayey SILT, low plasticity, grey and grey-brown, with some fine grained sand, abundant with roots/rootlets	w~PL		FILL
		SPT 2, 3, 5 N=8	D							
		PP100 - 130kPa								
		0.95m	0.95m	1.0						
				1.25		Cl	Silty Sandy CLAY, medium plasticity, pale grey mottled orange, fine grained sand	w>PL	F - St	ALLUVIUM
		1.50m	1.50m	1.5						
		PP90 - 150kPa								
		SPT 2, 4, 5 N=9	D							
		PP200 - 250kPa								
		1.95m	1.95m	1.85		CI-CH	Sandy CLAY, medium to high plasticity, pale grey and orange, fine grained sand, with some embedded roots/rootlets throughout		St - VSt	
				2.0						
				2.5						
		3.00m	3.00m	3.0						
		PP170 - 200kPa								
		SPT 3, 3, 4 N=7	D							
		3.45m	3.45m	3.5			sand becoming fine to medium grained, orange, with some fine to medium angular ironstone gravel at ~3.4m			
				4.0						
		4.50m	4.50m	4.5						SPT at 4.5m 0.05m of sample recovery. Sampled directly from auger
	19/02/24	SPT 3, 5, 7 N=12	D							
		4.95m	4.95m							

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 19/02/2024
DATE COMPLETED: 19/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T				5.00		SP	SAND, fine to medium grained, pale grey-brown	W	MD	ALLUVIUM
		6.00m	6.00m	6.0						
		SPT 3, 5, 6 N=11	D	6.20		CI-CH	Sandy CLAY, medium to high plasticity, pale grey and orange, fine grained sand, trace of fine angular ironstone gravel	w>PL	VSt	
		PP250 - 350kPa 6.45m	6.45m	6.45						
				6.5			BOREHOLE BH1 TERMINATED AT 6.45 m Limit of investigation			
				7.0						
				7.5						
				8.0						
				8.5						
				9.0						
				9.5						

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 19/02/2024
DATE COMPLETED: 19/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T			0.50m	0.5		SM-SC	FILL/TOPSOIL, Silty Clayey SAND, fine grained, grey-brown, with some rootlets	M		FILL / TOPSOIL Grass root mattress to ~0.1m
		SPT 5, 5, 5 N=10 PP80kPa	D 0.95m	0.80		CL-CI	FILL, Silty Sandy CLAY, low to medium plasticity, grey-brown, fine grained sand, trace of roots/rootlets	w>PL		FILL
		1.50m	1.50m	1.0 1.20		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange, fine grained sand, trace of embedded rootlets		St - VSt	ALLUVIUM
		SPT 4, 5, 6 N=11 PP170 - 220kPa 1.95m	D 1.95m	1.5 2.0					St	
		3.00m PP150kPa	3.00m	2.5 3.0			with some fine to medium angular ironstone gravel to ~3.2m			
		SPT 3, 3, 3 N=6 PP30 - 70kPa 3.45m	D 3.45m	3.5					S - F	
		4.50m PP180 - 210kPa	4.50m	4.00 4.5		CH	Silty CLAY, high plasticity, pale grey mottled orange-brown, with fine grained sand, with some fine to medium angular ironstone gravel		St - VSt	
	19/02/24	SPT 4, 7, 7 N=14 PP250 - 350kPa 4.95m	D 4.95m	4.70		CH	Silty CLAY, high plasticity, pale grey, trace of fine grained sand		VSt	

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GEOTECHNICAL BOREHOLE LOG

BH2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 19/02/2024
DATE COMPLETED: 19/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information						
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T						CH	Silty CLAY, high plasticity, pale grey, trace of fine grained sand	w>PL	VSt	ALLUVIUM
				5.5			becoming with some to a trace of fine grained sand at ~5.5m			
		6.00m	6.00m	6.0						
		SPT 3, 5, 8 N=13	D							
		PP280 - 360kPa								
		6.45m	6.45m	6.45						
				6.5			BOREHOLE BH2 TERMINATED AT 6.45 m Limit of investigation			
				7.0						
				7.5						
				8.0						
				8.5						
				9.0						
				9.5						

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH3

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 19/02/2024
DATE COMPLETED: 19/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	19/02/24		0.50m	0.5		SM-SC	FILL/TOPSOIL, Silty Clayey SAND, fine grained, grey-brown, with some rootlets	M		FILL / TOPSOIL Grass root mattress to ~0.1m
		SPT 7, 8, 9 N=17 PP160kPa 0.95m	D 0.95m	0.60 1.0		ML	FILL, Clayey Sandy SILT, low plasticity, grey-brown and pale grey, fine grained sand, with embedded roots/rootlets throughout, dry and friable	w<PL		FILL
				1.25		Cl	Silty Sandy CLAY, medium plasticity, pale grey mottled orange, fine grained sand	w>PL	F - St	ALLUVIUM
		1.50m PP90 - 110kPa SPT 2, 5, 5 N=10 PP25 - 50kPa 1.95m PP100kPa	1.50m D 1.95m	1.5 2.0					S - F F	
				2.5			becoming with iron oxide stained veinlets at ~2.5m			
		3.00m SPT 2, 2, 3 N=5 PP50 - 100kPa 3.45m	3.00m D 3.45m	3.0 3.50						
				4.0		CI-SC	Sandy CLAY/Clayey SAND, medium plasticity clay, fine grained sand, pale grey and orange-brown	w>PL / W	St / MD	
		4.50m SPT 3, 4, 6 N=10 PP150 - 170kPa 4.95m	4.50m D 4.95m	4.5 4.60						
						CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange, fine grained sand	w>PL	St	

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GEOTECHNICAL BOREHOLE LOG
BH3

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 19/02/2024
DATE COMPLETED: 19/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information						
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T				5.5		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange, fine grained sand	w>PL	St	ALLUVIUM
									VSt	
		6.00m PP260 - 400kPa	6.00m	6.0						
		SPT 5, 8, 10 N=18	D							
		6.45m	6.45m	6.45						
				6.5			BOREHOLE BH3 TERMINATED AT 6.45 m Limit of investigation			
				7.0						
				7.5						
				8.0						
				8.5						
				9.0						
				9.5						

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GEOTECHNICAL BOREHOLE LOG

BH4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 20/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		0.50m	0.50m	0.5		CL-CI	FILL, Silty Sandy CLAY, low to medium plasticity, grey-brown and brown, fine to coarse grained sand, with fine to coarse sub-angular to angular gravel	w~PL		FILL Grass root mattress to ~0.1m
		SPT 5, 3, 4 N=7	D							
		0.95m	0.95m	0.80		CL	FILL, Silty CLAY, low plasticity, dark grey-brown, with fine grained sand, with some decomposed organic matter throughout, trace of medium to coarse angular gravel	w>PL		
				1.0						
		1.50m	1.50m	1.5			with a trace of fine to medium angular weathered coal fragments (easily crumbled via finger pressure) at ~1.5m			
		SPT 3, 4, 5 N=9	D							
		PP150 - 170kPa								
		1.95m	1.95m	2.00		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange, fine grained sand, trace of embedded rootlets throughout to ~4.0m		F - St	ALLUVIUM
				2.5						
		3.00m	3.00m	3.0						
		PP90 - 110kPa								
		SPT 3, 6, 4 N=10	D							
		3.45m	3.45m	3.5						
				4.0					VSt - H	
	▽ 20/02/24	4.50m	4.50m	4.5						Hard and grinding drilling (thin band of indurated sand?) from ~4.4m to ~4.5m
		PP320 - 400kPa								
		SPT 4, 7, 13 N=20	D				trace of fine to medium angular ironstone gravel from ~4.7m to ~4.8m			
		4.95m	4.95m							

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GEOTECHNICAL BOREHOLE LOG

BH4

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 20/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T				5.00		SC	Clayey SAND, fine to medium grained, pale grey mottled orange	W	MD	ALLUVIUM
		6.00m	6.00m	6.0						
		SPT 1, 9, 11 N=20	D	6.20		SW	SAND, fine to coarse grained, pale grey and orange-brown		MD - D	NOTE: Groundwater table rose up to ~3.2m post drilling
		6.45m	6.45m	6.45						
				6.5			BOREHOLE BH4 TERMINATED AT 6.45 m Limit of investigation			
				7.0						
				7.5						
				8.0						
				8.5						
				9.0						
				9.5						

LOGGED: CD

CHECKED: MA

DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH5

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 20/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T			0.50m	0.5		CL	FILL, Silty Sandy CLAY, low plasticity, brown, fine to coarse grained, with fine to coarse angular gravel	w<PL		FILL Grass root mattress to ~0.1m
		SPT 2, 4, 4 N=8 PP150 - 190kPa 0.95m	D 0.95m	1.0			becoming with a trace of fine to medium angular gravel and roots/rootlets from ~0.5m			
				1.20		CL	FILL, Silty CLAY, low plasticity, dark grey-brown mottled black, with some fine grained sand, with embedded rootlets and decomposed organics throughout	w>PL		Slight sulfurous odour present
		1.50m PP100 - 110kPa SPT 2, 3, 4 N=7 PP110 - 150kPa 1.95m	1.50m D 1.95m	1.5						
				1.80		CH	Silty CLAY, medium to high plasticity, grey-brown and orange-brown, with some decomposed organic matter to ~2.5m, with a trace of fine grained sand		St	ALLUVIUM
				2.5			becoming pale grey mottled orange with fine grained sand and abundant with embedded rootlets/root fibres at ~2.5m		St - VSt	
		3.00m SPT 4, 5, 6 N=11 PP170 - 270kPa 3.45m	3.00m D 3.45m	3.0			with a trace of fine to medium angular ironstone gravel from ~3.3m to 4.0m			
				4.0			only a trace amount of embedded root fibres from ~4.0m		VSt	
		4.50m SPT 4, 6, 8 N=14 PP330kPa 4.95m	4.50m D 4.95m	4.5						
	20/02/24 ▽									

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GEOTECHNICAL BOREHOLE LOG
BH5

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 20/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T						CH	Silty CLAY, medium to high plasticity, grey-brown and orange-brown, with some decomposed organic matter to ~2.5m, with a trace of fine grained sand	w>PL	VSt	ALLUVIUM
				5.50		CH	Sandy CLAY, high plasticity, pale grey, fine grained sand			
		6.00m PP300 - 350kPa SPT 4, 9, 12 N=21 6.45m	6.00m D 6.45m	6.0 6.45						
				6.5			BOREHOLE BH5 TERMINATED AT 6.45 m Limit of investigation			
				7.0						
				7.5						
				8.0						
				8.5						
				9.0						
				9.5						

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH6

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 20/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T			0.50m	0.50		CL-CI	FILL, Silty Sandy CLAY, low to medium plasticity, grey-brown, fine to coarse grained sand, with fine to coarse angular gravel	w>PL		FILL Grass root mattress to ~0.1m
		SPT 8, 4, 3 N=7	D 0.95m	0.65		GM	FILL, Silty GRAVEL, fine to coarse, dark grey-brown and black, angular	W		
				1.0		CL	FILL, Silty CLAY, low plasticity, dark grey-brown, trace of decomposed organics	w>PL		Material was saturated (indicating perched groundwater?) from ~1.0m
			1.50m	1.40		CH	Silty CLAY, high plasticity, grey and dark grey mottled orange-brown, with some to a trace of fine grained sand, trace of embedded rootlets/root fibres throughout		St	ALLUVIUM
		SPT 2, 3, 5 N=8 PP140 - 190kPa	D 1.95m	1.5			becoming pale grey and orange-brown at ~1.8m			
				2.0						
				2.5						
			3.00m	2.60		CI-CH	Sandy CLAY, medium to high plasticity, pale grey, fine grained sand, trace of embedded root fibres throughout to ~5.5m		VSt	
		SPT 4, 5, 6 N=11 PP260 - 360kPa	D 3.45m	3.0						
				3.5						
			4.50m	4.0						
		SPT 4, 5, 8 N=13 PP290 - 390kPa	D 4.95m	4.5						

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GEOTECHNICAL BOREHOLE LOG

BH6

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 20/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	20/02/24 ▽					CI-CH	Sandy CLAY, medium to high plasticity, pale grey, fine grained sand, trace of embedded root fibres throughout to ~5.5m	w>PL	VSt	ALLUVIUM
				5.5			becoming with some iron oxide stained veinlets at ~5.5m			
		6.00m PP250 - 350kPa	6.00m	6.0						
		SPT 5, 9, 11 N=20	D				decomposed organics/roots from ~6.2m to ~6.3m			
		6.45m	6.45m	6.45						
				6.5			BOREHOLE BH6 TERMINATED AT 6.45 m Limit of investigation			
				7.0						
				7.5						
				8.0						
				8.5						
				9.0						
				9.5						

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH8

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 23/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	20/02/24 ▽	0.50m	0.50m	0.5		SM-SC	FILL, Silty Clayey SAND, fine grained, brown and grey-brown, with fine to coarse angular gravel to ~0.5m	D - M		FILL Grass root mattress to ~0.1m
		SPT 10, 8, 6 N=14	D							
		0.95m 1.00m	0.95m 1.00m	1.0						
		SPT 4, 5, 4 N=9	D	1.25						
		1.45m 1.50m	1.45m 1.50m	1.5		CI	Sandy CLAY, medium plasticity, pale grey mottled orange, fine grained sand	w~PL	St - VSt	ALLUVIUM
		SPT 4, 5, 7 N=12 PP230 - 330kPa	D					w>PL		
		1.95m 2.00m	1.95m 2.00m	2.00						
		SPT 5, 8, 9 N=17	D			SC	Clayey SAND, fine grained, pale grey	M - W	MD - D	
		2.45m 2.50m	2.45m 2.50m	2.5			decomposed roots (~3mm dia.) from ~2.35m to 2.45m becoming with orange mottles at 2.5m			
		SPT 5, 6, 6 N=12 PP140 - 180kPa	D	2.60		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange, fine grained sand, with some decomposed roots throughout	w>PL	St	
		2.95m 3.00m	2.95m 3.00m	3.0						
		SPT 4, 4, 4 N=8 PP90 - 120kPa	D	3.20		CH	Silty CLAY, high plasticity, dark grey mottled orange, with some to a trace of fine grained sand		F - St	
		3.45m 3.50m	3.45m 3.50m	3.5			becoming pale grey with some orange mottles, with fine grained sand at ~3.6m		St - VSt	
		SPT 3, 5, 6 N=11 PP150 - 250kPa	D							
		3.95m 4.00m	3.95m 4.00m	4.0			trace of embedded rootlets/root fibres from ~4.0m to ~4.2m			
		SPT 4, 5, 8 N=13 PP340 - 390kPa	D						VSt	
		4.45m 4.50m	4.45m 4.50m	4.5			becoming with some iron oxide stained veinlets from ~4.5m			
		PP350 - 380kPa								
		SPT 6, 8, 13 N=21	D							
		4.95m 5.00m	4.95m 5.00m							

