Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Groundwater Management Plan
EPBC 2007/3343

Proposed Industrial Subdivision
Stage 3, Lot 210 D.P.1174939, 2 Westrac Drive, Tomago

Prepared for
Northbank Enterprise Hub Pty Ltd
in consultation with
Torque Projects Pty Ltd

Project 39920.09
April 2024

Douglas Partners
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author	Dana Wilson	19 April 2024
Reviewer		19 April 2024

Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

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Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
15 Callistemon Close
Warabrook NSW 2304
PO Box 324
Hunter Region Mail Centre NSW 2310
Phone (02) 4960 9600

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1. Introduction

This Groundwater Management Plan (GWMngtP) has been prepared for the proposed industrial subdivision at Lot 210 D.P.1174939, 2 Westrac Drive, Tomago ("the site"). The investigation was undertaken for the land owner Northbank Enterprise Hub Pty Ltd (NEH) with refence to Douglas Partners Pty Ltd (DP) proposal 39920.09.P.001.Rev1 dated 31 October 2022.

The proposed industrial subdivision of Lot 210 is known as Stage 3 as previously approved by NSW Department of Planning and Environment (NSW DPE) under Major Project Approval MP07_0086 and Department of Climate Change, Energy, the Environment and Water (DCCEEW) under Environmental Protection and Biodiversity Conservation Act (EPBC) Approval 2007/3343. The approval to commence Stage 3 is subject to completing pre-commencement conditions, including management plans, for both MP07_0086 and 2007/3343.

The proposed development of Stage 3 is consistent and within the bounds of the approvals, which comprises an industrial subdivision, with industrial lots with associated access roads and drainage reserves. To facilitate development, the site will require importation of fill for site raising, which is proposed to be undertaken in smaller stages, subject to market demand.

This GWMngtP has been specifically prepared for Stage 3 as required under existing Environmental Protection and Biodiversity Conservation Act (EPBC) Approval 2007/3343 consent conditions as outlined herein.

The GWMngtP has been prepared to minimise potential groundwater impacts and risks arising from the proposed Stage 3 development on the nearby Hunter River Estuary Ramsar Wetlands and other nearby properties as required under the conditions of consent.

This GWMngtP includes the following information:

- Review of consent conditions and regulatory framework;
- Summary of the site condition, environmental setting and proposed development;
- Review of previous reports and groundwater level and quality data on the site and surrounding sites;
- Water quality data compilation, trend review and statistical assessment for site specific trigger levels;
- Development of a conceptual hydrogeological model (CHM);
- Identification of potential impacts to groundwater from the proposed development and risk evaluation considering mitigation measures;

- Groundwater management strategy including:
  - Requirements for continuous improvement and detailed design in line with data collection and staged development;
  - Summary of environmental standards for groundwater monitoring;
  - Recommendations for groundwater monitoring prior to, during and following construction;
  - Assessment criteria;
  - Contingency measures and reporting requirements;
  - Requirements for strategy and management plan review.

The Department of the Environment (2014) *Environmental Management Plan Guidelines* were referenced in preparation of this document. A declaration of accuracy signed by person accepting responsibility for this GWMngtP is inlcued in Appendix E.

2. Conditions of Approval

This GWMngtP has been prepared for Lot 210 / Stage 3 as required under existing EPBC Approval 2007/3343 consent conditions as outlined. It is noted that the proposed development represents Stage 3 of an existing conditional Project Approval granted by the NSW DPE under Approval MP07_0086.

A smaller stage of area, known as Stage 3.1A has been approved for 35,000 m^3 of fill by both NSW DPE and National Parks and Wildlife Service (NPWS). Stage 3.1A (1.2 hectares) lies within the Lot 210 / Stage 3 site, midway south along Westrac Drive (refer Figure 3 in Section 5.1 below).

The boundary of the EPBC Approval 2007/3343 extends south beyond the MP07_0086 approval boundary of Lot 210/Stage 3 as indicated in Figure 1 in Section 4, a further 17ha of area south within Lot 1001 DP 1127780. This will be a future stage, stage 4 of approved industrial development. Lot 1001 DP 1127780 is also approved for industrial development by NSW DPE under MP10_0185.

A separate Stage 3 Stormwater Management Plan (SWMP) (WRM, 2024) has been prepared to address surface water specific requirements of EPBC Conditions 2a-e and a-d. The specific conditions of the EPBC approval which relate to groundwater are provided in Table 1, together with sections are reported in the SWMP. The SWMP should be referred to for full details.

Table 1: Sections Addressing Condition 2 of EPBC Approval 2007/3343

Requirements for Groundwater Management Plan		Report Section	Additional Summary Comments to Report Section
2	*In order to minimise potential significant impacts on the Hunter River Estuary Ramsar Wetland site, prior to any commencement of works for each stage the person taking the action must submit to the Minister for approval a stormwater and groundwater management plan for that stage. Works must not commence until the plan is approved by the Minister. The approved plan must be implemented and address the following matters:*	This report	
a	*Documented industry best practice water sensitive design principles and practices*	NA (refer SWMP)	Water Sensitive Urban Design relates specifically to stormwater, refer to the SWMP by WRM (2024)
b	*A review of the environmental values and water quality objectives for the Hunter Estuary Wetlands Ramsar site*	Section 9.9	From the *Kooragang RAMSAR Wetland Ecological Character Description* (Brereton and Taylor-Wood, 2010), the Hunter Estuary Wetland Ramsar site has a range of biodiversity values and supports: • *A range of estuarine vegetation communities including intertidal sand and mud flats, saltmarsh, and freshwater/brackish wetlands which are important foraging and roosting habitat for migratory birds.* • *Infauna in intertidal mudflat areas which provide food for migratory waders.* • *Seventeen species of migratory shorebirds;* • *More than 1% of the Australian population of red-necked avocet.* • *A high diversity of flora and fauna … including 38 bird species which are listed as migratory under the EPBC Act.* The ANZECC (2000) and ANZG (2018) framework for water resource management have been considered in the derivation of water quality objectives. This framework for water quality is being followed in stormwater, groundwater monitoring and reporting for the site. Additionally refer to the WRM SWMP. The existing groundwater and surface water flows systems have been considered as a key aspect of the development of the development mitigation measures to replicate conditions during and post development.

	Requirements for Groundwater Management Plan	Report Section	Additional Summary Comments to Report Section
c	*Replication of natural surface and groundwater flows and water quality*	Sections 8 and 9	Monitoring for the past 10 years on site has assisted with understanding of natural water quality, surface and groundwater flows, including from external catchments. Refer to WRM SWMP for surface flows, which we understand has shifted the proposed discharge point onto Lot 1001 further west onto developed land away from the wetlands to the east for additional buffer protection. Similarly, groundwater at the downstream boundary of Lot 210 in existing drains from previous land uses of farming, will also be of controlled discharge further west for additional buffer. Refer to Sections 8 and 9 for further details.
d	*Protection of the environmental values of receiving waters, including the Hunter Estuary Wetlands Ramsar site*	Section 9.9	We understand the WRM SWMP has designed stormwater controls to guidelines for protection of receiving waters. The discharge onto Lot 1001 land area approved for development. It is understood that surface water discharge onto Lot 1001 has been considered appropriate as this location provides an additional buffer from flows to receiving waters to south (NPWS), the large available land area with existing incised drains to the Hunter River, current industrial zoning and Major Project Approval for industrial subdivision (MP10_0185).
e	*The principle of continuous improvement*	Section 9.1 and 9.10	The staging of development and monitoring program allows for adherence to the principle of continuous improvement.
a	*The water treatment management practices and management practice treatment trains that will be used to achieve or exceed environmental performance targets as detailed in the final Redlake Enterprises Pty Ltd – Tomago Road, Tomago – Environmental Assessment Report dated 12 March 2008 "Concept Engineering, Servicing, Earthworks and Stormwater Management" Appendix F.*	NA (refer SWMP)	This condition relates specifically to the WRM (2024) SWMP.
b	*How attainment of water quality objectives for these receiving waters will be supported by the action*	Section 9	The monitoring program includes provision for ongoing review and assessment of water quality data at specific stages and allows recommendations to improve the program and implement improvement actions.
c	*How monitoring activities will be undertaken to track environmental performance of the action; and*	Section 9	Monitoring of groundwater is described in Section 9 and will include ongoing review and assessment against long term data to track performance and include recommendations to improve the program and implement improvement actions to industry best practice standards.
d	*Groundwater and surface water monitoring must be undertaken pre, during and post development. This monitoring must continue until the Minister notifies that the construction and operation of this action is not impacting on the Hunter Estuary Wetlands Ramsar site.*	Section 9	Monitoring of groundwater is described in Section 9 and is in addition to the annual reporting completed for the past 10 years for this site.

3. Regulatory Setting

The legislation and guidelines that are considered most relevant to the environmental management for the Lot 210 / Stage 3 development are listed in Table 2.

Table 2: Environmental Legislation and Guidelines

Legislation / Guideline	Relevance / Applicability
Protection of the Environment Operations Act (1997) [POEO Act]	Key overarching legislation that enables the NSW Government to set out explicit policies for protection of the environment, including granting and administering Environmental Protection Licences (EPL).
Contaminated Land Management Act 1997 (as amended 2009) [CLM Act]	NSW Legislation for management of contaminated sites.
DECC Guidelines for the Assessment and Management of Groundwater (March 2007)	These guidelines are relevant for groundwater contamination in NSW. They stipulate the use of ANZECC groundwater investigation levels (GILs) for 95% protection of aquatic ecosystems.
National Environment Protection Council, National Environment Protection Measure 1999 (as amended 2013) [NEPM 2013]	The NEPMs outline *national* objectives for protecting or managing aspects of the environment. These may be a combination of goals, guidelines, standards, or protocols.
NSW EPA Guidelines for Consultants Reporting on Contaminated Land, 2020	These guidelines provide a reporting framework for consultant reporting on the management of contaminated land.
Water Management Act 2000	Framework for the sustainable and integrated management of the water sources of the state for the benefit of both present and future generations.
NSW Aquifer Interference Policy	Policy that covers requirements for obtaining water licences for aquifer interference activities.
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The Act and regulations provide guidance to protect and manage nationally and internationally 'matters of national environmental significance' including plants, animals, habitats and places.

4. Site Identification

This report pertains to industrial development of Lot 210 only, known as Stage 3 in MP07_0086 (“the site” as shown in red in Figure 1) and with relevant details summarised below.

Site Address	2 Westrac Drive, Tomago
Legal Description	Lot 210 D.P.1174939
Area	50.13 hectares
Zoning	Zone IN1 General Industrial
Local Council Area	Port Stephens Council
Current Use	Vacant
Existing monitoring locations	Established groundwater monitoring wells and surface water monitoring points are shown on Drawing 1 in Appendix C.

With regard to adjacent sites:

- Lot 212 (east/north-east):
  - Developed as Stage 1 of three proposed stages of industrial development;
  - Is leased/operated by Westrac as its NSW/ACT headquarters;
  - Owned by Industria Company No.2 (not connected to NEH);
- Lot 211 (east):
  - Approved as Stage 2 of three proposed stages of industrial development;
  - Development has not been progressed and remains undeveloped to date;
  - Part of Lot 211 is leased by Westrac;
  - Owned by Industria Company No.2 (not connected to NEH);
- Lot 1001 D.P.1127780 (south and west):
  - Stage 4 within the EPBC Approval boundary;
  - Undeveloped at this stage and not subject of this GWMngtP;
  - Owned by NEH.
- Lot 22 D.P.1150980 (south-east):
  - 22 ha conservation area dedicated by NEH as part of Stage 1 of MP07_0086;
  - Managed by NPWS.

The mapped location of the Hunter River Estuary Ramsar Wetlands relative to the site is shown in Figure 1. Hunter Water Corporation (HWC)'s groundwater pumping bore field is located north within the broader Tomago Sandbeds.

It is noted that surface water flows from Stage 3 primarily flow onto Lot 1001. Existing drains of the previous farming land uses conveyed surface water from the south-east corner of Stage 3 in an easterly direction, along the southern edge of Lot 22 toward the Ramsar Wetland area. However, the easterly drain connection is understood to be heavily congested, thickly vegetated and flows are observed to flow to the south onto Lot 1001. Lot 1001 has deeply incised drains toward the Hunter River. Owing to the congestion, it is understood that there remains a minor surface water connection with Lot 22. The interface of Lot 22 with Lot 210 is 320 m away from the wetlands. Lot 22 drains at low tide via the NPWS Floodgate into the North South Drain and then to the Hunter River, along the edge of the wetlands. Further discussion is provided in Section 6.2.2 below.

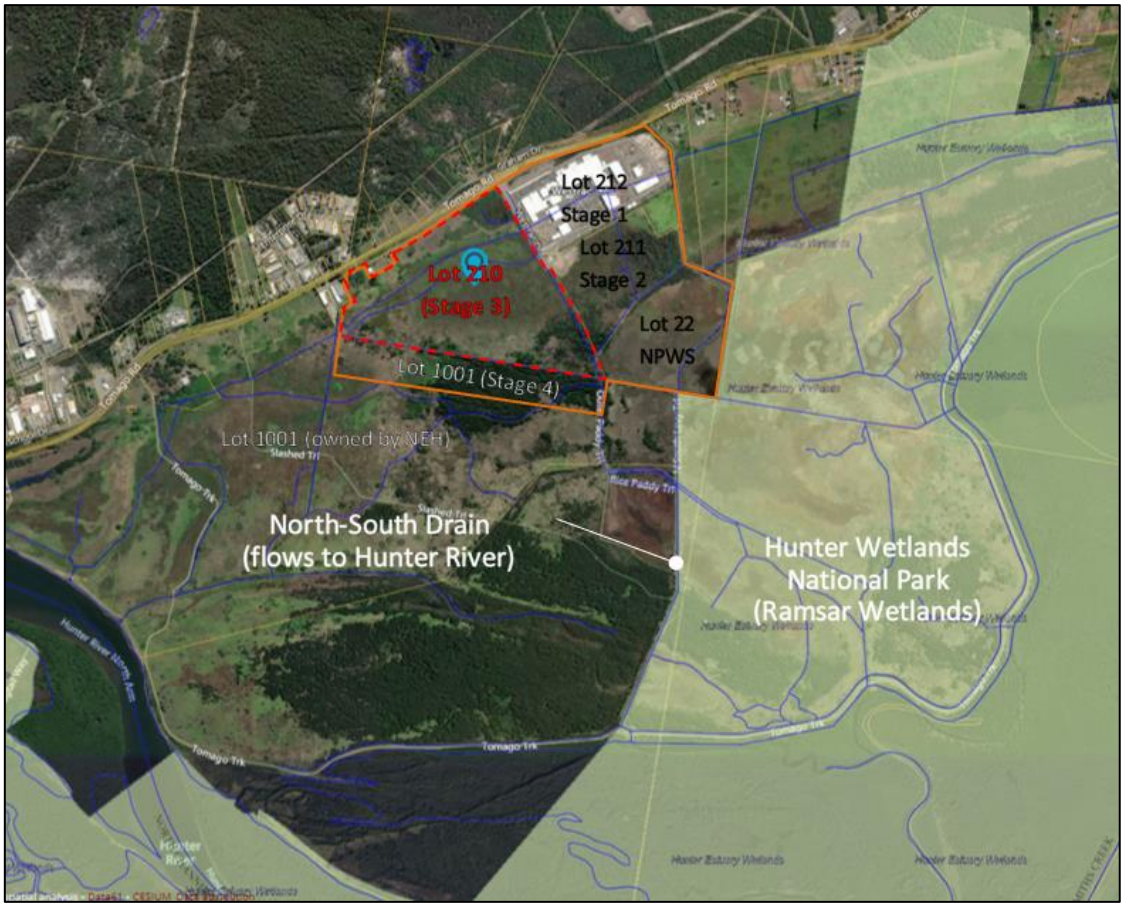


Figure 1: Lot 210 / Stage 3 boundary (red). EPCB Approval 2007/3343 (orange).

Figure 2: Approximate Lot 210/Stage 3 boundary shown in red. Westrac NSW/ACT Headquarters (Stage 1) in background (Image Adapted from Torque Projects)

5. Proposed Development

5.1 Overview

It is understood the development for Stage 3 will be staged and will comprise the following as shown on Figure 3:

- Bulk filling in the order of 2.5 m to 3 m above existing levels to reach flood planning levels/minimum floor levels. The finished levels of the lots will range from RL 3.5 to 4.0 AHD;
- Development of industrial lots and associated access roads, drainage reserves and water management ponds and drainage swales to be constructed above existing site levels;
- Water management ponds will be staged and include temporary basins as required with progression of bulk filling (located above existing ground levels);
- Excavation into natural soil is therefore likely to be minimal and for excavation of deeper service trenches only.

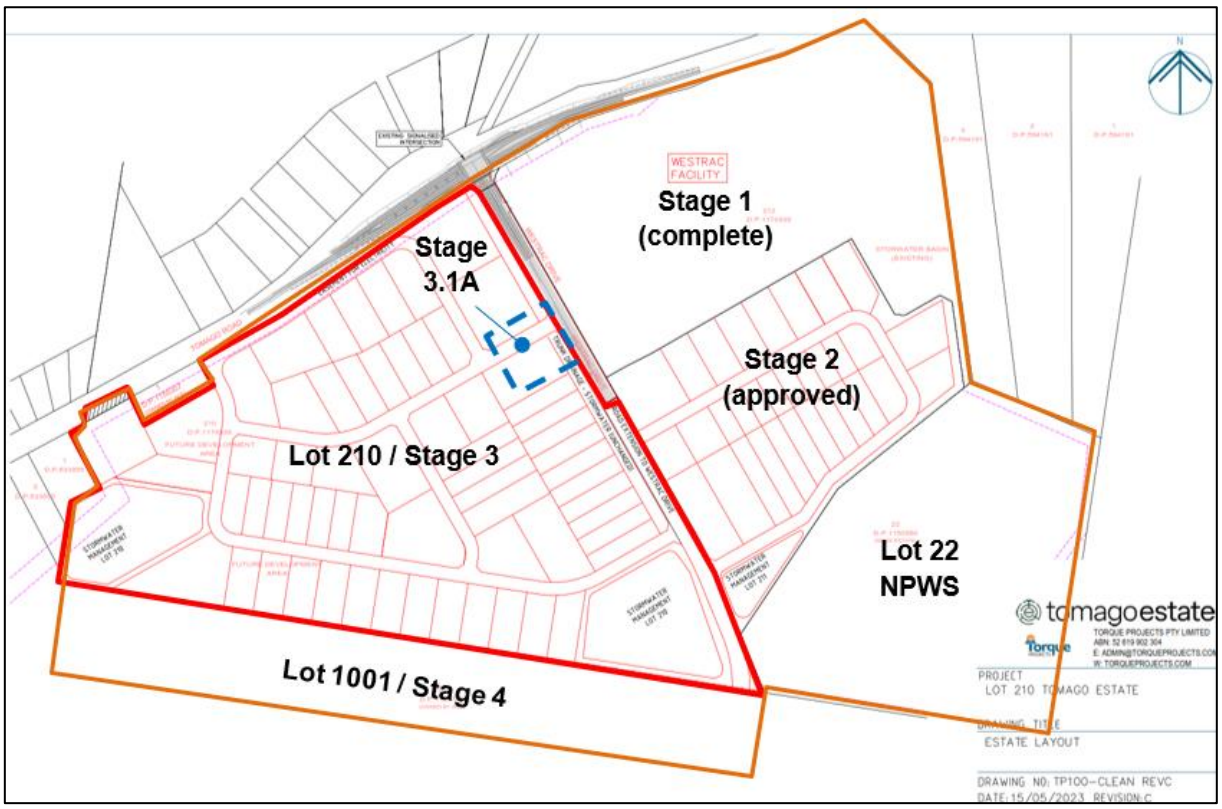


Figure 3: Proposed development layout. Lot 210/Stage 3 (red); Stage 3.1A (blue), EPBC Approval 2007/3343 (orange) (Adapted from Torque Projects, 2023)

It is understood that NSW DPE approval has been granted for partial filling of an area of about 1.2 hectares as “Stage 3.1A”, located midway down the eastern side of Lot 210 and adjoining Westrac Drive as shown in Figure 3.

Surface water management ponds and drainage features are proposed for the management of stormwater / surface water run off as discussed in Section 5.2.

It is noted that Stage 2 of the development, located east and outside the Stage 3 area, has been approved, however, there are no plans for commencement of site works (likely to occur following completion of Stage 3 work).

5.2 Stormwater Quality and Quantity Management Measures

As detailed in the SWMP, the proposed stormwater management measures have been designed to collect site-based surface water runoff as well as surface water drainage flows inflows from upstream areas of the catchment at Tomago Road. The surface water drainage configuration is shown in Figure 4 based on WRM Figure 4.1 from the SWMP (WRM, 2024) and includes the following:

- Two combined wetland and detention basins (Basins 1 and 2) to collect runoff and mitigate the total peak discharges which leave the site in a westerly direction onto the adjacent Lot 1001 (owned by NEH) and following further retention, ultimately drain toward the Hunter River (i.e. generally as per existing conditions). Basins 1 and 2 will be constructed above ground with minimal excavation with the basin invert being the existing natural surface;
- Three grassed open channels for collection of surface water and/or diversion to Basins 1 and 2;
- Incoming drainage flows via the Tomago Road culvert to the north-east would collect on the site via Channel 1 for integration with stormwater management system (maintaining cross drainage beneath Tomago Road);
- The existing 0.6 m diameter pipe at the northeastern corner of the site (which conveys runoff from Tomago Road) would discharge into the proposed Channel 1;
- Water quality management measures developed commensurate with water sensitive urban design principles include the following:
    - Unlined basins constructed above current ground levels with planted wetland macrophytes for water treatment;
    - Gross pollutant traps (GPTs) at roadside stormwater inlet pits;
    - Trash rack primary treatment filtration systems at the inlets to Basins 1 and 2;
    - Rainwater tanks.
- Interim storage basins will be constructed to meet the same design objectives and principles of the overall SWMP as construction stages progress.

Figure 4: Proposed Stormwater Measures for the overall Stage 3 Development (Excerpt of Figure 4.1 from SWMP (WRM, 2024))

The SWMP (WRM, 2024) notes the following:

- Groundwater flows upgradient of the site are not considered to contribute significant surface water runoff draining towards the Stage 3 development. Potential inflows from groundwater daylighting as surface water have been accounted for in surface water catchment design (up to a maximum rate of 140 ML/year).
- External / upslope surface water flows for immediate runoff during storm events towards the catchment have been limited to the paved intersection of Tomago Road and Westrac Drive, consistent with observations as detailed in the SWMP.

5.3 Stages and Timing

It is understood that importation of fill for site raising will be staged as required to achieve suitable geotechnical ground improvements. NEH wants to proceed with bulk earthworks on the initial stage approval area following completion of this plan with DCCEEW. The staging timeline will be market driven; however, an indicative staging plan is provided in Table 3.

Table 3: Stage 3 Works Staging

Stage and Description	Estimated Commencement of Stage	Estimated Completion of Stage
Stage 3.1A - Bulk earthworks / filling for the Stage 3.1 area (~1.2 ha), including preloading and interim/final surface water storage basins.	January 2024	May 2024
Stage 3.1 – bulk earthworks/filling for Stage 3.1 (~5.5 ha), including preload and interim/final water storage basins	March 2024	August 2024
Remaining Stage 3 development – Progressive bulk filling, including preloading and progressive construction of interim and permanent surface water storage basins, industrial lot completion and final development. Staging is expected to follow on as adjacent filling / development from Stage 3.1A, likely to be in an anticlockwise direction over Lot 210 along the northern boundary and then southward before returning east.	Subject to market demand (to be confirmed)	Subject to market demand (to be confirmed)

6. Environmental Setting

6.1 Overview

Site Topography	The majority of the site comprises generally flat water-logged terrain with typical elevations between RL 0.5 and 2.0 AHD. The northern part of the site adjacent to Tomago Road is elevated above this level, dominated by low sand dune formation with a maximum elevation of RL 4 AHD.
Site vegetation	Site vegetation includes dense reeds / scrubland, with reeds up to 3 m in height, mostly located in areas of water-logged terrain. Some mature trees are located on the site, mostly in the northern elevated parts.
Geology (Figure 5)	Reference to the 1:250,000 Newcastle Geology map indicates that the site is underlain by Quaternary alluvium, which typically comprises gravel, sand, silt and clay. The underlying bedrock comprises siltstone and sandstone of the Permian aged Tomago Coal Measures. Reference to the NSW Seamless Geology mapping indicates four mapped zones: • QP-bd: Coastal deposits of marine-deposited and aeolian-reworked coastal sand dunes; partially consolidated. • QP_brs: Coastal deposits comprising fine to medium-grained quartz-lithic-carbonate (marine-deposited) sand, organic-rich mud, peat. • QH-es: estuarine swamp comprising organic-rich mud, peat, clay, silt, very fine to fine-grained sand (marine-deposited), fine- to medium-grained sand (fluvially deposited). • QH_er: Estuarine shoreline ridge and dune deposits comprising fine- to medium-grained lithic-quartz sand (fluvially deposited), very fine- to fine-grained lithic-carbonate-quartz sand (marine deposited), polymictic gravel, silt, clay, shell material.

Acid Sulfate Soils (ASS) (Figure 6)	ASS typically occur at levels of approximately RL 5 AHD or below, but typically at elevations less than 1 AHD in coastal environments. Most of the site lies within an area of high risk of ASS conditions, most likely to be present between 1 m to 3 m below the ground surface, corresponding to lower-lying areas. The northern portion of the site fronting Tomago Road and on higher ground lies within an area of low probability of ASS conditions, which if present is mostly likely greater than 3 m below the ground surface, corresponding to the Aeolian sandplain, elevation >4 m). Previous testing on the Stage 1 site (east) and site to the west indicated natural soils were potential ASS. DP (2023a) has prepared an acid sulfate soil management plan (ASSMP) for the Lot210 / Stage 3 development based on the previous testing with similar conditions expected for the subject site. The ASSMP noted that site based activities would predominantly comprise filling, with minimal disturbance of natural soils.
Aquifer	Two groundwater systems are present within the project area: • The aquifer within the Tomago Sandbeds which outcrop immediately north of the site and include an extensive water-extraction bore field operated by the HWC. The aquifer is unconfined north of Stage 3 area and semi-confined where clay soils overly the Tomago Sandbeds. As discussed below, groundwater flows away from the bore field and towards the Stage 3 site. • The aquitard within the Quaternary clay soils overlying the Tomago Sandbeds in most of the project area (Figure 5). The aquitard acts as a semi-confining layer.
Surface Water Bodies	The Hunter River (North Arm) is located to the south-west and south of the site, varying in distance from about 1.6 km to 2.4 km. Fullerton Cove is located about 2 km east-south-east of the site. The North South Drain is also distant from Lot 210 / Stage 3 in a separate catchment (i.e. surface water flows are not directed towards the Ramsar wetlands). The Stage 3 site includes a number of existing and manmade open channels (farm drains for previous land uses) and watercourses that direct flow in the low-lying areas. The approximate watercourse locations are shown on Figure 1 in Section 4. The existing open channels/drains to the south of the site (within Lot 1001) convey runoff from the southern development site boundary across Lot 1001 to the Hunter River North Arm. Vegetation in the existing drains can reduce surface water conveyance and lead to increased waterlogging across the site. Annual maintenance to reduce vegetation overgrowth would allow surface water to drain more freely. Further details on surface water flow paths are provided in the SWMP (WRM, 2024).
Ramsar Wetlands	The Hunter Wetlands National Park is located southeast of the Stage 3 site and makes up part of the Hunter Estuary Wetlands Ramsar site which extends to the Hunter River (north Arm) and Fullerton Cove as shown in Figure 1 in Section 4. At its closest point, the wetlands are about 320 m from the Lot 210 boundary (measured from the south-eastern corner of Lot 210). The wetlands are important for a number of species including migratory birds. Surface water (comprising both surface water runoff and groundwater emanating as surface water) from Stage 3 overflows primarily south onto Lot 1001 and distant from the Ramsar area and the North-South Drain.