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GEOTECHNICAL BOREHOLE LOG

BH8

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 23/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		PP250 - 350kPa SPT 5, 8, 11 N=19 5.45m 5.50m SPT 6, 9, 11 N=20 5.95m 6.00m SPT 6, 10, 15 N=25 PP>400kPa 6.45m	D 5.45m 6.00m D 6.45m	5.00 5.5 6.00 6.5		CH	Silty CLAY, high plasticity, pale grey with some orange mottled, with fine grained sand	w>PL	VSt	ALLUVIUM SPT at 5.5m no sample recovered in SPT tube
WS				7.0 7.5 8.0 8.5 9.0 9.5		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange-brown and dark red-orange, fine grained sand, with some to a trace of fine to medium angular ironstone gravel throughout band of extremely weathered ironstone/coffee rock, iron oxide stained from ~6.3m to ~6.36m washbore cuttings pale red-brown in colour from ~6.5m to ~7.5m		VSt - H	

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GEOTECHNICAL BOREHOLE LOG

BH8

RCA AUSTRALIA
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CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 23/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
						CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange-brown and dark red-orange, fine grained sand, with some to a trace of fine to medium angular ironstone gravel throughout	w>PL	VSt - H	ALLUVIUM
		11.00m PP280 - 400kPa SPT 6, 10, 13 N=23 11.45m	11.00m D 11.45m	10.5 11.0 11.5						
WS				12.0 12.5						
				13.00		SW	SAND, fine to coarse grained, pale grey, with some to a trace of clay	W	D	
				13.5 14.0 14.5						

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GEOTECHNICAL BOREHOLE LOG

BH8

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PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 23/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
						SW	SAND, fine to coarse grained, pale grey, with some to a trace of clay	W	D	ALLUVIUM
				15.5						
		16.00m	16.00m	16.0						
		SPT 8, 12, 16 N=28	D							
		16.45m	16.45m	16.5						
WS				17.0						
				17.5						
				18.0						
				18.5						
				19.00		CI-CH	Sandy CLAY, medium to high plasticity, pale grey and orange-brown, fine grained sand	w>PL	VSt	
				19.5						
		20.00m	20.00m							

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GEOTECHNICAL BOREHOLE LOG

BH8

RCA AUSTRALIA
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PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 23/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
		SPT 7, 8, 9 N=17	D			CI-CH	Sandy CLAY, medium to high plasticity, pale grey and orange-brown, fine grained sand	w>PL	VSt	ALLUVIUM
		PP210 - 310kPa								
		20.45m	20.45m	20.5						
				21.0						
				21.5						
				22.0						
WS				22.5						
				23.0						
				23.50		SW	SAND, fine to coarse grained, grey	W	D - VD	
				24.0						
				24.5						
		25.00m	25.00m							

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GEOTECHNICAL BOREHOLE LOG

BH8

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 23/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
WS		SPT 20, 30/100mm N=R 25.25m	D 25.25m	25.5		SW	SAND, fine to coarse grained, grey	W	D - VD	ALLUVIUM
				26.0						
				26.5						
				27.0						
				27.5						
				28.00		CH	Silty CLAY, high plasticity, red-brown, trace of fine grained sand	w>PL	VSt - H	RESIDUAL / EXTREMELY WEATHERED MATERIAL
				28.5						
				29.0						
				29.5						
							CONTINUED AS CORED BOREHOLE			

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CORED BOREHOLE LOG
BH8

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 23/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Description					
METHOD	WATER LOSS	CORE RECOVERY	RQD	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				25.5						
				26.0						
				26.5						
				27.0						
				27.5						
				28.0						
				28.5						
				29.0						
				29.5						
				29.80		START CORING AT 29.80m				
NMLC	0% LOSS	89	13			CORE LOSS 0.22m (29.80-30.02)				

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CORED BOREHOLE LOG
BH8

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 20/02/2024
DATE COMPLETED: 23/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information | Field Material Description

METHOD	WATER LOSS	CORE RECOVERY	RQD	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	89	13	30.02		CLAYSTONE, red-brown, with soil properties, generally recovered as SIlty CLAY, high plasticity	XW			
				30.49		CLAYSTONE, red-brown	XW - HW			FZ highly fractured (some drilling induced?)
							HW			HB
										DB
										HB
				31.0		band of extremely weathered sandstone, fine grained, pale grey with iron oxide staining (20mm thick) at 31.04m	XW - HW			FZ
							XW			PP = 200kPa
				31.5		band of extremely weathered sandstone, fine grained, pale grey with iron oxide staining (20mm thick) at 31.80m	XW - HW			FZ
							HW			FZ
							XW - HW			DB
				31.85		CORE LOSS 0.19m (31.85-32.04)				
				32.0						
				32.04		CLAYSTONE, red-brown, with some intermittent thin lenses of SANDSTONE, fine grained, pale grey	MW - SW			
	0% LOSS	94	93	32.5						DB
				33.0						HB x 2
				33.5			HW			
							XW			CS 0° red-brown clay 20mm thick
							SW			
				34.0						
				34.5						DB
										NOTE: Groundwater table measured to be at ~2.0m post drilling
						CORED BOREHOLE BH8 TERMINATED AT 34.80 m				

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GEOTECHNICAL BOREHOLE LOG

BH10

SHEET 1 OF 8

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 26/02/2024
DATE COMPLETED: 28/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T			0.50m	0.50		SM-SC	FILL/TOPSOIL, Silty Clayey SAND, fine to coarse grained, brown, with some to a trace of fine to medium angular gravel	M		FILL / TOPSOIL Grass root mattress to ~0.1m
		SPT 3, 4, 5 N=9 PP180 - 220kPa	D 0.95m 1.00m	1.0		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange, fine grained sand, with embedded rootlets/root fibres to ~1.5m becoming with a trace of fine to medium angular ironstone gravel from ~0.9m	w~PL	St - VSt	ALLUVIUM
		SPT 3, 3, 5 N=8 PP180 - 210kPa	D 1.45m 1.50m	1.5						
		SPT 3, 5, 8 N=13 PP210 - 300kPa	D 1.95m 2.00m	2.0				w>PL	VSt	
		SPT 3, 5, 6 N=11 PP250 - 280kPa	D 2.45m 2.50m	2.5			becoming pale grey with some embedded root fibres from ~2.5m			
		SPT 3, 5, 8 N=13 PP230 - 300kPa	D 2.95m 3.00m	3.00		CI-CH	Silty CLAY, medium to high plasticity, pale grey, with fine grained sand		F	
	26/02/24	SPT 3, 3, 3 N=6 PP30 - 90kPa	D 3.45m 3.50m	3.5						
		PP70 - 100kPa SPT 3, 6, 11 N=17	D 3.95m 4.00m	3.85		SC	Clayey SAND, fine to medium grained, pale grey	W	MD	
		SPT 7, 7, 5 N=12	D 4.45m 4.50m	4.0			becoming fine to coarse grained, grey and dark grey-brown at 4.2m			
		SPT 2, 2, 2 N=4 PP70 - 110kPa	D 4.95m 5.00m	4.5						
				4.85		CI-SC	Sandy CLAY/Clayey SAND, medium plasticity clay, fine to coarse grained sand, grey	w>PL / W	F-St - MD	

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GEOTECHNICAL BOREHOLE LOG

BH10

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
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LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 26/02/2024
DATE COMPLETED: 28/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		PP60 - 100kPa		5.10						ALLUVIUM
		SPT 3, 4, 6 N=10	D 5.45m			CI-CH	Sandy CLAY, medium to high plasticity, pale grey, fine grained sand	w>PL	St - VSt	
		PP190 - 200kPa 5.45m								
		5.50m	5.50m	5.5						
		SPT 3, 4, 5 N=9	D 5.95m							
		PP150 - 250kPa 5.95m								
		6.00m	6.00m	6.0						
		PP280 - 380kPa								
		SPT 3, 6, 13 N=19	D 6.45m						VSt	
				6.5						
				6.75		SP	SAND, fine to medium grained, pale grey, with some to a trace of clay	W	L	
		7.00m	7.00m	7.0						
		SPT 0, 1, 1 N=2	D 7.45m							
				7.5			becoming medium to coarse grained sand, with fine sub-rounded to rounded alluvial gravel from ~7.6m to ~8.2m		MD	
		8.00m	8.00m	8.0						
		SPT 8, 11, 16 N=27	D 8.45m							
WS				8.5						
		9.00m	9.00m	9.0						
		SPT 10, 11, 11 N=22	D 9.45m				becoming with some fine to medium angular weathered coal fragments (easily crumbled via finger pressure) from ~9.3m			
				9.5						
				9.75		SC	Clayey SAND, fine to medium grained, pale grey, with a trace of fine sub-rounded to rounded alluvial gravel to ~10.2m			
		10.00m	10.00m							

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GEOTECHNICAL BOREHOLE LOG

BH10

RCA AUSTRALIA
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CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 26/02/2024
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SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information						
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
		SPT 4, 10, 13 N=23	D			SC	Clayey SAND, fine to medium grained, pale grey, with a trace of fine sub-rounded to rounded alluvial gravel to ~10.2m	W	MD	ALLUVIUM
		10.45m	10.45m	10.5					D	
		11.00m	11.00m				becoming pale grey and orange-brown in colour from ~10.75m			
		SPT 10, 20, 21 N=41	D	11.0						
		11.45m	11.45m	11.5						
				11.70		CH	Silty CLAY, high plasticity, pale grey mottled orange-brown, with fine grained sand	w>PL	VSt	
		12.00m	12.00m	12.0						
		PP250 - 350kPa								
		SPT 8, 9, 10 N=19	D							
		12.45m	12.45m	12.5						
WS										
		13.00m	13.00m	13.0						
		PP300 - 400kPa								
		SPT 4, 9, 15 N=24	D	13.25		CI-CH	Extremely Weathered Ironstone/Coffee Rock generally recovered as Silty Gravelly CLAY, medium to high plasticity, dark orange-brown, heavily iron oxide stained, fine to medium angular ironstone gravel		VSt - H	
		13.45m	13.45m	13.505		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange-brown, fine grained sand		VSt	
		14.00m	14.00m	14.0						
		PP250 - 320kPa								
		SPT 6, 9, 13 N=22	D							
		14.45m	14.45m	14.5						
				14.80		SC	Clayey SAND, fine to coarse grained, pale grey and orange-brown, trace of fine rounded alluvial gravel	W	MD	
		15.00m	15.00m							

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GEOTECHNICAL BOREHOLE LOG

BH10

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 26/02/2024
DATE COMPLETED: 28/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information						
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
						SC	Clayey SAND, fine to coarse grained, pale grey and orange-brown, trace of fine rounded alluvial gravel	W	MD	ALLUVIUM
		SPT 4, 8, 10 N=18 15.45m	D 15.45m	15.5						
		16.00m		16.0						SPT at 16.0m no sample recovered due to broken sand catcher
		SPT 6, 10, 11 N=21 16.45m								
		17.00m	17.00m	16.5						
WS		SPT 8, 11, 11 N=22 17.45m	D 17.45m	17.0			becoming fine to medium grained sand from ~17.0m to ~18.5m			
		18.00m	18.00m	17.5						
		SPT 8, 11, 11 N=22 18.45m	D 18.45m	18.0						
		19.00m	19.00m	18.5					D	
		SPT 12, 16, 16 N=32 19.45m	D 19.45m	19.0			becoming with some to a trace of clay from ~19.3m			
		20.00m	20.00m	19.5						

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GEOTECHNICAL BOREHOLE LOG

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CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 26/02/2024
DATE COMPLETED: 28/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
				20.00		CI-CH	Sandy CLAY, medium to high plasticity, pale grey and orange-brown, fine to coarse grained sand, trace of fine rounded alluvial gravel becoming with some pale grey-brown lenses from ~20.3m	w>PL	F - St	ALLUVIUM
		SPT 5, 6, 6 N=12 PP70 - 120kPa 20.45m	D 20.45m	20.5						
				21.0						
				21.50		SP	SAND, fine to medium grained, pale grey and orange-brown, with some to a trace of clay	W	D	
WS				22.0						
				22.5						
				23.0						
				23.5						
				24.0						
				24.5						
		25.00m	25.00m							

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GEOTECHNICAL BOREHOLE LOG

BH10

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 26/02/2024
DATE COMPLETED: 28/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
						SP	SAND, fine to medium grained, pale grey and orange-brown, with some to a trace of clay	W	D	ALLUVIUM
		SPT 13, 14, 22 N=36	D							
		25.45m	25.45m	25.5			becoming orange-brown mottled dark orange, increasing in clay content from ~25.6m			
				26.0						
				26.5						
WS				27.0						
				27.50			Interbedded SANDSTONE and CLAYSTONE, pale grey and dark red-brown, very fine grained, with iron oxide staining	XW - HW	VL - L	BEDROCK
		28.00m	28.00m	28.0						
		28.05m SPT 15/50mm N=R	D 28.05m							
							CONTINUED AS CORED BOREHOLE			
				28.5						
				29.0						
				29.5						

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CORED BOREHOLE LOG

BH10

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 26/02/2024
DATE COMPLETED: 28/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Description					
METHOD	WATER LOSS	CORE RECOVERY	RQD	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				25.5						
				26.0						
				26.5						
				27.0						
				27.5						
				28.0						
				28.30		START CORING AT 28.30m				
NMLC	0% LOSS	92	63	28.5		CORE LOSS 0.23m (28.30-28.53)				
				28.53		CLAYSTONE, red-brown and pale grey, with some intermittent thin bands of SANDSTONE, fine grained, pale grey with some iron oxide staining throughout	XW - HW			DB
										FZ
										DB
							XW			CS 0° pale grey clay, 2-3mm thick
										CZ
				29.0						CZ
							XW - HW			JT 70° Fe VNR PR S
										DZ
				29.5						HB
							HW			JT 75° Clay PR S 1-2mm thick
										JT 76° Clay VNR PR closed
										CS 0° pale grey clay, 15mm thick

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CORED BOREHOLE LOG
BH10

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 26/02/2024
DATE COMPLETED: 28/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information | Field Material Description