Groundwater dependent ecosystems (GDEs)	Review of the Bureau of Meteorology GDE Atlas indicated no known or mapped GDEs on the Stage 3 (Lot 210) site. GDEs were mapped near the site as shown in Figure 7: • High probability of terrestrial GDEs south of the site and south-east of the site. Vegetation - Parramatta red gum/ Fern-leaved banksia/ Melaleuca sieberi swamp woodland. Ecological fieldwork mapping has this area to be Swamp Oak Forest; • High probability of terrestrial GDEs south of the fronting the Hunter River. Vegetation – salt marshes. Lot 1001, downstream of Lot 210, includes mapped GDEs. The majority of approved to be developed under EPBC Approval 2007/3343 and MP10_0185.

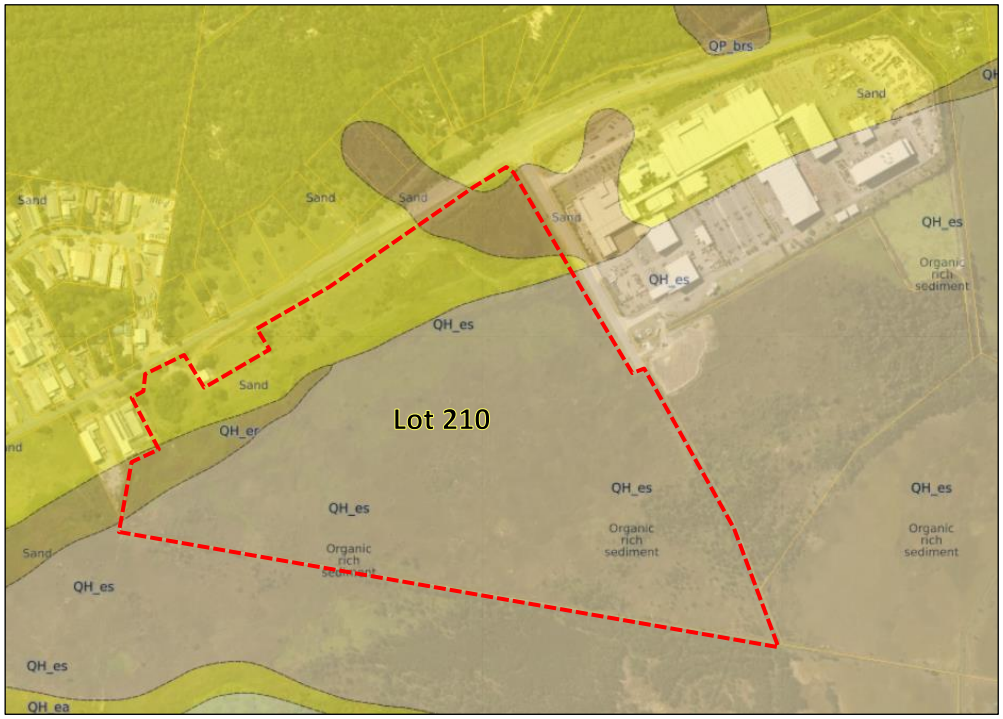


Figure 5: NSW Seamless Geology Map. Site boundary shown in red (Base Image source: MetroMap 2023)

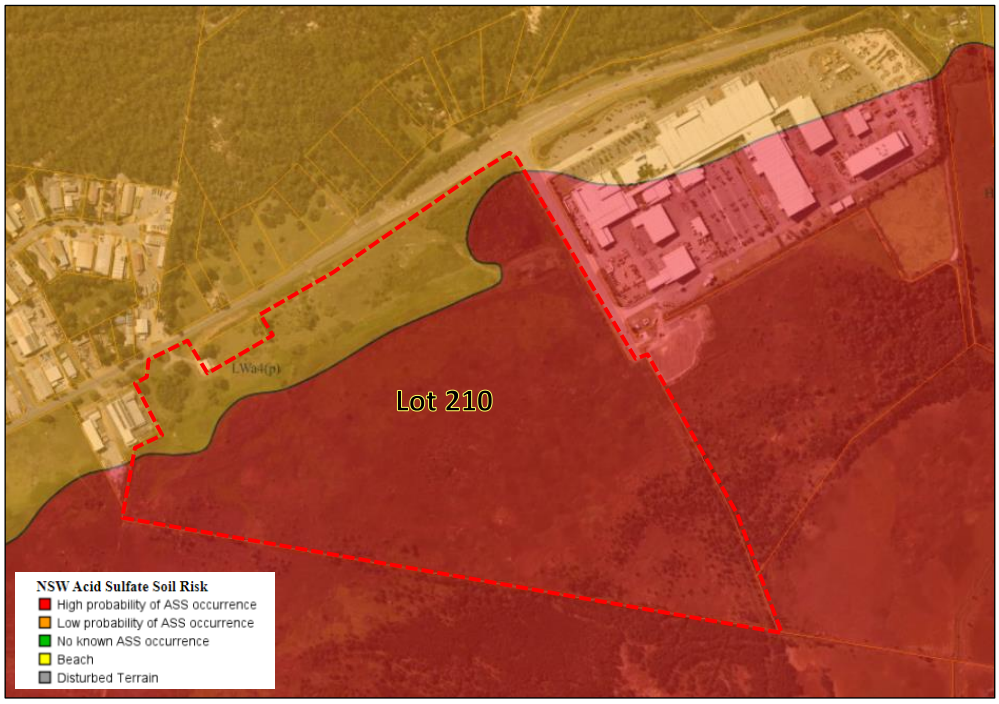


Figure 6: ASS Risk Map. Site boundary shown in red (Base Image source: MetroMap 2023)

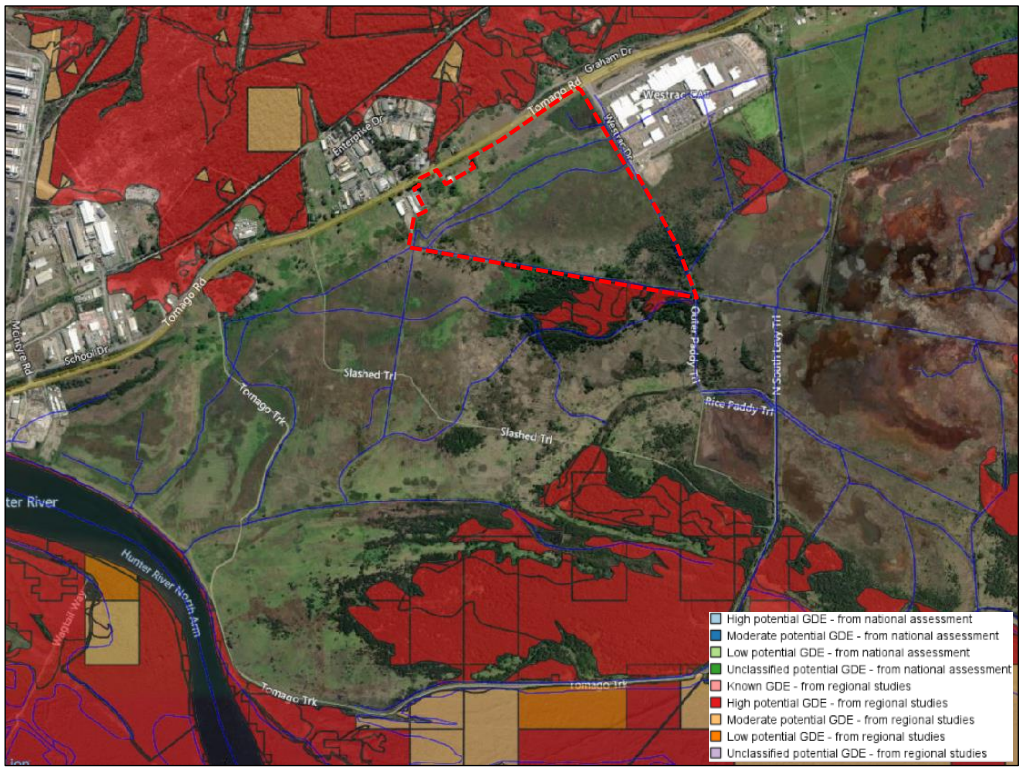


Figure 7: Mapped GDEs. Site boundary shown in red (Base Image source: MetroMap 2023)

The site hydrogeology and conceptual hydrogeological model is discussed in Section 7.

6.2 Previous Assessments

6.2.1 Stage 1 Reports for Submission

DP has previously prepared a *Groundwater Monitoring Plan* (DP, 2010a) for Stage 1 of the development which was established immediately east at Lot 212 D.P. 1174939. The GMP was prepared in consultation with the Department of Water and Energy (DWE), which is now known as the Department of Planning and Environment (DPE). The relevant reports regarding geotechnical / hydrogeological conditions for the site and surrounding areas for the Stage 1 GMP are summarised in Table 4.

Table 4: Relevant Reports for the Stage 3 Site and Surrounds

Date	Title	Author
Jul 1990	Prediction of Maximum Water Levels at Tomago Aluminium	Douglas Partners Pty Ltd
1983 - 2000	Annual Reviews of Mineral Sands Mining at Tomago	Douglas Partners Pty Ltd
Jul 2001	Preliminary Geotechnical Investigation Proposed Steel Mill and Port Development, Tomago, New South Wales, Australia	Earth & Rock Engineering Pty Ltd
Dec 2001	Stage 2 Geotechnical Investigation Proposed Steel Mill, Tomago, New South Wales, Australia	Earth & Rock Engineering Pty Ltd
Aug 2006	Proposed Industrial Development, 197 - 325 Tomago Road, Tomago, NSW, Preliminary Geotechnical / Due Diligence Assessment	Coffey Geosciences Pty Ltd
Nov 2007	Proposed Westrac Industrial Development - Tomago - Geotechnical Assessment	Coffey Geotechnics Pty Ltd
Jul 2008	Geotechnical Review, Proposed Westrac Facility, Tomago Road, Tomago	Douglas Partners Pty Ltd
Aug 2008	Proposed Industrial Development - Tomago Hydrogeological Investigation	Coffey Geotechnics Pty Ltd
Jul 2009	Major Project Assessment: Redlake Enterprises Industrial Estate	NSW Department of Planning
Aug 2012	Modelling Shallow Groundwater - Lot 1001 Tomago, For Proposed Northbank Enterprise Hub Business and Industrial Park	Environ (now Ramboll)

DP has not independently confirmed the accuracy or completeness of the above reports where prepared by others and has taken the information presented at face value.

Relevant information from DP (2010a), including previous advice from DWE, has been incorporated herein.

6.2.2 Long Term Monitoring

Monitoring has and continues to be undertaken as part of approvals for Stage 1 (developed) and Stages 2 to 3 (undeveloped) comprising baseline monitoring prior to development and longer term continued monitoring post construction as required under:

- Annual Environmental Management Report (AEMR) for the Major Project Approval 07_0086 (including Stages 1 to 3) to NSW DPE; and
- Annual Report under Condition 9 of the EPBC Approval 2007/3343.

Bore hole logs and a summary of monitoring wells is included in Table A1 in Appendix A.

The program and frequency of monitoring is detailed in the Stage 1 Groundwater Monitoring Plan (DP, 2010). With reference to the GMP, monitoring on and near the Stage 3 site has broadly been undertaken as follows:

- 2015 to May 2023 - annual monitoring by Ramboll (formerly Environ). Includes two surface water and two groundwater monitoring wells on the Stage 3 site;
- 2013 – Environmental & Safety Professionals;
- 2014 – ADW Johnson;
- 2010 to 2011 – Coffey Geotechnics and Enviropacific;
- September 2011 – Douglas Partners on Lot 1001, west of the subject Stage 3 site;
- 2007 - Coffey Geotechnics including Stage 1 to 3 site.

NPWS has also engaged monitoring from 2008 to 2011. Other routine monitoring is also undertaken by HWC for the Tomago Sandbeds and drinking water aquifer extending to the north of the site and Tomago Aluminium located north-west. HWC monitoring well SK3520 is located north-east and upgradient of Stage 1. HWC water quality data has not been provided to DP for review as part of this GWMngtP, however, routine monthly water level monitoring (provided as groundwater RL) was provided from April 1976 to April 2023.

Annual monitoring has been conducted, most recently by Ramboll, and has included groundwater and surface water monitoring at the locations in Figure 8 below. The monitoring program has been restricted on occasion, however, is currently accessible. It is noted that the recent monitoring program comprises water quality sampling in March-May annually, and therefore may not show seasonal variability that may be more apparent by a more frequent monitoring program.

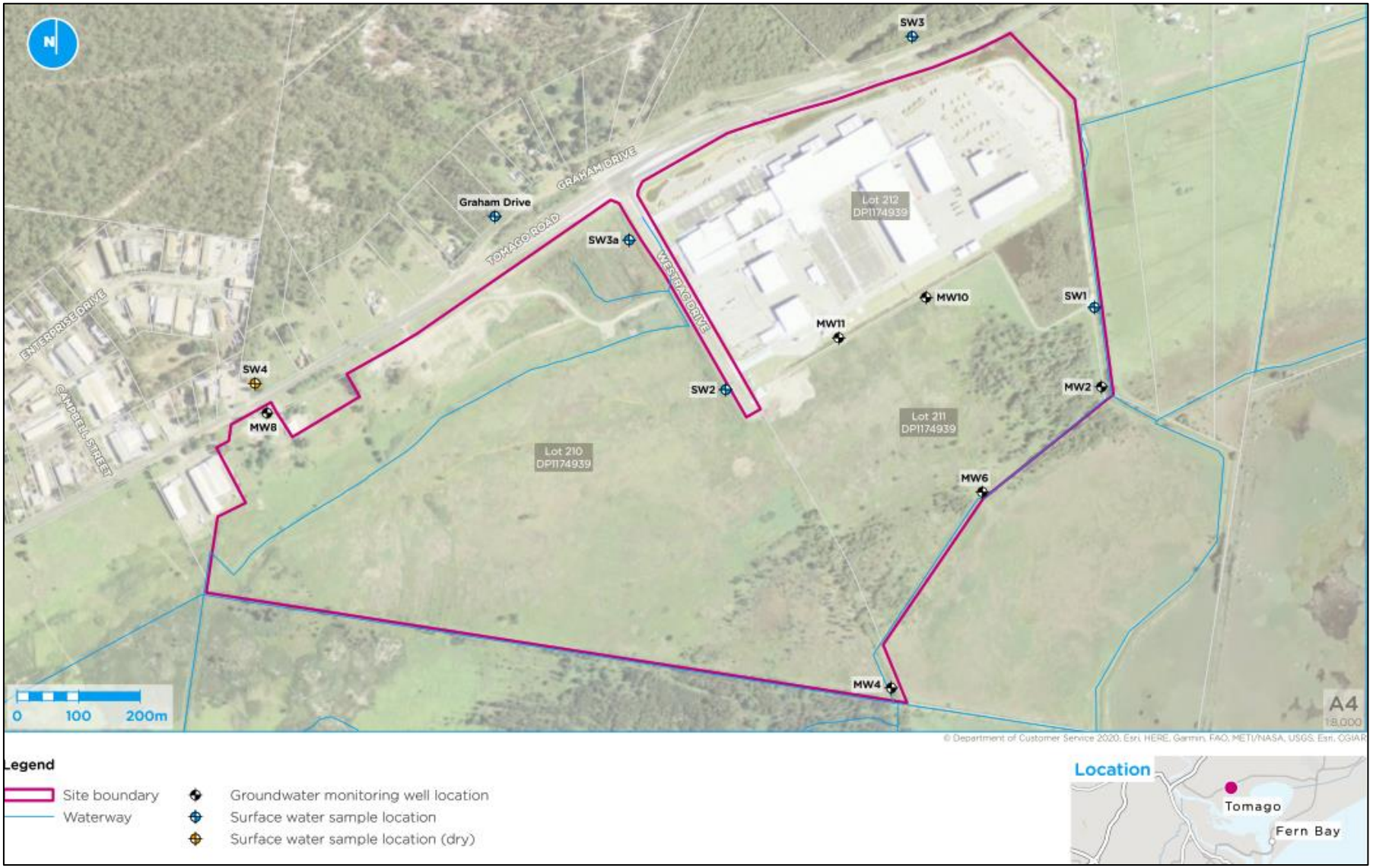


Figure 8: Groundwater and Surface Water Sampling Locations (Figure 1 of Ramboll (2022)).

Water quality has been assessed following each monitoring event with comparison against criteria relevant at the time of monitoring (i.e. guidelines have been periodically superseded or updated). Current monitoring assesses water quality against the following:

- NEPM (2013) Groundwater Investigation Levels (GILs) for 95% protection; and
- ANZG (2018) guidelines for freshwater guidelines for 95% protection;
- NHMRC Drinking Water guidelines for human health;
- ANZECC (2000) for the protection of 80-99% of species in fresh waters, with guideline values depending on the health of the receiving waters.

As per the Stage 1 GMP (DP, 2010), ongoing monitoring has included testing for physio-chemical field parameters and a range of potential contaminants and water quality indicators. Key information on water quality from Ramboll (2022) is summarised below:

Table 5: Summary of Comments in 2022 Annual Monitoring Report (Ramboll, 2022)

Item	Ramboll (2022) Interpretation / Comments:
Physio-chemical parameters (field testing)	For surface water: • *Slightly acidic pH at all surface water samples except for SW2 which reported neutral pH conditions. The lowest pH was recorded at upgradient location, SW3a on the corner of Tomago Road and Westrac Drive.* • *Aerobic conditions at all surface water samples ranging from 0.17-3.90 mg/L, (dissolved oxygen).* • *Fresh water conditions at all surface water samples with electrical conductivity ranging from 155-228 µS/cm.* • *Oxidising conditions were reported at both up-gradient locations (SW3 and SW3a) and reducing conditions were reported at both down-gradient locations (SW1 and SW2).* For groundwater: • *Neutral pH conditions at down-gradient wells MW2 and MW6.* • *Acidic pH conditions at downgradient wells MW10 and MW11.* • *Slightly aerobic conditions in all groundwater wells, ranging from 0.27-0.61 mg/L (dissolved oxygen).* • *Brackish conditions at down-gradient wells MW2 and MW6.* • *Fresh water conditions at downgradient wells MW10 and MW11.* • *Reducing conditions at all groundwater wells.* • *High turbidity was reported at MW2 and MW10.*
Chemical laboratory testing	• *Low pH levels were reported in the groundwater samples, MW10, MW11, which is consistent with the 2021 sampling round, and background surface water sample SW3a.* • *Concentrations of total phosphorous, total arsenic, chromium, copper, lead, manganese, zinc and iron were reported for one or more surface water samples above the ecological and/or human health criteria. The results are consistent with the 2021 round.* • *Concentrations of sulphate, chloride, ammonia, total phosphorous, dissolved chromium, manganese, zinc and iron were reported for two or more groundwater samples above the ecological and/or human health criteria; however results were consistent with results from the 2021 sampling round.*

Item	Ramboll (2022) Interpretation / Comments:
Chemical laboratory testing (continued)	• *Several LORs were above the ecological and/or human health criteria for mercury, OCP/OPP/PCBs, phenols and PAHs.* • *Detectable concentrations of TRH (C_{10} – C_{40}) compounds were reported for SW2. In previous rounds TRH with Silica Gel Cleanup has been undertaken to obtain a better representation of the 'petroleum hydrocarbons' in the sample and the results have consistently indicated levels of non-petroleum hydrocarbon interferences.* • *All remaining samples reported concentrations of BTEXN, PAH, OCP/OPP, PCB and phenols below the limits of reporting.* • *All other analytes were below the ecological and human health criteria at the groundwater wells.* • *The elevated concentrations above the ecological and human health criteria are not of concern as they likely represent the natural existing conditions in the low-lying swampy marshland of the site and results were consistent with results from the 2021 sampling round.* • *Concentrations found in surface water and groundwater are generally consistent with the previous sampling rounds.*

It is understood that the most recent annual report, including water quality results for EPBC Approval 2007/3343 was provided to DCCEEW on 16 May 2023.

Available groundwater level data from earlier groundwater studies by DP, annual monitoring by Ramboll and others and HWC SK3520 bore data has been plotted in Figure 9 below for 2010 to 2023.

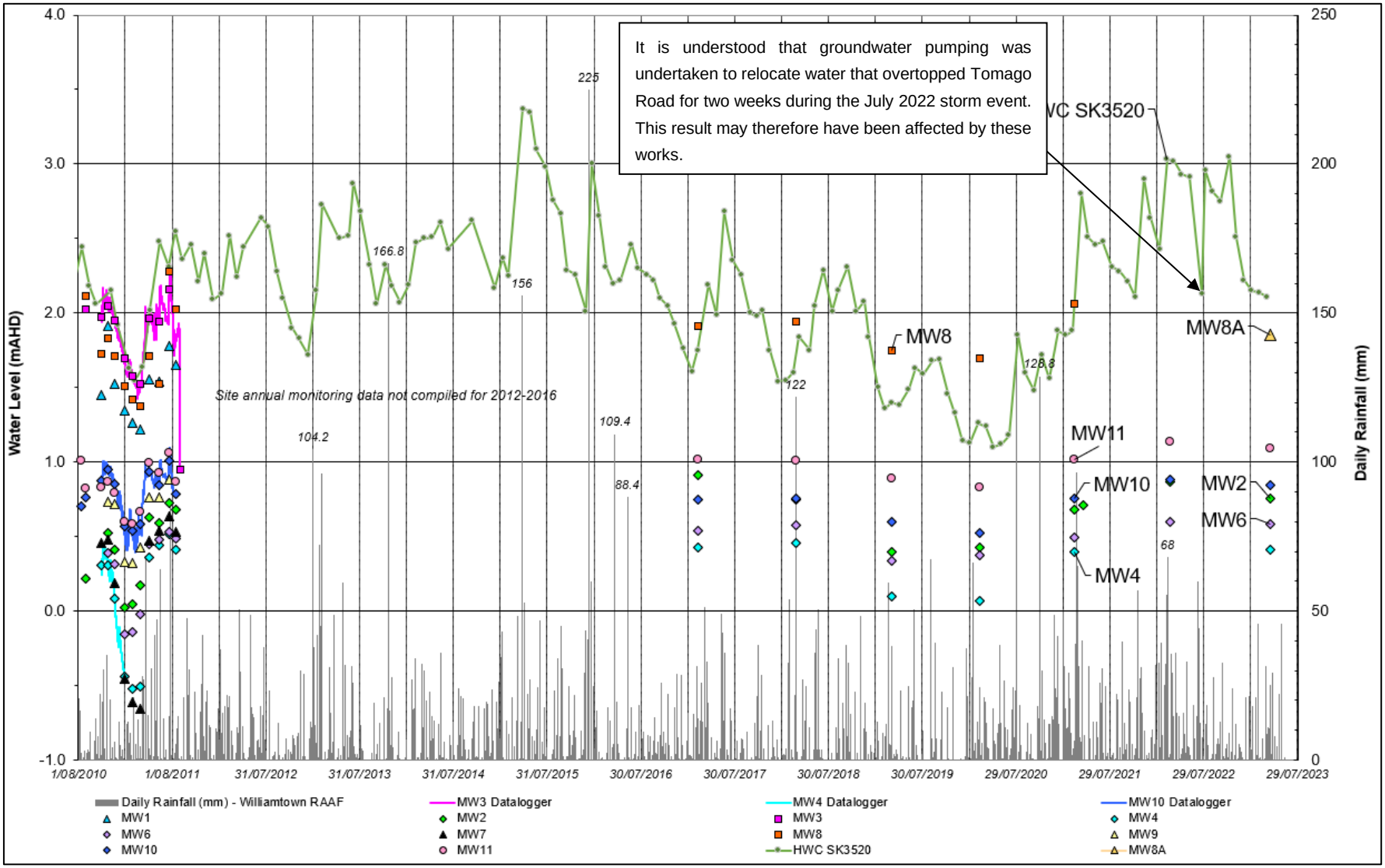


Figure 9: Groundwater wells in monitoring wells 2010-2023. Monitoring well locations shown on Drawing 1 in Appendix C.

The following comments are provided regarding water levels data in the Tomago Sandbeds shown in Figure 9:

- Groundwater levels at the upgradient bore SK3520 in the Tomago Sandbeds have remained above levels recorded for the northern most wells, with the exception of MW8 on a number of occasions. Levels correlate with groundwater flows from the Tomago Sandbeds southward toward the Hunter River;
- Upgradient wells in sand have shown the most variability. Wells at the downgradient boundaries have shown a lesser amount of variability owing to the overlying clay acting as a confining layer in this area and to the groundwater daylighting into surface drains, noting that monitoring from 2017 has only been undertaken annually and may not capture seasonal or short term water level trends.

It is noted that the Figure 9 includes data provided by others which has been corrected to estimated RL.

It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will vary with time. Similarly, groundwater quality will be subject to variability and these influences.

6.3 Water Quality Trends and Statistical Assessment

Available groundwater quality data have been reviewed to analyse baseline conditions and noticeable trends and to determine site-specific trigger levels (refer Section 9.9). The trigger levels were based on the historical data set and the first of the Baseline 2 monitoring event undertaken in September 2023. As noted in Section 9.9.2, the trigger levels will be updated following completion of the third Baseline 2 monitoring round (April 2024).

The monitoring borefield targets two different groundwater systems: the aquifer in the Tomago Sandbeds and the aquitard in the overlying clay soils, where present. Review of water quality data shows the two groundwater systems have different chemistry. For the purpose of the statistical analysis and trigger level determination, groundwater quality data were divided in two categories based on the profile screened by each well: sand and clay.

The 80th percentiles were assessed for each analyte to establish site-specific upper trigger levels, and the 20th percentiles were determined for analytes requiring a lower bound trigger level (i.e. pH which is expressed as an upper range by the 80th percentile and lower range by the 20th percentile). The UCL95-mean was also calculated to be used as a tool to indicate when monitored values are above average background levels.

Graphs presenting historical groundwater quality results for the main parameters and analytes of interest are presented in Appendix D.

DP also notes that low groundwater pH is common for the area regionally, including the adjacent Lot 1001 to the west and other sites extending to Heatherbrae and Williamtown. Low pH could be attributed to a number of reasons which have not been confirmed by the current studies, but could possibly include: former sand mining within the broader Tomago Sandbeds (upgradient); podzol soils in coastal dunes; and acid sulfate soils.

7. Conceptual Hydrogeological Model

7.1 Topography and Geology

Key features of the site include:

- The southern part of the site comprises flat water-logged terrain with a typical surface elevation of 0.5 to 1.0 AHD, with existing drains cut in lower than natural surface levels;
- The soil profile comprises alluvial / estuarine sediments (deposited under water), with some aeolian (wind-blown) sand deposits;
- The northern part of the site is dominated by a low sand dune formation with a maximum elevation of RL 4.0 AHD. This is generally underlain by estuarine sand deposits to depth;
- On the central and southern parts of the site the upper soil profile consists of very soft to stiff silty clay, clay and sandy clay soils, overlying very loose to medium dense clayey estuarine sand. These are subsequently underlain by dense sand and stiff to hard clay strata. The depth to bedrock has not been established, but exceeds 18 m.

7.2 Hydrogeology

The site is underlain by estuarine sands at depth associated with the Tomago Sandbeds. On the northern parts of the site, these are overlain by aeolian sands and on the southern parts of the site the sand is overlain with estuarine swamp deposits primarily clay (low permeability) soils.

Monitoring to date has typically encountered groundwater at depths ranging from above ground surface in lower lying areas to slightly below ground level for the unconfined aquifer (refer Figure 9 above).