METHOD	WATER LOSS	CORE RECOVERY	RQD	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	92	63	30.5		CLAYSTONE, red-brown and pale grey, with some intermittent thin bands of SANDSTONE, fine grained, pale grey with some iron oxide staining throughout	HW			JT 85° Clay VNR IR closed FZ HB
							XW - HW			JT 75° Fe SN PR RF
				31.0			MW			FZ JT 80° Clay PR closed 1-2mm thick CS 0° pale grey clay, 3-4mm thick DB
	0% LOSS	100	89	31.5		becoming CLAYSTONE, red-brown, with some intermittent thin lenses of Sandstone, pale grey from ~31.46m	SW			JT 70° Fe VNR PR S HB BP 0° CN PR S
				32.0			XW			Extremely weathered seam/DZ FZ
						becoming with some calcite veneered joints at irregular intervals, typically 73-86° inclination and closed	SW			JT 86° CA VNR PR S partially closed DB JT 73° CA VNR PR closed JT 73° CA VNR PR closed DB
				33.0						DB DB NOTE: Groundwater table rose up to ~1m post drilling (on 28/2/24)
				33.30		CORED BOREHOLE BH10 TERMINATED AT 33.30 m [Standpipe piezometer P1 installed to 19.85m]				
				33.5						
				34.0						
				34.5						

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH12

SHEET 1 OF 9

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
DATE COMPLETED: 06/03/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T				0.15		GM	FILL, Silty Sandy GRAVEL, fine to coarse, grey and pale grey-brown, angular, fine to coarse grained sand	D - M		EXISTING PAVEMENT MATERIAL
						CI-CH	FILL, Silty Sandy CLAY, medium to high plasticity, dark brown-grey and brown, fine to medium grained sand, with some to a trace of fine to medium angular gravel	w>PL		FILL
		0.50m	0.50m	0.5						
		SPT 3, 4, 4 N=8 PP100 - 190kPa	D	0.60		CH	Silty CLAY, high plasticity, grey and orange-brown, with fine grained sand, with some decomposed organics/rootlets embedded throughout to ~0.7m becoming with fine to medium angular ironstone gravel from ~0.7m	w~PL	St	ALLUVIUM
		0.95m 1.00m	0.95m 1.00m	1.00						
		SPT 3, 3, 4 N=7 PP110 - 140kPa	D			CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange, fine grained sand, with a trace of fine to medium angular ironstone gravel, trace of embedded rootlets/root fibres to ~2.0m			
		1.45m 1.50m	1.45m 1.50m	1.5				w>PL		
		SPT 3, 4, 5 N=9 PP150 - 200kPa	D							
		1.95m 2.00m	1.95m 2.00m	2.0			becoming pale grey and orange-brown from ~2.0m		St - VSt	
		PP150 - 250kPa SPT 4, 6, 10 N=16	D							
		2.45m 2.50m	2.45m 2.50m	2.5						
		PP250 - 350kPa SPT 5, 8, 9 N=17	D							
		2.95m 3.00m	2.95m 3.00m	3.0						
		SPT 5, 6, 8 N=14 PP320kPa	D	3.20		CI-SC	Sandy CLAY/Clayey SAND, medium plasticity clay, fine grained sand, pale grey and orange-brown, trace of rootlets to ~3.4m	w>PL / W	VSt / MD-D	
		3.45m 3.50m	3.45m 3.50m	3.5						
	▽	SPT 5, 9, 9 N=18	D	3.65		SC	Clayey SAND, fine grained, pale grey with a trace of orange mottles	W	MD	
		3.95m 4.00m	3.95m 4.00m	4.0						
		SPT 3, 3, 5 N=8	D	4.30		SP	SAND, fine to medium grained, pale grey, with some to a trace of clay		D	
		4.45m 4.50m	4.45m 4.50m	4.5						
WS		SPT 7, 10, 14 N=24	D							
		4.95m 5.00m	4.95m 5.00m	4.90		SW	SAND, fine to coarse grained, pale grey		D - VD	

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GEOTECHNICAL BOREHOLE LOG

BH12

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
DATE COMPLETED: 06/03/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
						SW	SAND, fine to coarse grained, pale grey	W	D - VD	ALLUVIUM
		SPT 12, 14, 19 N=33	D				becoming pale grey and orange-brown, trace of clay at ~5.2m			
		5.45m	5.45m							
		5.50m	5.50m	5.5						
		SPT 13, 13, 12 N=25	D							
		5.95m	5.95m	5.80		SC	Clayey SAND, fine to coarse grained, pale grey and orange-brown		MD - D	
		6.00m	6.00m	6.0						
		SPT 10, 8, 5 N=13 PP220kPa	D	6.25		CH	Silty CLAY, high plasticity, pale grey, with fine grained sand	w>PL	VSt	
		6.45m	6.45m	6.5						
WS				7.0						
				7.5						
				8.0						
				8.50		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange and dark red-orange, fine to medium grained sand			
				9.0						
				9.5						

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GEOTECHNICAL BOREHOLE LOG

BH12

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
DATE COMPLETED: 06/03/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
						CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange and dark red-orange, fine to medium grained sand	w>PL	VSt	ALLUVIUM
				10.5						
		11.00m PP240 - 340kPa	11.00m	11.0						
		SPT 9, 10, 12 N=22	D				becoming with iron oxide stained veinlets throughout from ~11.2m			
		11.45m	11.45m	11.5						
				12.0						
WS				12.5						
				13.0						
				13.5						
				14.0			becoming with a trace of fine to medium angular ironstone gravel (extremely weathered), iron oxide and manganese stained			
				14.5						

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GEOTECHNICAL BOREHOLE LOG

BH12

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LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
DATE COMPLETED: 06/03/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
				15.5		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange and dark red-orange, fine to medium grained sand	w>PL	VSt	ALLUVIUM
		16.00m	16.00m	16.0						
		SPT 4, 8, 10 N=18 PP320kPa	D							
		16.45m	16.45m	16.5						
WS				17.0						
				17.5						
				18.0						
				18.5						
				19.00		SW	SAND, fine to coarse grained, pale grey and pale orange-brown, with a trace of fine to medium sub-rounded to rounded alluvial gravel	W	MD - D	
				19.5						

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GEOTECHNICAL BOREHOLE LOG

BH12

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

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SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
				20.5		SW	SAND, fine to coarse grained, pale grey and pale orange-brown, with a trace of fine to medium sub-rounded to rounded alluvial gravel	W	MD - D	ALLUVIUM
		21.00m	21.00m	21.0						
		SPT 10, 13, 20 N=33	D	21.15		SC	Clayey SAND, fine to medium grained, pale grey and orange-brown		D	
		21.45m	21.45m	21.5						
WS				22.0						
				22.5						
				23.0						
				23.5						
				24.00		CI	Sandy CLAY, medium plasticity, orange-brown mottled pale grey and dark red, fine grained sand	w>PL	St	
				24.5						

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GEOTECHNICAL BOREHOLE LOG

BH12

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
DATE COMPLETED: 06/03/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
				25.5		CI	Sandy CLAY, medium plasticity, orange-brown mottled pale grey and dark red, fine grained sand	w>PL	St	ALLUVIUM
		26.00m	26.00m	26.0						
		SPT 5, 7, 9 N=16	D							
		PP110 - 190kPa 26.45m	26.45m	26.5						
WS				27.0						
				27.5						
				28.0						
				28.50		CH	Silty CLAY, high plasticity, red-brown (extremely weathered claystone?)	w>PL	VSt - H	RESIDUAL / EXTREMELY WEATHERED MATERIAL
				29.0						
				29.5						

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GEOTECHNICAL BOREHOLE LOG

BH12

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
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LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
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COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
				30.5		CH	Silty CLAY, high plasticity, red-brown (extremely weathered claystone?)	w>PL	VSt - H	RESIDUAL / EXTREMELY WEATHERED MATERIAL
WS				30.70			CLAYSTONE, red-brown	XW - HW	VL - L	BEDROCK
				31.0						
				31.5			CONTINUED AS CORED BOREHOLE			
				32.0						
				32.5						
				33.0						
				33.5						
				34.0						
				34.5						

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CORED BOREHOLE LOG
BH12

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
DATE COMPLETED: 06/03/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Description				
METHOD	WATER LOSS	CORE RECOVERY	RQD	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				30.5						
				31.0						
				31.40		START CORING AT 31.40m				
NMLC	0% LOSS	100	91	31.46 31.5		SANDSTONE, fine grained, pale grey with iron oxide staining	XW HW			BP 0° Fe VNR PR closed BP 0° Fe SN PR S Reduced core diameter due to excessive core spin from ~31.4m to ~31.8m DB DB
						CLAYSTONE, red-brown				
				32.0			XW MW			BP 0 - 20° Fe SN CU S DZ/CS red-brown clay DZ/XW seam 0°
				32.5						HB HB
				33.0		very thin band of slightly weathered sandstone, fine grained, pale grey from 33.08m to 33.09m				XW seam 0° 2-4mm thick DB DZ/XW seam 0°
				33.5						HB HB
	0% LOSS	100	88	34.0		potential shear zone? extremely to highly weathered from 33.8m to 34.1m	XW - HW MW			CZ/SZ?
				34.5			XW - HW MW			FZ/CZ FZ DB

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CORED BOREHOLE LOG
BH12

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
DATE COMPLETED: 06/03/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Description					
METHOD	WATER LOSS	CORE RECOVERY	RQD	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	100	88	35.20		CLAYSTONE, red-brown	MW			CS 0° red-brown clay
				35.5		Interbedded SANDSTONE, fine grained, pale grey and CLAYSTONE, red-brown with slight iron oxide staining	SW			BP 0° Fe SN PR S BP 10° Fe SN PR S DB
				36.0						JT 70° CA VNR PR closed DB
				36.5		becoming predominately sandstone, fine grained from ~36.3m	SW - FR			BP 2 - 3° Fe SN PR S BP 0° Fe SN PR S
				36.90		CORED BOREHOLE BH12 TERMINATED AT 36.90 m				
				37.0						
				37.5						
				38.0						
				38.5						
				39.0						
				39.5						

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH13

SHEET 1 OF 2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 29/02/2024
DATE COMPLETED: 29/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	29/02/24			0.50		SM-SC	FILL/TOPSOIL, Silty Clayey SAND, fine to coarse grained, brown, with some to a trace of fine to medium angular gravel	M		FILL / TOPSOIL Grass root mattress to ~0.1m
				1.0		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange, fine grained sand, with embedded rootlets/root fibres to ~1.5m becoming with a trace of fine to medium angular ironstone gravel from ~0.9m	w~PL	St - VSt	ALLUVIUM
				1.5				w>PL	VSt	
				2.0						
				2.5			becoming pale grey with some embedded root fibres from ~2.5m			
				3.00		CI-CH	Silty CLAY, medium to high plasticity, pale grey, with fine grained sand		F	
				3.5						
				3.85		SC	Clayey SAND, fine to medium grained, pale grey	W	MD	
				4.0						
				4.5			becoming fine to coarse grained, grey and dark grey-brown at 4.2m			
				4.85		CI-SC	Sandy CLAY/Clayey SAND, medium plasticity clay, fine to coarse grained sand, grey	w>PL / W	F-St - MD	

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH13

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 29/02/2024
DATE COMPLETED: 29/02/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T				5.10		CI-CH	Sandy CLAY, medium to high plasticity, pale grey, fine grained sand	w>PL	St - VSt	ALLUVIUM
				5.5						
				6.0						
									VSt	
				6.5						
				6.75		SP	SAND, fine to medium grained, pale grey, with some to a trace of clay	W	L	
				7.0						
				7.40			BOREHOLE BH13 TERMINATED AT 7.40 m [Standpipe piezometer P2 installed to 7.4m]			NOTE: BH13 drilled in close proximity to BH10 (i.e. ~4m offset). No logging of subsurface profile undertaken. Profile considered to be representative of that encountered in BH10
				7.5						
				8.0						
				8.5						
				9.0						
				9.5						

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH14

SHEET 1 OF 2

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
DATE COMPLETED: 01/03/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T						GM	FILL, Silty Sandy GRAVEL, fine to coarse, grey and pale grey-brown, angular, fine to coarse grained sand	D - M		EXISTING PAVEMENT MATERIAL Grass root mattress to ~0.05m
				0.15		CI-CH	FILL, Silty Sandy CLAY, medium to high plasticity, dark brown-grey and brown, fine to medium grained sand, with some to a trace of fine to medium angular gravel	w>PL		FILL
				0.5						
				0.60		CH	Silty CLAY, high plasticity, grey and orange-brown, with fine grained sand, with some decomposed organics/rootlets embedded throughout to ~0.7m becoming with fine to medium angular ironstone gravel from ~0.7m	w~PL	St	ALLUVIUM
				1.00		CI-CH	Sandy CLAY, medium to high plasticity, pale grey mottled orange, fine grained sand, with a trace of fine to medium angular ironstone gravel, trace of embedded rootlets/root fibres to ~2.0m			
				1.5				w>PL		
				2.0			becoming pale grey and orange-brown from ~2.0m		St - VSt	
				2.5						
				3.0						
				3.20		CI-SC	Sandy CLAY/Clayey SAND, medium plasticity clay, fine grained sand, pale grey and orange-brown, trace of rootlets to ~3.4m	w>PL / W	VSt / MD-D	
	01/03/24			3.5						
				3.65		SC	Clayey SAND, fine grained, pale grey with a trace of orange mottles	W	MD	
				4.0						
				4.30		SP	SAND, fine to medium grained, pale grey, with some to a trace of clay		D	NOTE: Due to borehole wall collapse, washboring commenced from 4.4m to facilitate piezometer installation
WS				4.5						
				4.90		SW	SAND, fine to coarse grained, pale grey		D - VD	

LOGGED: CD | CHECKED: MA | DATE: 12/03/2024

GEOTECHNICAL BOREHOLE LOG

BH14

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660b
CLIENT: Pariter
PROJECT: Additional Geotechnical Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE COMMENCED: 01/03/2024
DATE COMPLETED: 01/03/2024
SURFACE RL:
COORDS:
DRILL MODEL: Massenza MI2

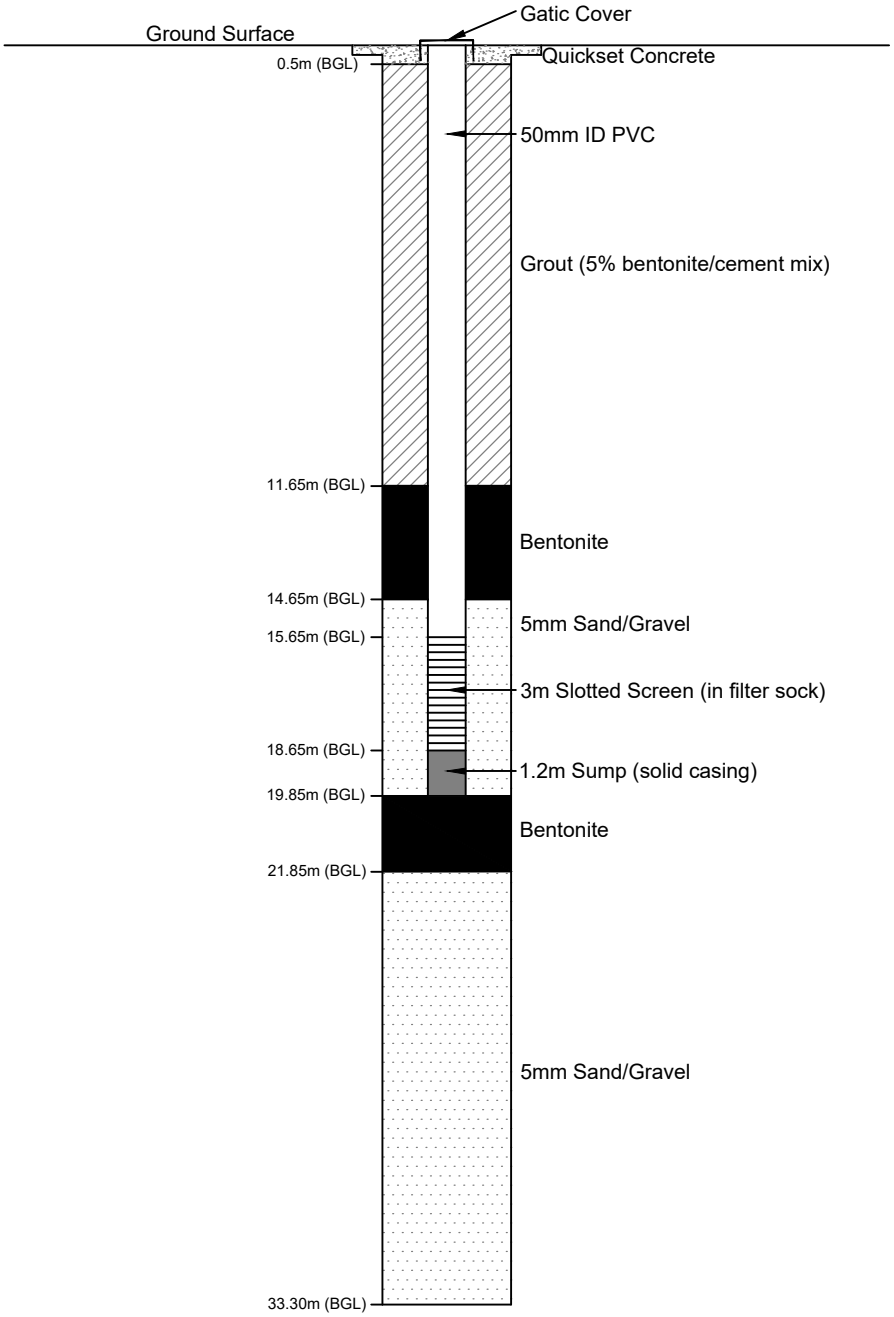
Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
						SW	SAND, fine to coarse grained, pale grey becoming pale grey and orange-brown, trace of clay at ~5.2m	W	D - VD	ALLUVIUM
				5.5						
				5.80		SC	Clayey SAND, fine to coarse grained, pale grey and orange-brown		MD - D	
				6.0						
				6.25		CH	Silty CLAY, high plasticity, pale grey, with fine grained sand	w>PL	VSt	
WS				6.5						
				7.0						
				7.5						
				8.00			BOREHOLE BH14 TERMINATED AT 8.00 m [Standpipe piezometer P3 installed to 7.2m]			NOTE: BH14 drilled in close proximity to BH12 (i.e. ~3m offset). No logging of subsurface profile undertaken. Profile considered to be representative of that encountered in BH12
				8.5						
				9.0						
				9.5						

LOGGED: CD

CHECKED: MA

DATE: 12/03/2024

BH10/P1



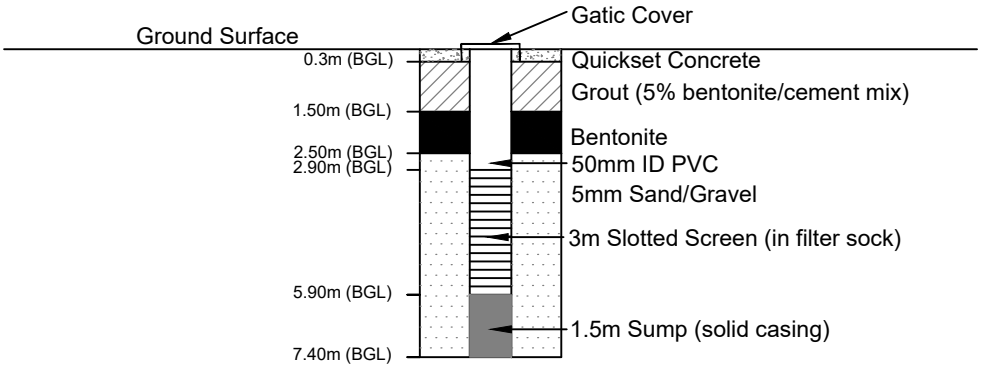
RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

STANDPIPE PIEZOMETER
CONSTRUCTION DETAILS
MINGARA RECREATION CLUB
TUMBI UMBI

CLIENT	Pariter						
DRAWN BY	CD	SCALE	N.T.S	RCA Ref	15660b-201/0	OFFICE	NEWCASTLE
APPROVED BY	MA	DATE	12/03/2024	DRAWING No	BH10/P1	Rev	0

CDT-DWG-A4V-001/1

BH13/P2



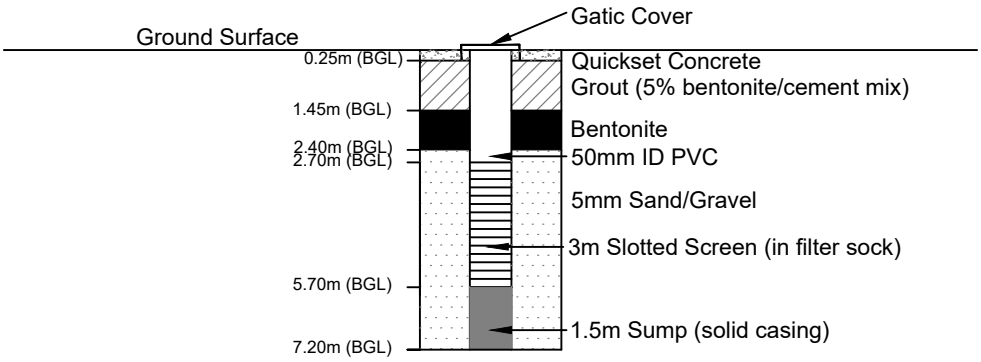
RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

STANDPIPE PIEZOMETER
CONSTRUCTION DETAILS
MINGARA RECREATION CLUB
TUMBI UMBI

CLIENT	Pariter						
DRAWN BY	CD	SCALE	N.T.S	RCA Ref	15660b-201/0		OFFICE
APPROVED BY	MA	DATE	12/03/2024	DRAWING No	BH13/P2	Rev 0	NEWCASTLE

CDT-DWG-A4V-001/1

BH14/P3



RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

STANDPIPE PIEZOMETER
CONSTRUCTION DETAILS
MINGARA RECREATION CLUB
TUMBI UMBI

CLIENT	Pariter						
DRAWN BY	CD	SCALE	N.T.S	RCA Ref	15660b-201/0	OFFICE	NEWCASTLE
APPROVED BY	MA	DATE	12/03/2024	DRAWING No	BH14/P3	Rev	0

CDT-DWG-A4V-001/1

ENVIRONMENTAL TEST PIT LOG

TP1

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m TP1a DUP1 0.20m	0.10		FILL, Silty CLAY, brown		W		FILL
					FILL, Silty CLAY, grey	0	M		
			0.5						
		1.10m TP1b 1.20m	1.0			0			
		1.30m TP1c 1.40m	1.30		Sandy CLAY, grey mottled yellow	0			NATURAL
			1.5						
			1.80		TEST PIT TP1 TERMINATED AT 1.80 m				
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP2

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL/TOPSOIL, Silty CLAY, brown		W		FILL / TOPSOIL
		TP2a 0.20m			FILL, Silty Sandy CLAY, grey mottled yellow	0	M		FILL
			0.5						
			1.0						
		1.40m	1.40						
		TP2b DUP 2 1.50m	1.5		Sandy CLAY, grey mottled white/orange	0			NATURAL
			2.00		TEST PIT TP2 TERMINATED AT 2.00 m				
			2.5						

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ENVIRONMENTAL TEST PIT LOG

TP3

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL, Silty CLAY, brown		W		FILL
		TP3a 0.20m			FILL, Silty CLAY, grey/brown mottled yellow, speckles of green	0	M		
		0.50m	0.50		FILL, Sandy CLAY, orange/grey				
		TP3b 0.60m	0.60		FILL, Sandy CLAY, grey				
		1.40m	1.40						
		TP3c DUP 3 1.50m	1.5		Silty CLAY, grey mottled orange	0			NATURAL
			1.90		TEST PIT TP3 TERMINATED AT 1.90 m				
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP4

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL/TOPSOIL, Silty CLAY, brown		W		FILL / TOPSOIL
		TP4a 0.20m			FILL, Sandy CLAY, low plasticity, grey mottled orange	0	M		FILL
			0.50		FILL, Silty CLAY, orange/grey/red mottled				Wood encountered
			1.0						
		1.30m	1.30						
		TP4b 1.40m			CLAY, white/grey/orange mottled	0			NATURAL
			1.5						
			1.90		TEST PIT TP4 TERMINATED AT 1.90 m				
			2.0						
			2.5						

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ENVIRONMENTAL TEST PIT LOG

TP5

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL/TOPSOIL, Silty CLAY, brown		M		FILL / TOPSOIL
		TP5a 0.20m			FILL, Silty CLAY, grey mottled orange, some plastic/tiles	0			FILL
			0.5						Log and plastic pipes encountered
			1.0						
		1.20m	1.20						
		TP5b 1.30m			Silty CLAY, grey mottled yellow	0			NATURAL
			1.5		increasing plasticity with depth				
			1.80		TEST PIT TP5 TERMINATED AT 1.80 m				
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP6

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m TP6a 0.20m	0.05 0.10 0.50 0.70 1.0 1.50 2.0 2.5		FILL/TOPSOIL, Silty CLAY, brown FILL, Clayey SAND, pale brown FILL, Silty Clayey SAND, brown mottled orange FILL, Sandy CLAY, pale brown FILL, Silty CLAY, dark brown, tree roots TEST PIT TP6 TERMINATED AT 1.50 m Due to a tree	0	M		FILL / TOPSOIL FILL Tree encountered

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP7

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m TP7a 0.20m	0.5		FILL, Silty Sandy CLAY, brown/grey mottled orange	0	M		FILL Brick encountered Stump
		1.50m TP7b 1.60m	1.0 1.50		Silty CLAY, pale grey mottled orange	0			NATURAL
			1.90 2.0 2.5		TEST PIT TP7 TERMINATED AT 1.90 m				

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP8

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL/TOPSOIL, Silty CLAY, brown/grey		M		FILL / TOPSOIL
		TP8a 0.20m			FILL, Sandy CLAY, brown/grey	0			FILL
			0.5						
			1.0						
		1.50m	1.50						
		TP8b 1.60m			CLAY, grey/orange increasing plasticity with depth	0			NATURAL
			2.00		TEST PIT TP8 TERMINATED AT 2.00 m				
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP9

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL/TOPSOIL, Silty CLAY, brown mottled red		M		FILL / TOPSOIL
		TP9a 0.20m			FILL, Silty CLAY, grey/brown mottled orange, small stones and chitter	0			FILL 5 cent coin
			0.5		becoming paler with depth				
			1.0						
		1.50m	1.50						
		TP9b 1.60m			Sandy CLAY, white/grey mottled orange	0			NATURAL
			2.00		TEST PIT TP9 TERMINATED AT 2.00 m				
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP10

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m TP10a 0.20m	0.10		FILL, Clayey GRAVEL, dark grey (gravel from the track)		M		FILL
					FILL, Silty CLAY, brown mottled orange	0			
		0.60m TP10b 0.70m	0.60		Sandy CLAY, pale brown/yellow/grey	0			NATURAL
			1.20		Sandy CLAY, white/grey/orange				
			1.50		TEST PIT TP10 TERMINATED AT 1.50 m				

0.5
1.0
2.0
2.5

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP11

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL, Silty CLAY, brown/grey		M		FILL
		TP11a 0.20m			FILL, Silty CLAY, brown/grey mottled orange	0			
			0.40		FILL, Silty CLAY, pale brown				
			0.5						Pockets of grey clay throughout
			1.0						
			1.50		FILL, Gravelly CLAY, dark grey mottled orange				
		1.80m	1.80						
		TP11b 1.90m			Sandy CLAY, pale grey	0			NATURAL
			2.0						
			2.40		TEST PIT TP11 TERMINATED AT 2.40 m				
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP12

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.05m TP12a 0.10m	0.05		FILL, GRAVEL (track base)		M		FILL
					FILL, Gravelly CLAY, brown mottled red and black	0			
			0.30		FILL, SAND, coarse grained, pale brown				
			0.40		FILL, Silty CLAY, pale grey/orange				
			0.5						
			0.70		FILL, Sandy CLAY, brown				
			1.00		FILL, Silty Sandy CLAY, pale brown				
		1.30m TP12b 1.40m	1.30		Sandy CLAY, high plasticity, grey	0			NATURAL
			1.5						
			1.80		TEST PIT TP12 TERMINATED AT 1.80 m				
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP13

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL, CLAY, grey/brown, mixed with pale brown sand		M		FILL
		TP13a 0.20m			FILL, SAND, coarse grained, pale brown	0			
			0.30		FILL, Sandy Gravelly CLAY, pale grey/brown				
			0.5						
			1.0						
		1.30m	1.30						
		TP13b 1.40m			Sandy CLAY, pale grey mottled orange				NATURAL
			1.5						
			1.80		TEST PIT TP13 TERMINATED AT 1.80 m				
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP14