Review of groundwater levels from Ramboll (2022) March 2022 monitoring indicated levels ranged from 0.6 to 1.1 AHD as shown in Figure 8. Groundwater levels in the range of 0 to 2.5 AHD are generally considered to be typical or average conditions based on previous datalogger monitoring by DP in 2011.

Groundwater flow on the site is to the south and south-east, with the main recharge coming from the Sandbeds to the north as evidenced by HWC monitoring bore SK3520 as well as surface infiltration on the site. Rainfall infiltration is expected to be limited on the southern lower lying parts of the site. This is partly due to the low permeability of the soil and partly due to the low-lying nature of the ground resulting in groundwater levels close to the surface and thereby inhibiting infiltration. As a result, groundwater is predominantly evident in the existing surface drains at the southern downstream boundary of the site. Evapotranspiration rates on the southern parts of the site are expected to be relatively high due the shallowness of the groundwater.

The observed limited variability of the groundwater level on the central and southern parts of the site is due to the low elevation of the natural ground surface which provides an upper limiting groundwater level for the shallow groundwater. Therefore, the groundwater level is kept lower than would occur for the same recharge conditions if a higher ground surface were present, for example across the northern parts of the site. The low natural surface and existing drains cut below natural levels limit the fluctuations which have been observed on the higher northern parts of the site from occurring on the low-lying parts downstream of the site.

Groundwater flow is expected to be split vertically by the presence of the estuarine swamp deposits, with some flowing up over the swamp deposits and discharging as seepage from the toe of the aeolian sands on the northern parts of the site. It is expected that the seepage discharge to surface flows will be subject to a combination of flow into surface drains, reinfiltration to groundwater within the swamp deposits and evapotranspiration, the relative proportions of which will vary depend on prevailing climatic conditions.

Shallow groundwater flows at the site are altered by the presence of the existing surface watercourses and drains excavated under previous land uses. These drains previously removed ponded surface water efficiently including near surface groundwater from the site draining the water in multiple directions including to the east and south-west towards the adjacent Lot 1001 and eventually discharge to the Hunter River.

A proportion of groundwater flows towards the south and south-east will occur within the estuarine sands below the swamp deposits and discharge downstream of the site, to various surface water bodies including most to the Hunter River and possibly Fullerton Cove. The estuarine sands below the site form a confined aquifer with limited interaction with the shallow groundwater conditions on most of the site. Previous investigations by DP at downstream sites indicated groundwater heads in the confined aquifer are typically lower and indicate flows towards the Hunter River.

It is noted that the downstream landscape of the wetlands has been altered by the introduction of tidal inundation via the North South Drain which is deeply incised below wetland ground levels.

Groundwater quality monitoring for the area has indicated dissolved metals that exceed ANZG (2018) ecological criteria which is not uncommon for groundwater quality in the Tomago locality (refer Section 6.2.2). Ammonia concentrations routinely exceed ANZG (2018) criteria at several locations. A high level trend analysis for the available data has been undertaken (Section 6.3), which suggests no obvious impacts to groundwater from the Stage 1 development.

8. Potential Development Impacts

The management of groundwater at the site is highly dependent on the surface water management measures. To replicate natural conditions during and post development (as practicably as possible), integrated management groundwater and surface water strategies is therefore required and this will be refined as future detailed studies for design progress.

The proposed development has the potential to change the groundwater flow regime as follows:

- As typically anticipated with any development site, the distribution of recharge on the site will change, with recharge on impervious surface being transferred to drainage swales and basins, more concentrated infiltration will occur in these locations, the amount of which will depend on the permeability of the fill utilised for the bulk filling;
- Evaporative losses from the shallow groundwater will be less due to the impedance of the filling and impervious surfaces;
- Groundwater inflows into below water table excavations could result in drawdown in the intersected groundwater systems;

- Raising of the surface by filling allows the potential for groundwater levels to mound within the filling to higher levels than were previously possible;
- Placement of the filling without any assessment or design has the potential to impede groundwater seepage flows from the dune sands onto the flood plain which could lead to backing up of water upstream and possibly higher average groundwater levels in the Tomago Sandbeds upstream of the site;
- Flow in the deeper estuarine aquifer is not expected to be affected materially by the proposed development;
- If there were no controls, potential contamination of groundwater/surface water from site filling and activities during and post development.

A key element to replicating the natural groundwater conditions on the site is replicating the key role of the shallow ground surface in controlling the current groundwater flow regime. The drainage offered by the current ground surface is proposed to be replicated by installation of appropriately designed subsoil drainage within the fill platform at a level close to the existing ground level and/or the existing groundwater level. The subsurface drainage would be routed to the downstream toe of the fill and into the downstream surface water drains. The subsurface drainage would mitigate mounding within the fill and address potential damming of upstream flows from the Tomago Sand Beds. Similarly, lowering of groundwater water levels would be unlikely due to ongoing infiltration of water from the swales and basins and the removal of evaporative losses from the water table, which would have previously been a large component of the mass balance of the system. There may be some excess water from the overall site mass balance resulting in increased average flow in the surface drains downstream of the site. The proposed discharge point is to be approximately 700 m further west along the Lot 210 southern boundary onto Lot 1001 (owned by NEH). This approach was proposed by NEH and its consultants during the NSW state government consultation process with National Parks & Wildlife Service to be distant from the adjoining wetlands.

The identified potential effects of the development on groundwater and proposed management measures for the Stage 3 development are summarised in Table 6 with reference to the risk rating tables following. Reference should be made to the SWMP for surface water specific comments and surface water related risk evaluation.

Table 6: Summary of Identified Potential Effects on Groundwater and Risk Evaluation (refer accompanying tables)

Potential effects	Description	Initial Risk Assessment			Groundwater Management Measures	Residual Risk Assessment*			DP Comments on Considerations for Surface Water Management Measures
		Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating	
Groundwater mounding	Groundwater mounding from bulk filling which allows the water to rise above the existing surface, as well as preloading of soils which has the potential to 'squeeze' water from clay soils. Mounding is likely to be temporary / short term with effects reduced by staging of filling and placement of granular / well-draining soils. Some mounding may also occur near the surface water wetlands/basins following more typical rainfall and the potential for this should be considered as part of detailed design and for sizing of the wetland and infiltration basins.	Likely	Minor	Low	• Bulk earthworks geotechnical assessment, design and reporting for filling activities; • Provision of drainage blanket and subsoils drains within the near the existing ground surface and discharging into downstream surface drainage. • Monitoring of groundwater levels during preloading for possible mounding effects; • Staging and selection of bulk fill for geotechnical / information properties; • Detailed design of management measures for groundwater and surface water, including drainage blanket and subsoil drains; • Routine maintenance of subsurface drainage system (where implemented).	Unlikely	Minor	Low	• Routing of subsoil drainage outflows to downstream surface drainage. • Design of subsoil drainage to account for potential infiltration from swales and basins.
Changes to downgradient groundwater	Changes to downgradient groundwater level, and to a lesser extent, flow directions due to construction of impervious surfaces and redistribution of runoff from the stormwater management system on site.	Likely	Moderate	Medium	• Monitoring of groundwater levels and flow prior to development for increased accuracy of groundwater flow directions; • Monitoring of groundwater levels during preloading for possible mounding effects; • Installation of mitigation measures such as subsoil drains / diversion trenches (if required) to ameliorate effects and maintain pre development conditions (subject to detailed design). • Routine maintenance of subsurface drainage system (where implemented).	Possible	Minor	Low	• Appropriate sizing of surface water wetlands/basins and design of drainage paths to capture/release flows to replicate natural surface and groundwater flows and water quality; • Implementation of WSUD principles for management of volumes and quality. • Discharge of drained groundwater into drains downstream of site, flowing to Hunter River.
Increase of the groundwater table levels on the site and for upgradient sites including HWC borefield	The site is located downgradient of HWC extraction bores within the Tomago Sandbeds and therefore infiltration at the development site would not flow towards the HWC bore field. Bulk filling and preloading of soils for Stage 3 may reduce the ability for groundwater from upgradient sites (including HWC borefield) to permeate through the site and increase groundwater levels upgradient.	Likely	Minor	Low	• Bulk earthworks geotechnical assessment, design and reporting for filling activities; • Installation of mitigation measures such as subsoil drains / diversion trenches (if required) to ameliorate effects and maintain pre-development conditions (subject to detailed design). • Monitoring of groundwater levels and flow prior to development to confirm groundwater flow directions, levels and inform range of levels. • Routine maintenance of subsurface drainage system (where implemented).	Possible	Minor	Low	• Appropriate sizing of surface water wetlands/basins and design of drainage paths to capture/release flows to replicate natural surface and groundwater flows and water quality.
Reduction of the groundwater table due to reduced infiltration	Lowering of water table leading to oxidation of ASS because of reduced infiltration into the site following completion of the development and increased hardstand areas. DP considers that this scenario is unlikely given that swales surface water basins will more likely allow for increased infiltration at targeted locations (and possibly localised mounding as above) and that groundwater evaporative losses from below the filling will be minimised	Unlikely	Minor	Low	• Monitoring of groundwater levels and flow prior to development to confirm groundwater flow directions within the Lot 210/Stage 3 site and continue observation monitoring of the groundwater at the downstream boundaries moving in existing drains; • Desing of surface water measures such as swales to allow infiltration to occur. • Design of subsoil drains to an invert level that replicates current groundwater levels. • Routine maintenance of subsurface drainage system (where implemented).	Unlikely	Minor	Low	• Appropriate sizing of surface water wetlands/basins to capture/release flows to replicate natural surface and groundwater flows and water quality; • Implementation of erosion and sediment control measures (ESC) during and following construction as required; • Design of sealed and vegetated areas and management measures. • Implementation of long-term environmental management measures for lot specific development.

Potential effects	Description	Initial Risk Assessment			Groundwater Management Measures	Residual Risk Assessment*			DP Comments on Considerations for Surface Water Management Measures
		Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating	
Leaching of contamination or suspended solids from filling	Leaching of contamination or suspended solids from filling.	Possible	Moderate	Medium	• DP considers that this scenario would be rare subject to the importation of suitable fill with low contaminant levels such as excavated natural material (ENM) and/or virgin excavated natural material (VENM) and implementation of environmental management strategies during construction. • Soils should be demonstrated as “fit for purpose” from a geotechnical and environmental perspective; • Implementation of development specific environmental measures and controls for each site post-development (e.g. bunding, leak detection devices, environmental management procedures and incident responses). • Collation of the existing ten years of water level and quality data to confirm the full baseline data set for future data assessment.	Unlikely	Moderate	Low	• Soils should be demonstrated as “fit for purpose” from a geotechnical and environmental perspective; • Implementation of environmental management strategies during construction including sediment and erosion control measures outlined in the SWMP (WRM, 2024).
Contamination of groundwater and surface water during or post development	Contamination from site activities and usage reaching the groundwater tables and/or surface water.	Possible	Moderate	Medium	• Design and implementation of the groundwater quality monitoring network (Section 9 of this GWMngtP); • Implementation of long-term environmental management measures for lot specific development (future development applications for each lot). • Collation of the existing ten years of water level and quality data to confirm the full baseline data set for future data assessment.	Unlikely	Moderate	Low	• Implementation of erosion and sediment control measures (ESC) during and following construction as required; • Design of sealed and vegetated areas and management measures. • Appropriate sizing of surface water wetlands/basins to capture/release flows, including GPTs and other tertiary controls for management of water quality.

* Residual risk rating is on the basis that the management measures are in place

Table 6A: Environmental Risk Likelihood (adapted from Department of the Environmental (2014))

Qualitative measure of likelihood (how likely is it that this event/issue will occur after control strategies have been put in place)	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances

Table 6B: Environmental Risk Consequence (adapted from Department of the Environmental (2014))

Qualitative measure of consequences (what will be the consequence/result if this issue does occur rating)	
Minor	Minor incident of environmental damage that can be reversed
Moderate	Isolated but substantial instances of environmental damage that could be reversed with intensive efforts
High	Substantial instances of environmental damage that could be reversed with intensive efforts
Major	Major loss of environmental amenity and real danger of continuing
Critical	Severe widespread loss of environmental amenity and irrecoverable environmental damage

Table 6C: Environmental Risk Rating (adapted from Department of the Environmental (2014))

		Consequence			
	Minor	**Moderate**	**High**	**Major**	**Critical**
Highly Likely	Medium	High	High	Severe	Severe
Likely	Low	Medium	High	High	Severe
Possible	Low	Medium	Medium	High	Severe
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	High

In summary, the potential risks and potential changes as a result of development are expected to be mitigated or controlled and limited to the Lot 210 / Stage 3 development site or limited to the future development land Lot 1001, also approved for industrial development. Impacts to the Ramsar Wetlands are inherently reduced as Stage 3 is situated in a separate surface water catchment distant from the North South Drain. The future surface water discharge point of Stage 3 is also proposed to be located a further 700 m west of the current overflow location onto Lot 1001 (further increasing the buffer distance from the wetlands to the east).

9. Groundwater Management Strategy

9.1 Continuous Improvement and Detailed Design

It is noted that the proposed development is at conceptual planning stages, and detailed design will be completed for each stage to achieve appropriate management strategies for groundwater, surface water and geotechnical considerations as outlined in Section 8.

In addition to the requirements for on-going monitoring to achieve continuous improvement and as detailed in this Groundwater Management Strategy, detailed design will include the following:

- Details of fill materials, drainage blanket, and sizing of subsoil drains and possibly diversion trenches for the respective stage area;
- Geotechnical review of bulk fill, subject to identification of source materials;
- Confirm groundwater level ranges at specific locations based on historical data for determination of design invert levels for inflow and outflow points;
- Groundwater modelling of scenarios to confirm impacts can be mitigated;
- Continuing site wide integration of monitoring results for groundwater, surface water and geotechnical considerations as staging progresses;
- Monitoring equipment improvements to provide greater resolution for observing the water level responses to rainfall via equipment/technology which relay 'live' water levels.

In summary, detailed design of controls will be undertaken for respective stages to mitigate impacts and implement management strategies.