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m TP14a 0.20m			FILL, Sandy CLAY, brown mottled orange	0	M		FILL Bricks encountered
			0.40						
			0.5		FILL, Silty Sandy CLAY, dark brown				
		0.70m	0.70						
		TP14b 0.80m			Sandy CLAY, grey/white/orange mottled	0			NATURAL
			1.0						
			1.30		TEST PIT TP14 TERMINATED AT 1.30 m				
			1.5						
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP15

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 26/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.20m TP15a 0.30m	0.10		FILL, Silty CLAY, brow/grey, with patches of pale brown sand and stones (gravel track base)				FILL
			0.20		FILL, Mix of various CLAY, GRAVEL and STONES				
					FILL, Silty Sandy CLAY, brown/grey	0			
			0.5						
			1.0						
		1.20m TP15b 1.30m	1.20		Sandy CLAY, pale grey mottled orange	0			NATURAL
			1.5						
			1.70		TEST PIT TP15 TERMINATED AT 1.70 m				
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP16

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL, GRAVEL (track base)		M		FILL
		TP16a 0.20m			FILL, Sandy CLAY, brown mottled red-orange	0			
			0.30		FILL, Silty CLAY, brown/grey				
			0.5						
			1.0						
		1.10m	1.10						
		TP16b 1.20m			Sandy CLAY, pale grey/white/orange mottled	0			NATURAL
			1.5						
			1.60		TEST PIT TP16 TERMINATED AT 1.60 m				
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

GEOTECHNICAL TEST PIT LOG

TP17

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered		PP 80kPa	0.50m	0.50		CI	FILL, Silty CLAY, medium plasticity, dark grey-brown, trace of fine grained sand	w>PL		FILL
			D 0.60m			CI	FILL, Silty CLAY, medium plasticity, trace of sand, cemented structure	w<PL		
			0.80m							
			D 0.90m	1.0						
			1.20m	1.10		CH	Silty CLAY, high plasticity, grey with orange mottles, trace of fine grained sand	w>PL	St	ALLUVIUM
			D 1.30m							
		PP 150 - 200kPa		1.5						
				2.0						
				2.20			TEST PIT TP17 TERMINATED AT 2.20 m			
				2.5						

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

GEOTECHNICAL TEST PIT LOG

TP18

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered			0.30m D 0.40m	0.0		CL	FILL, Silty CLAY, low plasticity, dark brown-grey, trace of sand and fine to coarse sub-angular gravel, with construction waste (bricks)	w>PL		FILL
		PP 80kPa	0.70m D 0.80m	0.50 1.0		CL	FILL, Silty CLAY, low plasticity, dark grey, trace of fine grained sand			
			1.60m D 1.70m	1.50		CL	Silty CLAY, low plasticity, grey with orange mottles		F	ALLUVIUM
		PP >600kPa		1.90 2.0 2.5		CI	Silty CLAY, medium plasticity, pale grey with orange mottles, extremely weathered natural, some rock structure		H	
							TEST PIT TP18 TERMINATED AT 2.60 m			

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

GEOTECHNICAL TEST PIT LOG

TP19

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered				0.05		GM-GP	FILL, Sandy GRAVEL, fine to coarse, sub-angular, fine to coarse grained sand	M		FILL
						GC-CI	FILL, Gravelly CLAY/Clayey GRAVEL, fine to coarse gravel (10-15mm), low plasticity clay, with construction waste, timber, bricks etc	w>PL		
			0.30m D 0.40m							
				0.5						
			1.00m D 1.10m	1.00		SM	FILL, Silty SAND, fine to medium grained, dark grey	M		
				1.50		CI	Silty CLAY, low plasticity, grey with orange mottles, with fine to medium grained sand	w>PL	F	ALLUVIUM
		PP 80kPa	1.70m D 1.80m							
				2.0						
				2.10			TEST PIT TP19 TERMINATED AT 2.10 m			
				2.5						

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

GEOTECHNICAL TEST PIT LOG
TP20

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered			0.50m D 0.60m	0.5		CL	FILL, Silty CLAY, low plasticity, dark brown-grey, trace of fine grained sand	w>PL		FILL
				1.0						
		PP 200 - 250kPa	1.30m D 1.40m	1.20		CI	Silty CLAY, medium plasticity, pale grey with orange mottles, trace of fine grained sand		St - VSt	ALLUVIUM
				1.5						
				2.00			TEST PIT TP20 TERMINATED AT 2.00 m			
				2.5						

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

GEOTECHNICAL TEST PIT LOG

TP21

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered			0.50m D 0.60m	0.5		CI	FILL, Silty CLAY, medium plasticity, dark brown mottled with red	w>PL		FILL
		PP 200 - 250kPa	0.70m D 0.80m	0.60 1.0		CH	FILL, CLAY, high plasticity, pale grey with orange mottles			
			1.30m D 1.40m	1.20 1.5		CI	FILL, Silty CLAY, medium plasticity, dark grey, with fine to medium sub-angular gravel			
		PP 200kPa		1.80 2.0		CH	Silty CLAY, high plasticity, pale grey with orange mottles			ALLUVIUM
				2.20 2.5			TEST PIT TP21 TERMINATED AT 2.20 m			

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

GEOTECHNICAL TEST PIT LOG

TP22

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered			0.50m D 0.60m	0.15		SP	FILL, Gravelly SAND, fine to coarse grained, brown, fine to coarse sub-angular gravel	M		FILL
				0.5		CI	FILL, Silty CLAY, medium plasticity, dark grey	w~PL		
		PP 150 - 180kPa	1.10m D 1.20m	1.00		CI	Silty CLAY, medium plasticity, pale grey with orange mottles, trace of fine grained sand	w>PL	St	ALLUVIUM
		PP 200kPa		1.5						
				2.00			TEST PIT TP22 TERMINATED AT 2.00 m			
				2.5						

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

GEOTECHNICAL TEST PIT LOG

TP23

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information						
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
						SP	FILL, Gravelly SAND, fine to coarse grained, fine to medium sub-angular gravel, with silt	W		FILL
				0.20		CL	FILL, Silty CLAY, low plasticity, dark grey-brown	w<PL		
			0.40m D 0.50m	0.5						
			0.90m	0.90		CI	Silty CLAY, medium plasticity, grey with orange-brown mottles	w>PL	St	ALLUVIUM
		PP 160 - 200kPa	D 1.00m	1.0						
				1.50		CH	Silty CLAY, high plasticity, pale grey with orange mottles, trace of fine grained sand			
		PP 180 - 200kPa		2.0						
				2.20			TEST PIT TP23 TERMINATED AT 2.20 m			
				2.5						

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

GEOTECHNICAL TEST PIT LOG

TP24

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information						
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered		PP 180 - 200kPa	0.30m D 0.40m 0.60m D 0.70m 1.20m D 1.30m	0.20 0.45 0.5 0.70 1.0 1.5 2.00 2.5		SP	FILL, Gravelly SAND, fine to coarse grained, brown, with fine sub-angular gravel	M		FILL
						CL	FILL, Silty CLAY, medium plasticity, pale grey with orange mottles, trace of fine grained sand	w<PL		
						CL	FILL, Silty CLAY, medium plasticity, dark brown-grey	w>PL		
						CH	Silty CLAY, high plasticity, grey with orange mottles		St	ALLUVIUM
							TEST PIT TP24 TERMINATED AT 2.00 m			

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

GEOTECHNICAL TEST PIT LOG

TP25

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered		PP 180 - 200kPa	0.30m D 0.40m	0.30		GM-GP	FILL, Sandy GRAVEL, fine to coarse, brown, sub-angular, fine to coarse grained sand	D		FILL
				0.5		CI	FILL, Silty CLAY, medium plasticity, dark grey	w<PL		
		PP 150 - 200kPa	0.90m D 1.00m	0.60		CH	Silty CLAY, high plasticity, pale grey with orange mottles	w>PL	St	ALLUVIUM
			1.30m D 1.40m	1.0						
				1.5						
				2.00			TEST PIT TP25 TERMINATED AT 2.00 m			
				2.5						

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

GEOTECHNICAL TEST PIT LOG

TP26

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter Pty Ltd
PROJECT: Geotechncial Investigation
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 27/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator with 450mm Bucket

Test Pit Information					Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.40m D 0.50m	0.5		CL	FILL, Silty CLAY, low plasticity, with fine to coarse sub-rounded gravel, containing glass and plastic waste	w>PL		FILL
▶			0.90m D 1.00m	0.90 1.0		GM-GP	FILL, Sandy GRAVEL, fine to coarse, grey, sub-angular, fine to coarse grained sand, with cobbles and boulders, containing large bricks	W		
			1.20m D 1.30m	1.20		CI	FILL, Silty CLAY, medium plasticity, dark brown-grey	w>PL		
		PP 200kPa		1.50 2.0		CH	CLAY, high plasticity, grey with orange mottles		St	ALLUVIUM
				2.40 2.5			TEST PIT TP26 TERMINATED AT 2.40 m			

LOGGED: MT | CHECKED: MA | DATE: 16/11/2022

ENVIRONMENTAL TEST PIT LOG

TP27

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.50m TP27a 0.60m	0.5		FILL, Silty CLAY, brown mottled orange	0	D		FILL Plastic litter
			1.0						
			1.5						
			1.70		FILL, Gravelly CLAY, dark grey		M		
		2.20m TP27b 2.30m	2.0 *2.20* 2.5		Sandy CLAY, grey mottled orange	0			NATURAL
					TEST PIT TP27 TERMINATED AT 2.60 m				

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP28

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.60m TP28a 0.70m	0.5		FILL, Silty CLAY, brown	0	M		FILL
		0.80m TP28b 0.90m	0.70 1.0		Sandy CLAY, grey/orange mottled	0			NATURAL
			1.5 1.60		TEST PIT TP28 TERMINATED AT 1.60 m				
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP29

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
		0.10m	0.10		FILL, GRAVEL base		M		FILL
		TP29a 0.20m			FILL, Silty CLAY, brown mottled orange	0			Plastic encountered
		0.70m	0.70		Silty CLAY, grey/white/orange mottled	0			NATURAL
		TP29b 0.80m	1.50		Sandy CLAY, grey/white				
▽			1.80		SAND, coarse grained, white		W		
			2.30		TEST PIT TP29 TERMINATED AT 2.30 m				

0.5 1.0 2.0 2.5

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP30

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL, GRAVEL base		M		FILL
		TP30a 0.20m			FILL, Silty CLAY, brown	0			
		0.40m	0.40		Silty Sandy CLAY, white/grey/orange	0			NATURAL
		TP30b 0.50m	0.5						
			0.90		Sandy CLAY, white				
			1.0						
			1.20		TEST PIT TP30 TERMINATED AT 1.20 m				
			1.5						
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP31

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m TP31a DUP 8 0.20m	0.5		FILL, Silty CLAY, pale brown mottled orange	0	D		FILL
			1.00		FILL, Sandy CLAY, brown/orange/grey mottled		M		FILL Presumed to be cut and fill of natural material
			1.30		FILL, Gravelly Silty CLAY, grey				FILL
		1.70m TP31b 1.80m	1.5						
			1.70		Sandy CLAY, white/grey/orange mottled	0			NATURAL
			2.0						
			2.20		TEST PIT TP31 TERMINATED AT 2.20 m				
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP32

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m TP32a 0.20m	0.10 0.50		FILL, GRAVEL base FILL, Silty CLAY, brown mottled orange	0	M		FILL
		0.60m TP32b 0.70m	1.0		Sandy CLAY, white/grey/orange mottled becoming less orange with depth	0			NATURAL
			1.10 1.5 2.0 2.5		TEST PIT TP32 TERMINATED AT 1.10 m				

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ENVIRONMENTAL TEST PIT LOG

TP33

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.20m TP33a 0.30m	0.10		FILL, GRAVEL base mixed with sand				FILL
					FILL, Silty SAND, brown/red/grey				Wood encountered
			0.40		FILL, Silty CLAY, orange/brown mottled				
		0.70m	0.5						
		TP33b 0.80m	0.70		Sandy CLAY, white/orange/grey mottled				NATURAL
			1.0		mottled rusty red sandstone with depth				
			1.20		TEST PIT TP33 TERMINATED AT 1.20 m				
			1.5						
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP34

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m	0.10		FILL, GRAVEL track base		D		FILL
		TP34a 0.20m			FILL, Silty CLAY, brown/grey mottled orange	0	M		
			0.40		FILL, CLAY, orange-grey mottled				
			0.5						
		0.60m	0.60		Sandy CLAY, orange/grey, sandstone	0			NATURAL
		TP34b 0.70m							
			1.0						
			1.10		TEST PIT TP34 TERMINATED AT 1.10 m				
			1.5						
			2.0						
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

ENVIRONMENTAL TEST PIT LOG

TP35

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.30m TP35a 0.40m	0.20		FILL, Gravelly Silty Sandy CLAY, brown mottled red/orange		M		FILL
			0.5		FILL, Sandy GRAVEL, grey		W		Plastic, wood, bricks, concrete
			0.60		FILL, Silty CLAY, brown/grey mottled orange		M		
		1.20m TP35b 1.30m	1.0 1.20		Silty Sandy CLAY, grey/orange				NATURAL
			1.5		red sandstone				
			1.90		TEST PIT TP35 TERMINATED AT 1.90 m				
			2.0						
			2.5						

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ENVIRONMENTAL TEST PIT LOG

TP36

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15660a
CLIENT: Pariter
PROJECT: Preliminary Site (Contamination) Assessment
LOCATION: Mingara Recreation Club, Tumbi Umbi

DATE: 28/09/2022
SURFACE RL:
COORDS:
EXCAVATION METHOD: 8t Excavator, 450mm Bucket

Test Pit Information				Field Material Information						
WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	PID (ppm)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE/AESTHETICS AND ADDITIONAL OBSERVATIONS
Not Encountered		0.10m TP36a 0.20m	0.30		FILL, Gravelly Silty CLAY, mix of brown/orange	0	M		FILL
			0.40		FILL, Silty CLAY, brown				
			0.5		FILL, CLAY, orange/grey mottled red				FILL Presumed to be cut and fill of natural material
			0.60		FILL, Silty CLAY, brown		D		FILL
			0.90		FILL, Silty CLAY, brown/grey mottled orange		M		FILL Presumed to be cut and fill of natural material
			1.0						
			1.30		FILL, Silty CLAY, dark grey				FILL
			1.5						
		1.70m TP36b 1.80m	1.70		Silty Sandy CLAY, grey mottled orange	0			NATURAL
			2.0						
			2.30		TEST PIT TP36 TERMINATED AT 2.30 m				
			2.5						

LOGGED: RM | CHECKED: FB | DATE: 07/11/2022

Appendix D NATA Laboratory Reports

eurofins | Environment Testing

www.eurofins.com.au EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd

ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road	19/8 Lewalan Street	179 Magowar Road	Unit 1,2 Dacre Street	1/21 Smallwood Place	1/2 Frost Drive
Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield West
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	NSW 2304
+61 3 8564 5000	+61 3 8564 5000	+61 2 9900 8400	+61 2 6113 8091	T: +61 7 3902 4600	+61 2 4968 8448
NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261
Site# 1254	Site# 25403	Site# 18217	Site# 25466	Site# 20794	Site# 25079 & 25289

Eurofins ARL Pty Ltd

ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool
WA 6106
+61 8 6253 4444
NATA# 2377
Site# 2370

Eurofins Environment Testing NZ Ltd

NZBN: 9429046024954

Auckland	Auckland (Asb)	Christchurch	Tauranga
35 O'Rorke Road	Unit C1/4 Pacific Rise,	43 Detroit Drive	1277 Cameron Road,
Penrose,	Mount Wellington,	Rolleston,	Gate Pa,
Auckland 1061	Auckland 1061	Christchurch 7675	Tauranga 3112
+64 9 526 4551	+64 9 525 0568	+64 3 343 5201	+64 9 525 0568
IANZ# 1327	IANZ# 1308	IANZ# 1290	IANZ# 1402

Sample Receipt Advice

Company name:	Stantec Australia Pty Ltd (Newcastle)
Contact name:	Mitch Blencowe
Project name:	Not provided
Project ID:	301351398
Turnaround time:	5 Day
Date/Time received	Mar 13, 2024 3:50 PM
Eurofins reference	1077863

Sample Information

✓	A detailed list of analytes logged into our LIMS, is included in the attached summary table.
✓	All samples have been received as described on the above COC.
✓	COC has been completed correctly.
✓	Attempt to chill was evident.
✓	Appropriately preserved sample containers have been used.
✓	All samples were received in good condition.
✓	Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
✓	Appropriate sample containers have been used.
✓	Sample containers for volatile analysis received with zero headspace.
✓	Split sample sent to requested external lab.
✗	Some samples have been subcontracted.
N/A	Custody Seals intact (if used).

Notes

Trip 1 Sent to SGS

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Irem Haskara on phone : 61+ 428 995 496 or by email: IremHaskara@eurofins.com

Results will be delivered electronically via email to Mitch Blencowe - mitch.blencowe@stantec.com.

Note: A copy of these results will also be delivered to the general Stantec Australia Pty Ltd (Newcastle) email address.

CHAIN OF CUSTODY - Stantec

NOTE: TRIP1 sample to be sent to SGS for analysis.

Client: Stantec Australia Pty Ltd	**Project Number:** 301351398
Contact Person: Brock Collinson	**Project Name / Site etc (ie report title):**
Project Mgr: Mitch Blencowe	
Sampler: Brock Collinson	**Quote No. :**
Address: Suite 2, Level 2, 22 Honeysuckle Drive, Newcastle, NSW	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: 0435877208 **Mob:**	**Report format:** esdat / equis /
Results and Invoice: brock.collinson@stantec.com; mitch.blencowe@stantec.com	**Lab Comments:**

Sample information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	pH	TDS	Major Anions	Sulfate	Metals (8)Dissolved	Chloride	Major Cations									Provide as much information about the sample as you can
	BH10		13-03-24	Water	X	X	X	X	X	X	X									
	BH13		13-03-24	Water	X	X	X	X	X	X	X									
	BH14		13-03-24	Water	X	X	X	X	X	X	X									
	SW1		13-03-24	Water	X	X	X	X	X	X	X									
	DUP1		13-03-24	Water	X	X	X	X	X	X	X									
	TRIP1		13-03-24	Water	X	X	X	X	X	X	X									
	RIN01		13-03-24	Water																

Relinquished by (Company):	**Received by (Company):**
Print Name: Brock Collinson	**Print Name:** JRandall
Date & Time 13-03-24	**Date & Time:** 13/3/2024 3:50
Signature:	**Signature:**

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book

Page No:

15.5°

1077863

CHAIN OF CUSTODY - Stantec

NOTE: Please send TRIP1 sample to SGS

Client: Stantec Australia Pty Ltd	**Project Number: 301351398**
Contact Person: Brock Collinson	**Project Name / Site etc (ie report title):**
Project Mgr: Mitch Blencowe	
Sampler: Brock Collinson	**Quote No. :**
Address: Suite 2, Level 2, 22 Honeysuckle Drive, Newcastle, NSW	**Date results required:**
	Or choose: standard / same day / 1 day / 2 day / 3 day
	Note: Inform lab in advance if urgent turnaround is required - surcharges apply
Phone: 0435877208 **Mob:**	**Report format: esdat / equis /**
Results and Invoice: brock.collinson@stantec.com;	**Lab Comments:**

Sample information					Tests Required															Comments
Envirolab Sample ID	**Client Sample ID or information**	**Depth**	**Date sampled**	**Type of sample**	pH	TDS	B11C	B11E	Metals (8) dissolved	Aluminium (dissolved)										**Provide as much information about the sample as you can**
	BH10		13-03-24	Water	X	X	X	X	X	X										
	BH13		13-03-24	Water	X	X	X	X	X	X										
	BH14		13-03-24	Water	X	X	X	X	X	X										
	SW1		13-03-24	Water	X	X	X	X	X	X										
	DUP1		13-03-24	Water	X	X	X	X	X	X										
	TRIP1		13-03-24	Water	X	X	X	X	X	X										
	RIN01		13-03-24	Water			X	X												

Relinquished by (Company):	**Received by (Company):**	***Lab use only:***
Print Name: Brock Collinson	**Print Name:**	**Samples Received: Cool or Ambient (circle one)**
Date & Time 13-03-24	**Date & Time:**	**Temperature Received at: (if applicable)**
Signature: 	**Signature:**	**Transported by: Hand delivered / courier**

White - Lab copy / Blue - Client copy / Pink - Retain in Book Page No:

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road	19/8 Lewalan Street	179 Magowar Road	Unit 1,2 Dacre Street	1/21 Smallwood Place	1/2 Frost Drive
Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield West
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	NSW 2304
+61 3 8564 5000	+61 3 8564 5000	+61 2 9900 8400	+61 2 6113 8091	T: +61 7 3902 4600	+61 2 4968 8448
NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261
Site# 1254	Site# 25403	Site# 18217	Site# 25466	Site# 20794	Site# 25079 & 25289

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool
WA 6106
+61 8 6253 4444
NATA# 2377
Site# 2370

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland	Auckland (Asb)	Christchurch	Tauranga
35 O'Rorke Road	Unit C1/4 Pacific Rise,	43 Detroit Drive	1277 Cameron Road,
Penrose,	Mount Wellington,	Rolleston,	Gate Pa,
Auckland 1061	Auckland 1061	Christchurch 7675	Tauranga 3112
+64 9 526 4551	+64 9 525 0568	+64 3 343 5201	+64 9 525 0568
IANZ# 1327	IANZ# 1308	IANZ# 1290	IANZ# 1402

Company Name: Stantec Australia Pty Ltd (Newcastle)
Address: Level 22, 570 Bourke Street
Melbourne
VIC 3000

Project Name:
Project ID: 301351398

Order No.:
Report #: 1077863
Phone: (02) 9493 9700
Fax:

Received: Mar 13, 2024 3:50 PM
Due: Mar 20, 2024
Priority: 5 Day
Contact Name: Mitch Blencowe

Eurofins Analytical Services Manager : Irem Haskara

Sample Detail						Aluminium (filtered)	pH (at 25 °C)	Metals M8 filtered	Eurofins Suite B11E: Cl/SO4/Alkalinity	Eurofins Suite B11C: Na/K/Ca/Mg	Total Dissolved Solids Dried at 180 °C ± 2 °C
Sydney Laboratory - NATA # 1261 Site # 18217						X		X	X	X	X
Mayfield Laboratory - NATA # 1261 Site # 25079 & 25289							X				
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	BH10	Mar 13, 2024		Water	N24-Ma0031695	X	X	X	X	X	X
2	BH13	Mar 13, 2024		Water	N24-Ma0031696	X	X	X	X	X	X
3	BH14	Mar 13, 2024		Water	N24-Ma0031697	X	X	X	X	X	X
4	SW1	Mar 13, 2024		Water	N24-Ma0031698	X	X	X	X	X	X
5	DUP1	Mar 13, 2024		Water	N24-Ma0031699	X	X	X	X	X	X
6	RIN01	Mar 13, 2024		Water	N24-Ma0031700				X	X	
Test Counts						5	5	5	6	6	5

Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne
VIC 3000

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Mitch Blencowe**

Report **1077863-W**
Project name
Project ID 301351398
Received Date Mar 13, 2024

Client Sample ID			**BH10**	**BH13**	**BH14**	**SW1**
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins Sample No.			**N24-Ma0031695**	**N24-Ma0031696**	**N24-Ma0031697**	**N24-Ma0031698**
Date Sampled			**Mar 13, 2024**	**Mar 13, 2024**	**Mar 13, 2024**	**Mar 13, 2024**
Test/Reference	LOR	Unit				
Chloride	1	mg/L	500	530	190	170
pH (at 25 °C)	0.1	pH Units	5.3	6.4	5.2	7.6
Sulphate (as SO4)	2	mg/L	41	98	69	17
Total Dissolved Solids Dried at 180 °C ± 2 °C	10	mg/L	1100	1100	500	410
Alkalinity (speciated)						
Bicarbonate Alkalinity (as CaCO3)	20	mg/L	110	170	83	150
Carbonate Alkalinity (as CaCO3)	20	mg/L	< 20	< 20	< 20	< 20
Hydroxide Alkalinity (as CaCO3)	20	mg/L	< 20	< 20	< 20	< 20
Total Alkalinity (as CaCO3)	20	mg/L	110	170	83	150
Heavy Metals						
Aluminium (filtered)	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Arsenic (filtered)	0.001	mg/L	0.003	< 0.001	0.006	< 0.001
Cadmium (filtered)	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Chromium (filtered)	0.001	mg/L	0.001	< 0.001	0.001	< 0.001
Copper (filtered)	0.001	mg/L	< 0.001	0.006	< 0.001	0.006
Lead (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Mercury (filtered)	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel (filtered)	0.001	mg/L	0.085	0.048	0.062	0.004
Zinc (filtered)	0.005	mg/L	0.35	0.091	0.11	0.017
Eurofins Suite B11C: Na/K/Ca/Mg						
Calcium	0.5	mg/L	21	15	4.4	22
Magnesium	0.5	mg/L	36	51	10	15
Potassium	0.5	mg/L	7.1	5.0	3.1	5.4
Sodium	0.5	mg/L	290	290	150	110

Client Sample ID			DUP1	RIN01
Sample Matrix			Water	Water
Eurofins Sample No.			N24-Ma0031699	N24-Ma0031700
Date Sampled			Mar 13, 2024	Mar 13, 2024
Test/Reference	LOR	Unit		
Chloride	1	mg/L	190	< 1
pH (at 25 °C)	0.1	pH Units	5.3	-
Sulphate (as SO4)	2	mg/L	70	< 2
Total Dissolved Solids Dried at 180 °C ± 2 °C	10	mg/L	600	-
Alkalinity (speciated)				
Bicarbonate Alkalinity (as CaCO3)	20	mg/L	82	< 20
Carbonate Alkalinity (as CaCO3)	20	mg/L	< 20	< 20
Hydroxide Alkalinity (as CaCO3)	20	mg/L	< 20	< 20
Total Alkalinity (as CaCO3)	20	mg/L	82	< 20
Heavy Metals				
Aluminium (filtered)	0.05	mg/L	< 0.05	-
Arsenic (filtered)	0.001	mg/L	0.006	-
Cadmium (filtered)	0.0002	mg/L	< 0.0002	-
Chromium (filtered)	0.001	mg/L	0.001	-
Copper (filtered)	0.001	mg/L	< 0.001	-
Lead (filtered)	0.001	mg/L	< 0.001	-
Mercury (filtered)	0.0001	mg/L	< 0.0001	-
Nickel (filtered)	0.001	mg/L	0.055	-
Zinc (filtered)	0.005	mg/L	0.096	-
Eurofins Suite B11C: Na/K/Ca/Mg				
Calcium	0.5	mg/L	4.5	< 0.5
Magnesium	0.5	mg/L	10	< 0.5
Potassium	0.5	mg/L	3.1	< 0.5
Sodium	0.5	mg/L	150	< 0.5

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Eurofins Suite B11E: Cl/SO4/Alkalinity			
Chloride	Sydney	Mar 18, 2024	28 Days
- Method: LTM-INO-4270 Anions by Ion Chromatography			
Sulphate (as SO4)	Sydney	Mar 18, 2024	28 Days
- Method: In-house method LTM-INO-4270 Sulphate by Ion Chromatograph			
Alkalinity (speciated)	Sydney	Mar 18, 2024	14 Days
- Method: LTM-INO-4250 Alkalinity by Electrometric Titration			
pH (at 25 °C)	Newcastle	Mar 14, 2024	0 Day
- Method: LTM-GEN-7090 pH by ISE			
Heavy Metals (filtered)	Sydney	Mar 18, 2024	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Metals M8 filtered	Sydney	Mar 18, 2024	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Eurofins Suite B11C: Na/K/Ca/Mg	Sydney	Mar 18, 2024	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Total Dissolved Solids Dried at 180 °C ± 2 °C	Sydney	Mar 18, 2024	7 Days
- Method: LTM-INO-4170 Total Dissolved Solids in Water			

eurofins

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Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road	19/8 Lewalan Street	179 Magowar Road	Unit 1,2 Dacre Street	1/21 Smallwood Place	1/2 Frost Drive
Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield West
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	NSW 2304
+61 3 8564 5000	+61 3 8564 5000	+61 2 9900 8400	+61 2 6113 8091	T: +61 7 3902 4600	+61 2 4968 8448
NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261
Site# 1254	Site# 25403	Site# 18217	Site# 25466	Site# 20794	Site# 25079 & 25289

Eurofins ARL Pty Ltd
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NATA# 2377
Site# 2370

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland	Auckland (Asb)	Christchurch	Tauranga
35 O'Rorke Road	Unit C1/4 Pacific Rise,	43 Detroit Drive	1277 Cameron Road,
Penrose,	Mount Wellington,	Rolleston,	Gate Pa,
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IANZ# 1327	IANZ# 1308	IANZ# 1290	IANZ# 1402