9.2 Standards

The following standards have been identified for groundwater management strategy.

Table 7: Summary of Monitoring Network

Item	Reference Standard
Groundwater monitoring well installation	• *Minimum Construction Requirements for Water Bores in Australia* (NUDLC, 2020).
Groundwater level and quality monitoring procedures	• Monitoring sampling, testing and assessment of groundwater shall be undertaken by appropriately qualified hydrogeologists or environmental scientists. • NEPC. (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM].* Australian Government Publishing Services Canberra: National Environment Protection Council. • Australian/New Zealand Standard (AS/NZS) 5667.1:1998 Water quality: sampling part 1 – guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples; • AS/NZS 5667.4 Water quality: sampling guidance on sampling from lakes, natural and manmade; • AS/NZS 5667.6 Water quality: sampling guidance on sampling of rivers and streams; • AS/NZS 5667.11 Water quality: sampling guidance on sampling of groundwaters.
Laboratory testing	• Environment Protection Authority Approved methods for the sampling and analysis of water pollutants in NSW, 2022. • NATA accredited laboratory to test methods.
Review of groundwater quality, level and hydrogeological trends	• Appropriately qualified hydrogeologists or environmental scientists.

9.3 Groundwater Monitoring Network

The groundwater quality should be monitored using a network of nine wells, comprising two existing wells and six new wells specifically for Lot 210 / Stage 3 as shown on Drawing 1 in Appendix C. Well locations have been selected with consideration of upgradient, mid site and downgradient locations which would be suitable for long term monitoring (before and during construction). It is noted that access for personnel and machinery was notably limited by site vegetation and wet ground conditions at the downgradient locations.

Table 8: Summary of Monitoring Network

Well ID	New / Existing	Location within Site	Rationale
MW04	Existing	South-eastern corner Near southern boundary	Downgradient location Adjacent to future Basin 1
MW8A	New (replacement for MW8)	North-western corner Near northern boundary	Upgradient location Replacement / relocation of MW8 (damage and boundary adjustment)
MW101	New	North-western corner	Upgradient location
MW102	New	Central / northern part of the site	Downslope of elevated costal sand deposits
MW103	New	North-eastern corner	Accessible and suitable location for long term monitoring West and downgradient of proposed Stage 3.1 A fill area
MW104	New	Eastern portion	Mid site location Downgradient of proposed Stage 3.1 A fill area
MW105	New	Western corner	Accessible location on western part of site Downgradient of northern surface water flow path Near future western basin
MW106	New	Central / southern boundary	Downslope of future fill area and industrial lots Downslope / adjacent to surface water
MW107	New (to be installed)	Southern/ south-western boundary	Downslope of future fill area and industrial lots and western discharge area

The early installation of additional wells in Stage 3 and aim of upgradient locations is to further provide “background” water levels and quality with respect to groundwater flowing into the site. Similarly, downgradient locations provide water levels and quality for groundwater leaving the site. The wells near the initial Stage 3 fill area will allow for monitoring of groundwater responses and assist in detailed design of the remaining Stage 3 development.

The monitoring wells are screened to assess the upper water conditions in the unconfined aquifers.

The well locations are shown on the attached Drawing 1 in Appendix C. Well logs are included in Appendix A and should be read in conjunction with the preceding notes. A summary of the monitoring wells strata and installation depths is provided in Table A1, also in Appendix A.

9.4 Groundwater Quality Parameters

The parameters to be measured fall into three categories as shown in Table 9. The analytes comprise contaminants of concern based a typical suite of general water quality indicators and potential contaminants of concern considering future commercial/industrial use which has yet to be confirmed. The assessment criteria are shown on Table B1 and B2 in Appendix B.

Table 9: Groundwater Quality Parameters

Category 1 Parameters (Field parameters)	• Temperature (T) • pH • Electrical Conductivity (EC) • Dissolved oxygen • Oxidation-reduction potential (ORP) • Turbidity
Category 2 Parameters (Laboratory)	• Total Suspended Solids (TSS) • Cations: – Calcium (Ca) – Potassium (K) – Magnesium (Mg) – Sodium (Na) – Iron (Fe) – • Anions: – Chloride (Cl) – Sulphate (SO4) – Ammonia (NH3) – Bicarbonate (HCO3) – Carbonate (CO3) – Total alkalinity – Nitrite (NO2) – Nitrate (NO3) – Total Kjeldahl Nitrogen (TKN) – Total Phosphorous (PO4) – Fluoride (F) • Heavy Metals: – Aluminium (Al) – Arsenic (As) – Cadmium (Cd) – Chromium (Cr) – Copper (Cu) – Iron (Fe) – Lead (Pb) – Manganese (Mn) – Mercury (Hg) – Molybdenum (Mo) – Nickel (Ni) – Zinc (Zn)
Category 3 Parameters (Laboratory)	• Total recoverable hydrocarbons (TRH) • Polycyclic aromatic hydrocarbons (PAH) • Benzene, toluene, ethyl benzene, xylene (BTEX) • Polychlorinated biphenyl (PCB) • Phenols • Organochlorine pesticides (OCP) / organophosphorus pesticides (OPP) • Per- and polyfluoroalkyl substances (PFAS)

9.5 Sampling and Testing Protocols

The sampling should be undertaken in accordance with standard industry practice, including:

- Purging of at least three bore volumes or until T, pH, EC, DO, ORP and turbidity readings are steady;
- Filtering and preservation of samples;
- Chain of custody documentation;
- Duplicate samples on at least 10% of samples or one per monitoring event;
- Reporting (NSW EPA, 2020).

Laboratory testing should be undertaken at a NATA-accredited chemical laboratory and Practical Quantification Limits (PQLs) should be no greater than half of the relevant criteria for each parameter.

9.6 Baseline Monitoring (Prior to Construction of Stage 3)

Monitoring water quality for Stage 1 and the broader area of Lot 210 has been undertaken since 2010, therefore, groundwater quality has in part been established relevant to Lot 210/Stage 3. Stage 3.1A is already approved by NSW DPE and NPWS, is located well within site boundaries and of small scale and therefore can be compared to baseline monitoring data.

Prior to commencement of further filling of Stage 3, beyond Stage 3.1A, a baseline monitoring program will be undertaken comprising:

- Quarterly groundwater quality sampling, including Category 1, 2 and 3 parameters (Table 9); and
- Continuous groundwater level monitoring at hourly intervals using dataloggers in at least five of the monitoring wells and manual level measurements taken at the time of the water quality sampling events in every well.

The three Baseline 2 monitoring events have been undertaken in September 2023, January 2024 and April 2024).

9.7 Post Baseline Monitoring (During and After Stage 3 Construction)

Following baseline monitoring (i.e. during and after construction of Stage 3), monitoring will continue on a 6 monthly basis. The exact number of wells and suite of analytes that need monitoring will be reviewed based on the outcome of the baseline monitoring program. Some initial advice is provided below.

Monitoring wells should be retained for as long as possible to assess for potential impacts, especially wells MW102 to MW104 which are located downgradient of initial fill areas. Monitoring wells in the northern and central areas of the site will be adjusted if required as staging of the development progresses. Reinstallation or replacement well at suitable long term monitoring locations will be at the advice of the environmental/hydrogeological consultant. Monitoring wells will be replaced as soon as practicable and within three months.

For example, post-baseline monitoring for Stage 3 could comprise the following:

- Monitoring of wells MW04, MW8A and MW101 to MW106 for as long as possible. Key / minimum monitoring wells to be retained long term are MW04, MW106, MW8-A and MW101;
- The monitoring well coverage will generally maintain upstream and downstream locations for development staging. The interval and frequency of well installations will be confirmed by an environmental/hydrogeological consultant as staging progresses;
- Water quality sampling for the following parameters:
    - Category 1 and 2 Parameters on a 6 monthly basis during and after construction;
    - Category 3 Parameters on a 12 monthly basis;
- Groundwater level gauging on a 3 monthly basis if not subject to automated datalogger monitoring.

9.8 Monitoring Summary

The groundwater monitoring program is summarised in Table 10 with the nominated monitoring wells shown on Drawing 1 in Appendix C.

Table 10: Summary of Monitoring Program

Parameters	Baseline monitoring (Baseline 2) (Note 1)	During Stage 3 Construction
Wells to be Monitored	MW04, MW8A and MW101 to MW107 (all Stage 3 wells)	TBC (Note 2)
Water Levels	Continuous (dataloggers) 3 monthly (manual) (Note 3)	Continuous (dataloggers) 3 monthly (manual)
Category 1 and 2 Parameters	3 Monthly, min of 3 rounds	6 Monthly
Category 3 Parameters	3 Monthly, min of 3 rounds	12 Monthly
Reporting	On completion	12 Monthly
Monitoring Program Review	On Completion	3 Yearly

Notes to Table 10:
1. Baseline 1 was conducted as part of Stage 1 development and GMP (2009)
2. Exact wells that will be monitoring during and after construction will be determined based on the outcome of the baseline monitoring program. As a Minimum, we recommend monitoring of MW04, MW106, MW107, MW8A and MW101 be continued in addition to new wells installed for the project (if required).
3. Hourly water level monitoring by datalogger in wells MW04, MW8A and MW101 to MW106, 3 monthly manual measurements in all wells.

The three Baseline 2 monitoring events were undertaken in September 2023, January 2024 and April 2024.

9.9 Assessment Criteria

9.9.1 Groundwater Levels

Groundwater levels will fluctuate with variations in climatic conditions and therefore comparison will need to be made with the background fluctuations as well as with climatic conditions. The ongoing results of monitoring should be reviewed on an annual basis for variations in groundwater levels which are inconsistent with rainfall trends (measured at Williamtown Meteorological Station) and/or outside the range of measured background fluctuations.

Groundwater level data should be used in detailed design of the earthworks, surface water and drainage measures as outlined in Sections 8 and 9.

9.9.2 Groundwater Quality

The ANZG (2018) guidelines recommend the use of site baseline data and relevant default guideline values (DGVs) to derive site-specific trigger levels particularly where background concentrations naturally exceed DGVs. In this approach*, the natural range of values for key indicators at reference sites is used to provide a suitable baseline for comparison against values derived from similar aquatic ecosystems'* (ANZG, 2023). It is noted that adoption of site specific data, where lower than the DGV, would be an overconservative approach and not reflect the level of protection required.

Trigger levels do not guarantee a level of protection, rather, are defined as the concentration recorded by monitoring which would trigger further investigation to assess the potential for adverse impact on groundwater quality from a site. Periodic exceedances of the groundwater quality Trigger Levels can be expected to occur, particularly where values are based on the 20th/80th percentile calculations from the baseline data.

It is proposed that different criteria be used for monitoring bores screened in the Tomago Sandbeds aquifer and those in the overlying clay soils given the difference in water chemistry and beneficial uses of the two groundwater systems.

Typically, the guidelines (ANZG 2018) recommend the 80th percentile of the available baseline data be used as criterion for each analyte. For stressors that cause problems at low levels, it is recommended that the lower criterion be the 20th percentile of the baseline data (i.e. pH which is expressed as an upper range by the 80th percentile and lower range by the 20th percentile to provide a trigger level range, commensurate with the generic ANZG pH criteria).

Statistical analysis of groundwater quality data was undertaken on available site monitoring data to determine the 80th percentile for each analyte to establish site specific upper trigger levels, and the 20th percentiles for analytes requiring lower trigger levels (Section 6.3).

The methodology used to select preliminary trigger levels in each groundwater system is described below. Proposed criteria for each analyte are provided in Table B1 and B2 in Appendix B.

The statistical analysis and associated trigger levels will be reviewed and refined:

- At the end of the Stage 3 baseline monitoring program in April 2024 (Section 9.6); and
- Regularly thereafter as additional water quality data become available.

It should be noted that the site specific trigger levels for groundwater are not applicable to surface water quality. However, the applicable values for surface water are the ANZG (2018) 95% Freshwater protection criteria which are indicated in Tables B1 and B2 as 'Note A'.

9.9.2.1 Tomago Sandbeds Trigger Levels

Potential GDEs (GDE Atlas) in the Tomago Sandbeds are present upstream of the site. Risks of impacts from the project to these GDEs are currently considered to be low given their upstream location. However, the 95% freshwater species protection DGVs (ANZECC & ARMCANZ 2000) was considered to establish trigger criteria for bores in the Tomago Sandbeds aquifer. The Drinking Water Guidelines (NHMRC, 2021) have also been considered due to the proximity to drinking water supply bores in the Tomago Sandbeds aquifer. The guideline value for the most sensitive beneficial use should be adopted for each analyte (i.e. the lower of ANZECC & ARMCANZ 2000 and NHMRC, 2021).

It is recognised, however, that groundwater in the region can have background levels (e.g. dissolved metals attributed to historical mining activities) with concentrations higher than the guideline values. Analytes for which the background 80th percentile is higher than the guideline value for the most sensitive beneficial use have been assigned the 80th percentile background concentration as a trigger level. Otherwise, the guideline value for the most sensitive beneficial use has been adopted (i.e. the lower of ANZECC & ARMCANZ 2000 and NHMRC, 2021). Where no criteria or site based data exists, the trigger level has been adopted as the laboratory limit of reporting (LOR).

The trigger level and basis for derivation of the value is highlighted in Table B1 in Appendix B.

9.9.2.2 Clay Aquitard Trigger Levels

Due to the presence of the potential GDEs downgradient of the site, the 95% freshwater species protection DGVs (ANZECC & ARMCANZ 2000) have been considered to establish trigger criteria for bores in the clay aquitard. The adopted trigger levels for bores in the clay have been taken as the higher of the 80th percentile background concentrations and 95% freshwater species protection DGVs. Where no criteria or site based data exists, the trigger level has been adopted as the laboratory LOR.

The trigger level and basis for derivation of the value is highlighted in Table B2 in Appendix B.