Company Name: Stantec Australia Pty Ltd (Newcastle)
Address: Level 22, 570 Bourke Street
Melbourne
VIC 3000

Project Name:
Project ID: 301351398

Order No.:
Report #: 1077863
Phone: (02) 9493 9700
Fax:

Received: Mar 13, 2024 3:50 PM
Due: Mar 20, 2024
Priority: 5 Day
Contact Name: Mitch Blencowe

Eurofins Analytical Services Manager : Irem Haskara

Sample Detail						Aluminium (filtered)	pH (at 25 °C)	Metals M8 filtered	Eurofins Suite B11E: Cl/SO4/Alkalinity	Eurofins Suite B11C: Na/K/Ca/Mg	Total Dissolved Solids Dried at 180 °C ± 2 °C
Sydney Laboratory - NATA # 1261 Site # 18217						X		X	X	X	X
Mayfield Laboratory - NATA # 1261 Site # 25079 & 25289							X				
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	BH10	Mar 13, 2024		Water	N24-Ma0031695	X	X	X	X	X	X
2	BH13	Mar 13, 2024		Water	N24-Ma0031696	X	X	X	X	X	X
3	BH14	Mar 13, 2024		Water	N24-Ma0031697	X	X	X	X	X	X
4	SW1	Mar 13, 2024		Water	N24-Ma0031698	X	X	X	X	X	X
5	DUP1	Mar 13, 2024		Water	N24-Ma0031699	X	X	X	X	X	X
6	RIN01	Mar 13, 2024		Water	N24-Ma0031700				X	X	
Test Counts						5	5	5	6	6	5

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follow guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013. They are included in this QC report where applicable. Additional QC data may be available on request.
2. Unless otherwise stated, all soil/sediment/solid results are reported on a dry weight basis.
3. Unless otherwise stated, all biota/food results are reported on a wet weight basis on the edible portion.
4. For CEC results where the sample's origin is unknown or environmentally contaminated, the results should be used advisedly.
5. Actual LORs are matrix dependent. Quoted LORs may be raised where sample extracts are diluted due to interferences.
6. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
7. SVOC analysis on waters is performed on homogenised, unfiltered samples unless noted otherwise.
8. Samples were analysed on an 'as received' basis.
9. Information identified in this report with **blue** colour indicates data provided by customers that may have an impact on the results.
10. This report replaces any interim results previously issued.

Holding Times

Please refer to the 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours before sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and despite any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling; therefore, compliance with these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether, the holding time is seven days; however, for all other VOCs, such as BTEX or C6-10 TRH, the holding time is 14 days.

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ppm:** parts per million
µg/L: micrograms per litre	**ppb:** parts per billion	**%:** Percentage
org/100 mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100 mL:** Most Probable Number of organisms per 100 millilitres
CFU: Colony forming unit	**Colour:** Pt-Co Units	

Terms

APHA	American Public Health Association
CEC	Cation Exchange Capacity
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where moisture has been determined on a solid sample, the result is expressed on a dry weight basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples, these are performed on laboratory-certified clean sands and in the case of water samples, these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC represents the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a similar compound to the analyte target is reported as percentage recovery. See below for acceptance criteria.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment; however, free tributyltin was measured, and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 6.0
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should only be used as a guide and may be different when site-specific Sampling Analysis and Quality Plan (SAQP) have been implemented.

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is ≤30%; however, the following acceptance guidelines are equally applicable:

Results <10 times the LOR:	No Limit
Results between 10-20 times the LOR:	RPD must lie between 0-50%
Results >20 times the LOR:	RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range, not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS. SVOCs recoveries 20 – 150%, VOC recoveries 70 – 130%

PFAS field samples containing surrogate recoveries above the QC limit designated in QSM 6.0, where no positive PFAS results have been reported or reviewed, and no data was affected.

QC Data General Comments

1. Where a result is reported as less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown are not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery, the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results, a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data; thus, it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride	mg/L	< 1			1	Pass	
Sulphate (as SO4)	mg/L	< 2			2	Pass	
Total Dissolved Solids Dried at 180 °C ± 2 °C	mg/L	< 10			10	Pass	
Method Blank							
Alkalinity (speciated)							
Bicarbonate Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Carbonate Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Hydroxide Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Total Alkalinity (as CaCO3)	mg/L	< 20			20	Pass	
Method Blank							
Heavy Metals							
Aluminium (filtered)	mg/L	< 0.05			0.05	Pass	
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Cadmium (filtered)	mg/L	< 0.0002			0.0002	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Copper (filtered)	mg/L	< 0.001			0.001	Pass	
Lead (filtered)	mg/L	< 0.001			0.001	Pass	
Mercury (filtered)	mg/L	< 0.0001			0.0001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
Method Blank							
Eurofins Suite B11C: Na/K/Ca/Mg							
Calcium	mg/L	< 0.5			0.5	Pass	
Magnesium	mg/L	< 0.5			0.5	Pass	
Potassium	mg/L	< 0.5			0.5	Pass	
Sodium	mg/L	< 0.5			0.5	Pass	
LCS - % Recovery							
Chloride	%	101			70-130	Pass	
Sulphate (as SO4)	%	104			70-130	Pass	
Total Dissolved Solids Dried at 180 °C ± 2 °C	%	95			70-130	Pass	
LCS - % Recovery							
Alkalinity (speciated)							
Bicarbonate Alkalinity (as CaCO3)	%	115			70-130	Pass	
Hydroxide Alkalinity (as CaCO3)	%	115			70-130	Pass	
Total Alkalinity (as CaCO3)	%	115			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Aluminium (filtered)	%	112			80-120	Pass	
Arsenic (filtered)	%	117			80-120	Pass	
Cadmium (filtered)	%	112			80-120	Pass	
Chromium (filtered)	%	108			80-120	Pass	
Copper (filtered)	%	103			80-120	Pass	
Lead (filtered)	%	104			80-120	Pass	
Mercury (filtered)	%	98			80-120	Pass	
Nickel (filtered)	%	105			80-120	Pass	
Zinc (filtered)	%	106			80-120	Pass	
LCS - % Recovery							
Eurofins Suite B11C: Na/K/Ca/Mg							
Calcium	%	98			80-120	Pass	
Magnesium	%	107			80-120	Pass	
Potassium	%	102			80-120	Pass	
Sodium	%	103			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Eurofins Suite B11C: Na/K/Ca/Mg				Result 1					
Calcium	N24-Ma0031695	CP	%	91			75-125	Pass	
Magnesium	N24-Ma0031695	CP	%	91			75-125	Pass	
Potassium	N24-Ma0031695	CP	%	96			75-125	Pass	
Sodium	R24-Ma0032283	NCP	%	101			75-125	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Aluminium (filtered)	N24-Ma0031699	CP	%	94			75-125	Pass	
Arsenic (filtered)	N24-Ma0031699	CP	%	102			75-125	Pass	
Cadmium (filtered)	N24-Ma0031699	CP	%	97			75-125	Pass	
Chromium (filtered)	N24-Ma0031699	CP	%	89			75-125	Pass	
Copper (filtered)	N24-Ma0031699	CP	%	87			75-125	Pass	
Lead (filtered)	N24-Ma0031699	CP	%	87			75-125	Pass	
Mercury (filtered)	N24-Ma0031699	CP	%	98			75-125	Pass	
Spike - % Recovery									
				Result 1					
Chloride	N24-Ma0031700	CP	%	118			70-130	Pass	
Sulphate (as SO4)	N24-Ma0031700	CP	%	121			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
pH (at 25 °C)	N24-Ma0032276	NCP	pH Units	7.2	7.3	pass	30%	Pass	
Sulphate (as SO4)	S24-Ma0037154	NCP	mg/L	3000	3300	10.0	30%	Pass	
Total Dissolved Solids Dried at 180 °C ± 2 °C	S24-Ma0028471	NCP	mg/L	280	270	5.1	30%	Pass	
Duplicate									
Alkalinity (speciated)				Result 1	Result 2	RPD			
Bicarbonate Alkalinity (as CaCO3)	S24-Ma0035175	NCP	mg/L	85	84	<1	30%	Pass	
Carbonate Alkalinity (as CaCO3)	S24-Ma0035175	NCP	mg/L	< 20	< 20	<1	30%	Pass	
Hydroxide Alkalinity (as CaCO3)	S24-Ma0035175	NCP	mg/L	< 20	< 20	<1	30%	Pass	
Total Alkalinity (as CaCO3)	S24-Ma0035175	NCP	mg/L	85	84	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium (filtered)	W24-Ma0028917	NCP	mg/L	0.09	0.09	<1	30%	Pass	
Arsenic (filtered)	W24-Ma0028917	NCP	mg/L	0.001	0.001	5.2	30%	Pass	
Cadmium (filtered)	W24-Ma0028917	NCP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium (filtered)	W24-Ma0028917	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper (filtered)	W24-Ma0028917	NCP	mg/L	0.005	0.006	1.6	30%	Pass	
Lead (filtered)	W24-Ma0028917	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Mercury (filtered)	W24-Ma0028917	NCP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel (filtered)	W24-Ma0028917	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc (filtered)	W24-Ma0028917	NCP	mg/L	0.018	0.006	95	30%	Fail	Q15
Duplicate									
				Result 1	Result 2	RPD			
Chloride	N24-Ma0031699	CP	mg/L	190	190	<1	30%	Pass	
Duplicate									
Eurofins Suite B11C: Na/K/Ca/Mg				Result 1	Result 2	RPD			
Calcium	N24-Ma0031700	CP	mg/L	< 0.5	< 0.5	<1	30%	Pass	
Magnesium	N24-Ma0031700	CP	mg/L	< 0.5	< 0.5	<1	30%	Pass	
Potassium	N24-Ma0031700	CP	mg/L	< 0.5	< 0.5	<1	30%	Pass	
Sodium	N24-Ma0031700	CP	mg/L	< 0.5	< 0.5	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised by:

Nileshni Goundar	Analytical Services Manager
Fang Yee Tan	Senior Analyst-Metal
Kirra Bailey	Senior Analyst-Inorganic
Ryan Phillips	Senior Analyst-Inorganic

Glenn Jackson
Managing Director

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Appendix E Field Forms

SURFACE WATER SAMPLING FIELD SHEET

Ref. Number:	30135139 8	**Date:**	13/3/24
Project:	Tumbi Umbi	**Surface Water Location:**	SURFACE WATER 1
Location:	Concrete Drain south of Wetland	**Sampler(s):**	ZS/BC

Field Observations

Surface water body flow:	Minor discharge to Northern wetland	Volume of water in water body:	
Ponded / pooled water:	Pooled	Able to sample location:	Yes

Well Purging

Sampling method:	Direct	Field Parameter Measurement Device:	Multimeter

Time	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments (Appearance, odour, etc)
10:56	23.1	784	6.83	10.26	304	-6.7	Clear browny water, surficial algae & staining

Miscellaneous Field Comments

Samples Filtered:	Yes
Weather Condition:	Sunny
Other:	SWL 0.06m below concrete level

SURFACE WATER SAMPLING FIELD SHEET

Ref. Number:	30135139 8	**Date:**	13/3/24
Project:	Tumbi Umbi	**Surface Water Location:**	SW2
Location:		**Sampler(s):**	BC/JS

Field Observations

Surface water body flow:	Minor recharge from SW	Volume of water in water body:	
Ponded / pooled water:	Pooled	Able to sample location:	

Well Purging

Sampling method:		Field Parameter Measurement Device:	Multimeter

Time	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments (Appearance, odour, etc)
	27.3	1055	7.1	10.07	-9.9	-5.5	Clear brown water, surficial algae & staining

Miscellaneous Field Comments

Samples Filtered:	No
Weather Condition:	Sunny
Other:	

SURFACE WATER SAMPLING FIELD SHEET

Ref. Number:	301351398	**Date:**	12/3/24
Project:	Tumbi Umbi	**Surface Water Location:**	SW3
Location:	southern Base of Northern wetland	**Sampler(s):**	ZS/BC

Field Observations

Surface water body flow:	minor recharge from southern drain	Volume of water in water body:	
Ponded / pooled water:	Ponded	Able to sample location:	

Well Purging

Sampling method:		Field Parameter Measurement Device:	Multimeter

Time	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments (Appearance, odour, etc)
11:22	25.8	746	6.43	11.12	10.4	5.7	Clear brown water, surficial algae & staining

Miscellaneous Field Comments

Samples Filtered:	~~Yes~~ No
Weather Condition:	Sunny
Other:	

GROUNDWATER SAMPLING FIELD SHEET

Ref. Number:	30135139 8	**Date:**	13/3/24
Project:	Tumbi Umbi Retirement Village	**Well Number:**	BH10
Location:		**Sampler(s):**	BC/ZS

Field Measurements

Top of Casing (TOC):	0	m	Top of Casing Elevation	0	m AHD
Depth to Groundwater:	-	m (TOC)	Surface Elevation		m AHD
Depth to Groundwater:	0.35	m (bgl)	Groundwater Elevation :		m AHD
Well Depth:	-	m (TOC)	Organic vapours in well:		ppm
Well Depth:	19.65	m (bgl)	Depth to Immiscible Layer:		m
Thickness of Groundwater Column:		m	Thickness to Immiscible Layer:		m

Screen 15.65-18.65

Well Purging

Purge Method:	low-flow		Start Purge:	7:48-8:25	
Field Parameter Measurement Device:			End Purge:		
Volume Groundwater in Casing:		L	Total Volume Purged:		L

Brought up @ 7:55 as no water being pumped. Level rising & dropping with in out of Pump.