9.10 Reporting Requirements

An annual report should be prepared which shall include the following:

- Time and date of sampling;
- Sampling methods, including well purging records;
- Sample Chain of Custody Documentation;
- Results of QA/QC protocols;
- Laboratory test methods and LOR;
- Tabulated results of current round of testing;
- Plot of results over time to allow assessment of trends;
- Groundwater levels plotted against rainfall records;
- Comparison with groundwater quality trigger levels and assessment of trends in groundwater levels noting any exceedances of criteria;
- Areas of recommended improvement or improvements to site practices such as to meet the object of continuous improvement and/or improve overall water quality targets.

9.11 Contingency Measures

9.11.1 Groundwater Levels

If a consistent trend in variations in groundwater level are recorded, then the potential implications of the long-term variation should assess. The management strategy will depend on the nature of the groundwater variation and its expected effects as outlined in Sections 8 and 9.

9.11.2 Groundwater Quality

It is considered that the UCL95-mean values could be used to indicate when monitored values are above average background levels, prompting review and closer scrutiny if levels are consistently above average. Exceedance of the adopted trigger levels would prompt further sampling and testing. This procedure is summarised in Table 11.

Table 11: Actions Prompted by Monitoring Results

Event	Action
Consecutive results exceed UCL_{95}-mean value	Review trend in parameter(s) concerned and note in monitoring report.
Result exceeds trigger level	Review the significance of the exceedance against the adopted guideline value. Undertake additional round of sampling as soon as practical and analysis for parameter(s) concerned. Temporarily increase monitoring frequency until results have returned to below the trigger levels
Three consecutive results exceed the trigger level	Notify the following government agencies within 7 days: • NSW DPE. Investigate possibility of a contaminant plume or adverse changes to the groundwater quality/flow regime and if necessary implement appropriate actions to mitigate contamination.

9.12 Trigger Action Response Plan

A Trigger Action Response Plan (TARP) has been developed by Torque Projects to define the minimum set of corrective actions required in response to unpredicted impacts.

The TARP is included in Appendix E. The TARP defines different levels of impacts defined from 1 to 5. Level 1 applies to normal conditions (i.e. no noticeable impacts). Levels 2 to 5 refer to abnormal conditions with various degrees of impacts rated based on increased risk.

The TARP should be reviewed and updated at the end of the baseline monitoring period, following detailed design stages or as required.

9.13 Groundwater Management Strategy and Plan Review

A review of the GWMngtP including the groundwater monitoring program should be undertaken as follows:

- If there are additional monitoring requirements as a result of detailed design;
- Following completion of significant project work stages;
- Following significant environmental incidents;
- When improvements to performance have been recommended by the consultant in annual reports or as directed by the environmental authority;
- Every 3 years by a suitably qualified groundwater consultant to:

- Review land uses and potential contamination sources (given the development is staged and future use is unknown);
- Analyse trends in groundwater levels and quality;
- Assess effectiveness of existing monitoring program;
- Review trigger levels as additional baseline data are collected;
- Recommend any changes to provide an efficient and effective monitoring program.

Parameters which have been established to be of minimal concern from the results of monitoring may be dropped from the program and others may be added if warranted from changes to site use.

10. Conclusions

It is considered that implementation of this Groundwater Management Plan for Stage 3 at Lot 210, which includes provisions for detailed design, identification of appropriate mitigation measures, monitoring, review and continuous improvement, can achieve the objectives of minimising potential groundwater and surface water impacts on Lot 210, and other adjacent properties including the Hunter River Estuary Ramsar Wetlands.

11. References

Ahern, C. R., McElnea, A. E., & Sullivan, L. A. (2004). *Acid Sulfate Soils Laboratory Methods Guidelines. In Queensland Acid Sulfate Soils Manual 2004.* (QASSIT) Indooroopilly, Queensland, Australia: Department of Natural Resources, Mines and Energy.

ANZECC. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australia and New Zealand Environment and Conservation Council.

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

ANZG. (2023). *Using monitoring data to derive and assess against guideline values*. Retrieved from Australian and New Zealand Guidelines for Fresh & Marine Water Quality: https://www.waterquality.gov.au/anz-guidelines/monitoring/data-analysis/derivation-assessment

Brereton and Taylor-Wood. (2010). *Ecological Character Description of the Kooragang Component of the Hunter Estuary Wetlands Ramsar Site. Report to the Department of Sustainability, Environment,Water, Population and Communities (SEWPAC), Canberra.* Brereton, R., and Taylor-Wood, E.,.

Coffey. (2007). *Preliminary Acid Sulfate Soils Assessment, Proposed WesTrac Industrial Development, Tomago Road, Tomago.* Document No. Ref GEOTSGTE20301AA-AF, 25 June 2007.: Coffey Geotechnics.

Dear, S., Ahern, C., O'Brien, L., Dobos, S., McElnea, A., Moore, N., & Watling, K. (2014). *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines.* Brisbane: Department of Science: Department of Science, Information, Technology, Innovation and the Arts, Queensland Government.

Department of the Environment. (2014). *Environmental Management Plan Guidelines.* Department of Environment, Commonwealth of Australia.

DP. (2010a). *Groundwater Monitoring Plan, Proposed Industrial Subdivision, Tomago Road, Tomago.* Document No. 39920.02-GMP Rev1: Douglas Partners Pty Ltd.

DP. (2010b). *Acid Sulphate Soil Management Plan, Proposed Industrial Subdivision, Tomago Road, Tomago.* Document No. 39920.02-ASSMP Rev1. : Douglas Partners Pty Ltd. [Superseded by DP (2023a)].

DP. (2023a). *Acid Sulfate Soil Management Plan, Proposed Industrial Subdivision, Stage 3, Lot 210 D.P.1174939, 2 Westrac Drive, Tomago.* Document No. 39920.09.R.002.Rev1: Douglas Partners Pty Ltd.

DP. (2023b). *Report on Geotechnical Investigation, Stage 3.1 Northbank Enterprise Hub, WesTrac Drive, Tomago.* Doc 39920.11.R.001.Rev0: Douglas Partners Pty Ltd.

HEPA. (2020). *PFAS National Environmental Management Plan (NEMP).* Version 2.0: Heads of EPAs Australia and New Zealand and Australian Government Department of the Environment.

NEPC. (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM].* Australian Government Publishing Services Canberra: National Environment Protection Council.

NHMRC. (2021). *Australian Drinking Water Guidelines 6 2011, Version 3.6.* Canberra: National Health and Medical Research Council, National Resource Management Ministerial Council.

NSW EPA. (2020). *Guidelines for Consultants Reporting on Contaminated Land.* Contaminated Land Guidelines: NSW Environment Protection Authority.

NUDLC. (2020). *Minimum Construction Requirements for Water Bores in Australia.* 4th Edition: National Uniform Drillers Licensing Committee.

Ramboll. (2022). *2022 GROUNDWATER AND SURFACE WATER MONITORING 318001414 .* Document No. 318001414, Final Report, Version 1 : Ramboll.

Stone, Y., Ahern, C. R., & Blunden, B. (1998). *Acid Sulfate Soil Manual.* Acid Sulfate Soil Management Committee (ASSMAC).

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018). *National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Sampling and Identification Methods Manual.* Canberra ACT CC BY 4.0: Department of Agriculture and Water Resources.

Torque. (2022). *Annual Report EPBC/2007/3343, Reporting Period: 1 May 2021 – 30 April 2022.* Project No. TP100 Version A: Torque Projects.

WRM. (2024). *Industrial Estate at Lot 210 DP1174939 (Stage 3), Tomago, Stormwater Management Plan.* Document No 1918-02-B7: WRM Water & Environment Pty Ltd (WRM).

12. Limitations

Douglas Partners (DP) has prepared this report for this project at Lot 210 D.P.1174939, 2 Westrac Drive, Tomago with reference to DP's proposal 39920.09.P.001.Rev1 dated 31 October 2022 and acceptance received from Northbank Enterprise Hub Pty Ltd. The work was carried out under agreed terms between Douglas Partners Pty Ltd and Northbank Enterprise Hub Pty Ltd (Contract 20230206 ACE-LEG-005A executed 23 February 2023). This report is provided for the exclusive use of Northbank Enterprise Hub

Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.
The results provided in the report are indicative of the sub-surface conditions at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out, as reported by DP and others. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences.

DP's advice is based upon the conditions encountered during previous investigations as reported by others. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the environmental / groundwater components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About This Report

Sampling Methods

Soil Descriptions

Symbols and Abbreviations

Borehole logs (Bores MW6 to MW11, MW8A, MW101 to MW106) – Douglas Partners

Borehole logs (Bores MW1 to MW5) – Coffey

Table A1: Monitoring Well Summary

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

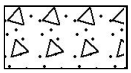
Symbols & Abbreviations

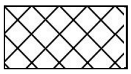
Graphic Symbols for Soil and Rock

General

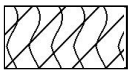

Asphalt

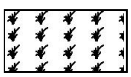

Road base

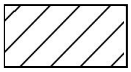

Concrete

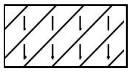

Filling

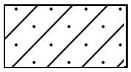
Soils


Topsoil

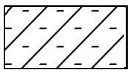

Peat

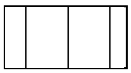

Clay

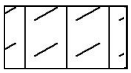

Silty clay

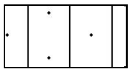

Sandy clay

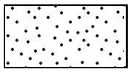

Gravelly clay

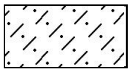

Shaly clay

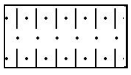

Silt


Clayey silt


Sandy silt

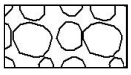

Sand

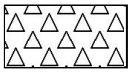

Clayey sand


Silty sand


Gravel

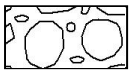

Sandy gravel


Cobbles, boulders

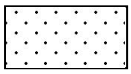

Talus

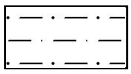
Sedimentary Rocks

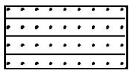

Boulder conglomerate

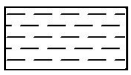

Conglomerate


Conglomeratic sandstone

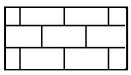

Sandstone


Siltstone

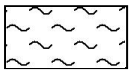

Laminite

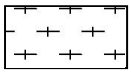

Mudstone, claystone, shale

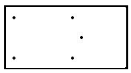

Coal


Limestone

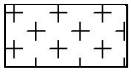
Metamorphic Rocks

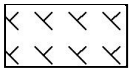

Slate, phyllite, schist

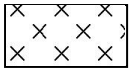

Gneiss

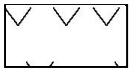

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: --
EASTING: 383518
NORTHING: 6367336
DIP/AZIMUTH: 90°/--

BORE No: MW6
PROJECT No: 39920.03
DATE: 7/10/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
									Stickup = 0.7m
	0.23	SILTY CLAY - Dark grey silty clay, M>Wp							From 0m to 0.5m, Concrete
		SILTY CLAY - Grey silty clay, M>>Wp							From 0.5m to 2m, Backfill
	6.0	SAND - Grey/brown fine to medium grained sand with some silt and clay, trace shell fragments, saturated							From 2m to 4.5m, Bentonite plug From 4.5m to 6m, 2.5mm washed gravel screen From 6m to 9m, Collapsed strata From 6m to 9m, 50mm diameter Class 18 machine slotted PVC screen
	9.0	Bore discontinued at 9.0m, limit of investigation							End cap

RIG: 4WD Truck Mounted Drill Rig **DRILLER:** **LOGGED:** Prowse **CASING:** Nil
TYPE OF BORING: 130mm hollow flight auger
WATER OBSERVATIONS: Free groundwater encountered at 0.3m whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
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BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: --
EASTING: 382801
NORTHING: 6366934
DIP/AZIMUTH: 90°/--

BORE No: MW7
PROJECT No: 39920.03
DATE: 26/10/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0	SILTY CLAY - Dark grey silty clay, M>Wp							Stickup = 0.85m From 0.0m to 0.2m, concrete From 0.0m to 0.6m, 50mm diameter Class 18 PVC blank From 0.2m to 0.5m, bentonite
	1	From 1.4m, trace sand and shell fragments							From 0.5m to 2.6m, 5/2mm gravel filter From 0.6m to 2.6m, 50mm diameter machine slotted Class 18 PVC screen End cap
	2	From 2.6m, collapsing							
	3	3.0 Bore discontinued at 3.0m, limit of investigation							
	4								
	5								
	6								
	7								
	8								
	9								

RIG: Hand Tools **DRILLER:** Parkinson **LOGGED:** Prowse **CASING:** Uncased
TYPE OF BORING: 75mm diameter Hand Auger
WATER OBSERVATIONS: Free groundwater observed at 1.2m during drilling
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▽	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: --
EASTING: 382353
NORTHING: 6367461
DIP/AZIMUTH: 90°/--

BORE No: MW8
PROJECT No: 39920.03
DATE: 4/8/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILLING - Brown fine to medium grained sand filling, with trace to some silt and abundant organics to 0.05m, moist							
	0.4	SAND - (Loose) light brown fine to medium grained sand, trace organics, moist		A	0.5				
		SAND (Loose) grey fine to medium grained sand, moist							From 0m to 1.8m, bentonite
	1	From 1.0m, loose		S	1.0		1,1,2 N = 3		
		From 1.3m, saturated			1.45				
	2								From 1.8m to 5.5m, gravel
		From 2.5m, brown, fine to coarse grained sand		S	2.5		1,2,4 N = 6		
	3				2.95				
	4	From 4.0m, medium dense		S	4.0		3,10,-		From 2.5m to 5.5m, machine slotted PVC screen
					4.3				
	5								End cap
				S	5.5		6,12,- (No Sample)		
	5.8	Bore discontinued at 5.8m, limit of investigation			5.8				
	6								
	7								
	8								
	9								

RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.3m during drilling

REMARKS: Class 18 piezometer PVC installed to 5.5m depth. Machine slotted from 2.5m to 5.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 0.78 AHD
EASTING: 383467
NORTHING: 6367675
DIP/AZIMUTH: 90°/--