Time	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Purge Volume (L)	Water Level (m TOC)	Comments (Appearance, odour, etc)
8:32	21.6	1651	5.17	7.32	70.1	18.2	1	0.6	clear, slight grey murk.
8:36	21.3	1664	5.04	5.50	-45	32.9	2	0.6	slightly murkier.
8:39	21.1	1323	5.06	5.46	-61.3	28.0	3	0.6	"
8:42	21.7	1721	5.44	6.27	-64.3	29.1	4	0.62	" "
8:46	21.6	1717	5.4	6.01	-80.4	33.3	5	0.65	" "
8:50	21.5	1690	5.19	5.89	-93.1	36.4	6	0.7	" "
8:54	21.7	1697	5.18	5.81	-81	34.9	7	0.71	" "

@PM 4

changed to CPM 3

pre

Well Sampling

Sampling Method:		Material:	
Start Sampling:	8:56	Finish Sampling:	9:00

	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments
Pre-Sampling:							
Post-Sampling:	24.3	1757	5.04	5.06	-96.9	-3.8	

Miscellaneous Field Comments

Well Head Integrity:	
Samples Filtered:	Aluminium
Weather Condition:	
Other:	

GROUNDWATER SAMPLING FIELD SHEET

Ref. Number:	301351398	**Date:**	13/3/24
Project:	Tumbi Umbi Retirement Village	**Well Number:**	BH13
Location:		**Sampler(s):**	BC/JS

Field Measurements

Top of Casing (TOC):	0	m	**Top of Casing Elevation**	0	m AHD
Depth to Groundwater:		m (TOC)	**Surface Elevation**		m AHD
Depth to Groundwater:	1.1	m (bgl)	**Groundwater Elevation :**		m AHD
Well Depth:		m (TOC)	**Organic vapours in well:**		ppm
Well Depth:	7.4	m (bgl)	**Depth to Immiscible Layer:**		m
Thickness of Groundwater Column:		m	**Thickness to Immiscible Layer:**		m

Well Purging

Purge Method:	low flow	**Start Purge:**	9:25
Field Parameter Measurement Device:		**End Purge:**	9:54
Volume Groundwater in Casing:	L	**Total Volume Purged:**	L

	Time	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Purge Volume (L)	Water Level (m TOC)	Comments (Appearance, odour, etc)
	9:29	23.1	1855	6.18	1.52	-12.5	32.9	1	1.36	CPM4
	9:33	23.2	1856	6.19	0.93	-28.1	31.6	2	1.6	CPM3
	9:35	23.4	1861	6.2	0.94	-35.1	32.7	3	1.8	CPM2
PRE =>	9:45	23.9	1884	6.19	1.74	-39.0	36.5	4	2.06	CPM1
POST =>	9:53	23.4	1864	6.17	2.01	-34.0	56.4	5	2.06	

Well Sampling

Sampling Method:		**Material:**	
Start Sampling:	9:47	**Finish Sampling:**	9:52

	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments
Pre-Sampling:							
Post-Sampling:	23.4	1864	6.17	2.01	-34.0	56.4	

Miscellaneous Field Comments

Well Head Integrity:	
Samples Filtered:	
Weather Condition:	
Other:	

GROUNDWATER SAMPLING FIELD SHEET

Ref. Number:	3013 51348	**Date:**	23/3/24
Project:	Tumbi Umbi	**Well Number:**	BH14
Location:		**Sampler(s):**	BC/ZS

Field Measurements

Top of Casing (TOC):		m	Top of Casing Elevation		m AHD
Depth to Groundwater:	0.87	m (TOC)	Surface Elevation		m AHD
Depth to Groundwater:		m (bgl)	Groundwater Elevation :		m AHD
Well Depth:	—	m (TOC)	Organic vapours in well:		ppm
Well Depth:	7.15	m (bgl)	Depth to Immiscible Layer:		m
Thickness of Groundwater Column:		m	Thickness to Immiscible Layer:		m

Well Purging

Purge Method:	low-flow	Start Purge:	10:18
Field Parameter Measurement Device:		End Purge:	10:43
Volume Groundwater in Casing:	L	Total Volume Purged:	L

Time	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Purge Volume (L)	Water Level (m TOC)	Comments (Appearance, odour, etc)
10:22	25.6	814	5.46	11.71	-80.3	28.0	1	.8	Cloudy grey, Sulfuric odour
10:27	25.3	765	5.45	7.58	-86.1	21.6	2	.84	"
10:29	25.3	757	5.55	6.99	-83.4	18.3	3	.86	"
PRE⇒ 10:32	25.2	947	5.59	7.86	-71.9	8.2	4	.86	"
~~PRE~~ POST⇒ 10:42	25.7	833	5.54	6.33	-67.6	8.5	5	.9	"

Well Sampling

Sampling Method:		Material:	
Start Sampling:		Finish Sampling:	

	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments
Pre-Sampling:							
Post-Sampling:							

Miscellaneous Field Comments

Well Head Integrity:	
Samples Filtered:	
Weather Condition:	
Other:	

Appendix F Site Photographs

Appendix F

Site Photographs

IMAGE 1 – Northwestern extents of site taken within the proximity of the informal carpark area (right of photo). Unnamed drainage feature in the west (left of photo).

IMAGE 2 – Northeastern extents of site taken within the proximity of the informal carpark area (left of photo).

IMAGE 3 – Site area, looking towards the south.

IMAGE 4 – Highly modified natural unnamed drainage creek immediately west of the site, looking northwest.

IMAGE 5 – Artificial wetland constructed northwest of site.

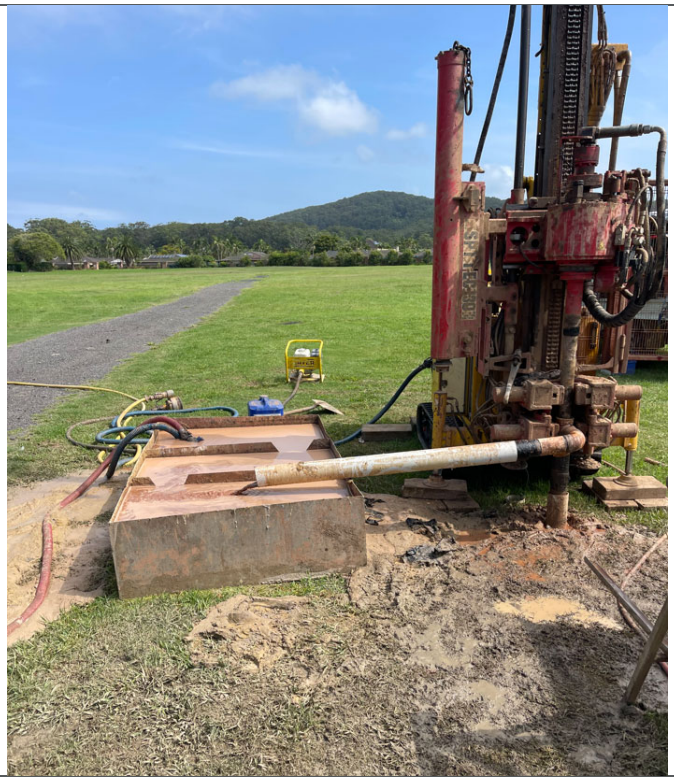

IMAGE 6 – Ongoing drilling at BH10.

IMAGE 7 – Installation of PVC pipe in one of the groundwater monitoring bores.

IMAGE 8 – Quickset concrete installation prior to addition of gatic cover on installed piezometers.

IMAGE 9 – Installed piezometer during groundwater testing and sampling.

IMAGE 10 – Gatic cover of piezometer.

IMAGE 11 – SW1 testing and sampling location.

IMAGE 12 – SW2 location.

IMAGE 13 – SW3 testing location.

IMAGE 14 – Unnamed drainage creek, southwest of SW1 site.

IMAGE 15 – Surrounds of the unnamed drainage creek (southwest of SW1).

IMAGE 16 – Unnamed drainage creek, southwest of SW1.

Appendix G Response to NSW Regulators

Stantec

Memo

To:	Michael Cardillo Pariter Mingara Partnership Pty Ltd Level 23, Deutsche Bank Place 126 Phillip Street Sydney NSW 2000 Australia	From:	Cameron Love & Mike Jorgensen Level 28, 600 Bourke Street Melbourne VIC 3000 AUSTRALIA ABN 17 007 820 322
Project/File:	301351398	Date:	2 April 2025

Reference: TURL RtS - Groundwater VPR011

Introduction

This technical memorandum pertains to the development works occurring at Mingara Retirement Villages, 12-14 Mingara Drive, Tumbi Umbi NSW 2261 (the Site). Pariter Mingara Partnership Pty Ltd (Pariter) are seeking evaluation of the estimated groundwater volume take for the proposed continuous flight auger (CFA) pile method of the bored piers beneath the building lift cores. Additionally, Site features where excavations will be undertaken, such as building and lift cores and onsite detention (OSD) basin and the 8 m deep screw piles will also be reviewed to evaluate if groundwater interception is likely to occur.

Purpose & Objectives

The purpose of this memo is to respond to the Department of Climate Change, Energy, Environment and Water's (DCCEEW) letter, dated 11 December 2024, *Attachment A, Section 1.0, Water Take and Licensing* and Department of Planning Housing and Infrastructure's (DPHI) letter, dated 29 January 2025, R*equest for Additional Information*, *item 30*, queries being:

1. DCCEEW:
    a. Quantify the maximum annual groundwater to take due to aquifer interference activities due to the project during construction and in operation in accordance with the NSW aquifer interference policy.
    b. Demonstrate the ability to acquire sufficient water entitlement for groundwater take, unless an exemption applies.
2. DPHI: Confirm the maximum annual groundwater take and the ability to acquire sufficient water entitlements.

The memo report objective is to confirm the depth to the underlying aquifers beneath the Site and obtain an estimated groundwater take during the proposed piling method. This will inform the potential groundwater take and licencing requirement.

Reference: TURL RtS - Groundwater VPR011

Scope

The scope of work included the following:

- Confirm the location and depth of the groundwater bearing units.
- Review proposed building and lift cores, boring method and OSD basin design plans.
- Estimate the maximum annual groundwater take during the CFA borehole piling method.
- Confirm the ability to acquire sufficient water entitlements.

Groundwater Bearing Units

Groundwater levels were measured by Stantec at shallow piezometers BH13 and BH14 and deep piezometer BH10 (Stantec 2024). Based on the RCA Australia (2024) lithological descriptions, Stantec identified a semi-confined upper alluvial aquifer that is likely present beneath the entire Site, from approximately 3.4 m below level surface (bls) to 3.9 mbls [3.41 m relative level (RL) to 3.94 m RL]. A persistent clayey layer (a potential semi-confined aquitard) is underlying this unit, from approximately 11.70 mbls, and overlays the confined lower alluvial aquifer from approximately 14.80 mbls to 27.5 mbls where claystone and sandstone bedrock was encountered.

The lower confined alluvial aquifer is considered independent of the shallow aquifer, with an upward pressure gradient, due to the higher groundwater head level observed at BH10 compared to BH13 and BH14. Standing water levels (SWLs) in piezometers BH13 and BH14 ranged from 0.87 to 1.1 m below the top of casing (bTOC) (6.14 to 6.34 m RL). At BH10 the SWL was 0.35 mbTOC (6.89 m RL).

Groundwater Considerations

Infrastructure that may intercept the upper alluvial aquifer or is at potential risk of vertical upward groundwater pressure are the lift core excavations, lift wells and stage 1 and 2 OSD basins. The following RLs were noted:

- Building lift cores 0.8 m deep core pad below the floor (6.13 m RL). Approximately 2.7 m above the estimated semi-confined upper groundwater bearing unit (the upper alluvial aquifer).
- Stage 1 OSD cut is 5.5 m RL. Approximately 1.6 m above the estimated semi-confined upper groundwater bearing unit.
- Stage 2 OSD cut is 6.9 m RL. Approximately 3 m above the estimated semi-confined upper groundwater bearing unit.

RCA Australia via email, dated 28 March 2025, assessed heave risk at the two OSD locations and based on available data and a maximum excavation depth of the order of 2.5m considered there is a satisfactory factor of safety against base heave occurring. Stantec noted that the building lift core elevations are indicated to be higher than the Stage 1 OSD excavation floor of 5.5 mAHD and the excavations for the lift wells are much smaller footprints compared to the OSD excavations. Therefore, Stantec assumed that floor heave at the lift well excavations would also not be at risk.

Additionally, screw piles will be constructed in each building, up to 8 m deep, and will likely intercept the upper alluvial aquifer. However, no dewatering will occur or be required to construct the screw piles.

Groundwater Take Estimate

The CFA pile design aims to drill eight 0.9 m diameter pile boreholes to approximately 20 m deep, per lift core (five building lift cores), equating to a total of 40 pile bore holes across the development Site (Dunnings 2024). No active groundwater pumping or dewatering from the aquifer is anticipated.

During the pile drilling step, groundwater inflow into the pile borehole is anticipated from the upper and lower alluvial aquifers. During concrete pouring and drill auger recovery, vertical groundwater displacement is anticipated. This step assumes that the entire borehole volume is displaced at the ground surface. Adopting a conservative approach for the top of the groundwater column as the ground surface, a single groundwater pile borehole volume estimate was calculated as approximately 13 kilolitres (kL).

Based on this, the estimated combined displacement volume for all 40 borehole piles is approximately 0.5 megalitres (ML). This assumes that one pile borehole volume of groundwater per hole is removed only, during concrete pouring, auger retrieval and insertion of the steel reinforcement.

Conclusions

Stantec evaluated that CFA pile borings will likely intercept the upper and lower alluvial aquifer, starting from approximately 3.4 mbls. The proposed onsite infrastructure or excavations is unlikely to intercept or result in upward vertical pressure from the upper alluvial aquifer unit, however they are semi-confined and the stability of the excavation floor and the Stage 1 OSD structure would need to be assessed by a geotechnical engineer.

Based on the review and estimated CFA piling bore hole, the total groundwater take is approximately 0.5 ML. This estimated volume is not a continuous annual take to be consumed or for supply and is considered the maximum take for the duration of the project. The estimated volume is also less than the 3 ML threshold volume requirement under NSW Department of Planning, Infrastructure and Environment[1]. A water supply work approval will be required for the duration of the construction dewatering works. However, a water access license is not anticipated to be required (an exemption[2]) for groundwater taken during CFA piling for the building cores.

[1] https://water.dpie.nsw.gov.au/our-work/licensing-and-trade/water-access-licences-and-approvals/exemptions-for-water-licences-and-works-and-or-use-approvals/groundwater-wal-exemptions

[2] https://www.waternsw.com.au/__data/assets/pdf_file/0006/160953/Water-access-licence-exemption-for-aquifer-up-to-3ML.pdf; https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0009/386181/wal-exemption-up-to-3ML-information-sheet.pdf, accessed 31 March 2025

Reference: **TURL RtS - Groundwater VPR011**

References

Dunnings (2024) Core Pad and Pile Arrangement Plan. SK240405_23169_VG01. 5 April 2024.

RCA Australia (2024) Additional Geotechnical Investigation – Proposed Retirement Living Adjacent Mingara Recreation Club, Mingara Drive, Tumbi Umbi. 15660b-201/3. Draft. July 2024.

Stantec (2024) SEARS 13: Groundwater, Surface Water & Salinity Impact Assessment. Mingara Leisure Group Pty Ltd. 301351398 Tumbi Umbi. 25 July 2024 (draft).

Yours sincerely

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