BORE No: MW9
PROJECT No: 39920.03
DATE: 2-3/8/10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	TOPSOIL - Grey silty clay/clayey silt with abundant organics, saturated							From 0.0m to 4.6m, bentonite
		SILTY CLAY - (soft to firm), grey silty clay, M>Wp		A	1.0				
		From 2.5m, (soft) with some fine to medium grained sand		S	2.5 2.95		0,0,0 N = 0 (No Sample)		
	4.0	SAND - Very loose, grey fine to medium grained sand, with trace to some clay and with trace organics, saturated		S	4.05 4.5		1,0,0 N = 0		
	5.75	SAND - Medium dense, grey, fine to medium grained gravel sand, saturated		S	5.75 6.2		1,1,2 N = 3		From 4.6m to 8.3m, machine slotted screen
		From 7.1m, loose		S	7.1 7.55		4,7,10 N = 17		
		From 9.8m, medium dense		S	9.8		4,12,13		From 8.3m to 10.6m, PVC damaged

RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Free groundwater obscured due to drilling water added

REMARKS: Class 18 piezometer PVC installed to 8.3m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 0.78 AHD
EASTING: 383467
NORTHING: 6367675
DIP/AZIMUTH: 90°/--

BORE No: MW10
PROJECT No: 39920.03
DATE: 2-3/8/10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	TOPSOIL - Grey silty clay/clayey silt with abundant organics, saturated							From 0.0m to 4.6m, bentonite
		SILTY CLAY - (soft to firm), grey silty clay, M>Wp		A	1.0				
		From 2.5m, (soft) with some fine to medium grained sand		S	2.5 2.95		0,0,0 N = 0 (No Sample)		
	4.0	SAND - Very loose, grey fine to medium grained sand, with trace to some clay and with trace organics, saturated		S	4.05 4.5		1,0,0 N = 0		
	5.75	SAND - Medium dense, grey, fine to medium grained gravel sand, saturated		S	5.75 6.2		1,1,2 N = 3		From 4.6m to 8.3m, machine slotted screen
		From 7.1m, loose		S	7.1 7.55		4,7,10 N = 17		
		From 9.8m, medium dense		S	9.8		4,12,13		From 8.3m to 10.6m, PVC damaged

RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Free groundwater obscured due to drilling water added

REMARKS: Class 18 piezometer PVC installed to 8.3m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: MW
Date: 9/8/10

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BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 0.78 AHD
EASTING: 383467
NORTHING: 6367675
DIP/AZIMUTH: 90°/--

BORE No: MW10
PROJECT No: 39920.03
DATE: 2-3/8/10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
-10	11	SAND - Medium dense, grey, fine to medium grained gravel sand, saturated *(continued)*		S	10.25		N = 25		End cap
-11				S	11.6		3, 8, 5/75mm		
-12	12				11.98				
	13			S	13.1		3, 6/100mm		
	13.35	Bore discontinued at 13.35m, limit of investigation			13.35				
-13	14								
-14	15								
-15	16								
-16	17								
-17	18								
-18	19								
-19									

RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Free groundwater obscured due to drilling water added

REMARKS: Class 18 piezometer PVC installed to 8.3m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: AMJ
Date: 9/9/10

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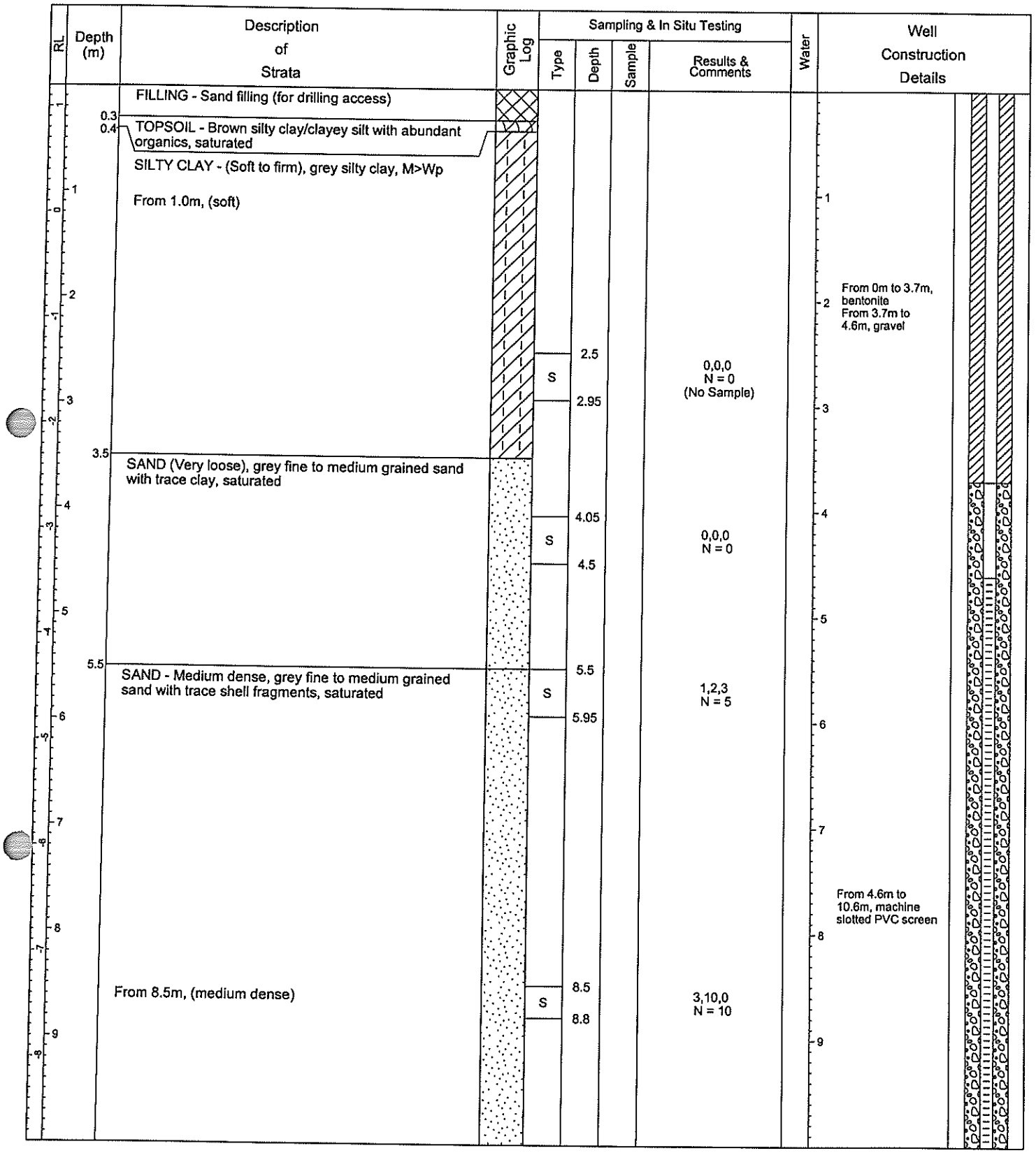
BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 1.2 AHD
EASTING: 383294
NORTHING: 6367675
DIP/AZIMUTH: 90°/--

BORE No: MW11
PROJECT No: 39920.03
DATE: 04 Aug 10
SHEET 1 OF 2



RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased

TYPE OF BORING: Hollow flight auger to 11.5m depth

WATER OBSERVATIONS: Free groundwater obscured due to drilling fluids

REMARKS: Class 18 piezometer PVC installed to 10.6m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo Ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: GRW
Date: 9/9/10

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BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 1.2 AHD
EASTING: 383294
NORTHING: 6367675
DIP/AZIMUTH: 90°/--

BORE No: MW11
PROJECT No: 39920.03
DATE: 04 Aug 10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
-9	11	SAND - Medium dense, grey fine to medium grained sand with trace shell fragments, saturated *(continued)*		S	11.5		6,17,0 N = 17		End cap
-10	11.8	Bore discontinued at 11.8m, limit of investigation			11.8				
-11	12								
-12	13								
-13	14								
-14	15								
-15	16								
-16	17								
-17	18								
-18	19								

RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased

TYPE OF BORING: Hollow flight auger to 11.5m depth

WATER OBSERVATIONS: Free groundwater obscured due to drilling fluids

REMARKS: Class 18 piezometer PVC installed to 10.6m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 9/9/10

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BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Stage 3 Northbank Enterprise Hub
LOCATION: Lot 210 Westrac Drive, Tomago

SURFACE LEVEL: 3.2 AHD
EASTING: 382656.6
NORTHING: 6367618.5
DIP/AZIMUTH: 90°/--

BORE No: MW101
PROJECT No: 39920.09
DATE: 12/4/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	SILTY SAND - fine to medium grained, dark brown, trace sub-angular to sub-rounded gravel, trace rootlets, moist		D	0.0 0.1				Stickup = 0.87 From 0m to 0.1m, concrete From 0.1m to 0.3m, bentonite From 0m to 0.5m, 50mm diameter Class 18 PVC Casing
		SAND - fine to medium grained, dark grey brown, moist		D	0.5				
		at 1.2m - light brown		D	1.5				
		at 2.75m - dark brown		D	2.5				
	3.2	SAND - fine to medium grained, dark brown, wet, (possibly indurated sand)		D	3.5				From 0.3m to 7.0m, 5/2mm graded gravel/sand From 0.5m to 7.0m, 50mm diameter Class 18 Machine Slotted PVC Screen
	4.35	SAND - fine to medium grained, brown, wet		D	4.5				
				D	5.5				
				D	6.5				
	7.0	Bore discontinued at 7.0m Limit of investigation							End cap

RIG: Geoprobe Dual Tube **DRILLER:** Tucker **LOGGED:** Krebs **CASING:** None

TYPE OF BORING: Push tube with disposable liners

WATER OBSERVATIONS: Free groundwater observed at 1.1m during drilling

REMARKS: Top of PVC casing level 4.09 AHD

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Stage 3 Northbank Enterprise Hub
LOCATION: Lot 210 Westrac Drive, Tomago

SURFACE LEVEL: 1.8 AHD
EASTING: 382677.6
NORTHING: 6367505.9
DIP/AZIMUTH: 90°/--

BORE No: MW102
PROJECT No: 39920.09
DATE: 11/4/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SANDY SILT - fine to medium grained, brown, trace rootlets, wet		D	0.0				Stickup = 0.76 From 0m to 0.15m, concrete From 0.15m to 0.3m, bentonite From 0m to 0.5m, 50mm diameter Class 18 PVC Casing
	0.3	SAND - fine to medium grained, brown, wet			0.2				
				D	0.6				
		at 0.8m - colour change to grey							
				D	1.5				
		at 1.95m - colour change to pale grey							From 0.3m to 4.0m, 2mm sand From 0.5m to 4.0m, 50mm diameter Class 18 Machine Slotted PVC Screen
				D	2.5				
				D	3.5				End cap
	4.0	Bore discontinued at 4.0m Limit of investigation							

RIG: Geoprobe Dual Tube **DRILLER:** Tucker **LOGGED:** Krebs **CASING:** None

TYPE OF BORING: Push tube with disposable liners

WATER OBSERVATIONS: Free groundwater observed at 0.2m during drilling

REMARKS: Top of PVC casing level 2.52 AHD

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Stage 3 Northbank Enterprise Hub
LOCATION: Lot 210 Westrac Drive, Tomago

SURFACE LEVEL: 2.3 AHD
EASTING: 382853.1
NORTHING: 6367613.9
DIP/AZIMUTH: 90°/--

BORE No: MW103
PROJECT No: 39920.09
DATE: 12/4/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	SILTY SAND - fine to medium grained, dark brown, trace sub-angular to sub-rounded gravel, trace rootlets, moist		D	0.0				Stickup = 0.97
	0.3	SAND - fine to medium grained, brown, moist			0.2				From 0m to 0.1m, concrete
		at 0.7m - colour change to grey		D	0.8				From 0.1m to 0.3m, bentonite
				D	1.5				From 0m to 0.5m, 50mm diameter Class 18 PVC Casing
		at 2.4m - colour change to pale brown		D	2.5				
		at 3.2m - dark brown		D	3.5				From 0.3m to 7.0m, 5/2mm graded gravel/sand
				D	4.5				From 0.5m to 7.0m, 50mm diameter Class 18 Machine Slotted PVC Screen
				D	5.5				
				D	6.5				
	7.0	Bore discontinued at 7.0m Limit of investigation							End cap

RIG: Geoprobe Dual Tube **DRILLER:** Tucker **LOGGED:** Krebs **CASING:** None

TYPE OF BORING: Push tube with disposable liners

WATER OBSERVATIONS: Free groundwater observed at 1.2m during drilling

REMARKS: Top of PVC casing level 3.31 AHD

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Stage 3 Northbank Enterprise Hub
LOCATION: Lot 210 Westrac Drive, Tomago

SURFACE LEVEL: 0.7 AHD
EASTING: 383147.6
NORTHING: 6367292
DIP/AZIMUTH: 90°/--

BORE No: MW104
PROJECT No: 39920.09
DATE: 17/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
0	0.0	SILTY CLAY (CH) - High plasticity, dark brown to brown with rootlets, W>PL		D	0.0				Stickup = 0.48m From 0m to 0.1m, concrete
	0.1				0.1				From 0.1m to 0.3m, bentonite From 0m to 0.5m, 50mm Class 18 blank PVC
				D	0.5				
	0.6	SILTY CLAY (CH) - High plasticity, grey, W=PL		D	0.7				
		From 0.9m, grey mottled brown							From 0.3m to 1.5m, 2mm sand
1				D	1.0				From 0.5m to 1.5m, 50mm diameter Class 18 machine slotted PVC screen
				D	1.4				End cap
	1.5	Bore discontinued at 1.5m Limit of investigation							
-1									
2									
-2									

RIG: Hand Tools **DRILLER:** Lambert/Krebs **LOGGED:** Lambert/Krebs **CASING:** None

TYPE OF BORING: 90mm diameter hand auger 0m to 1.5m

WATER OBSERVATIONS: Free groundwater observed at ground level during drilling

REMARKS: Top of PVC casing level 1.16 AHD

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Stage 3 Northbank Enterprise Hub
LOCATION: Lot 210 Westrac Drive, Tomago

SURFACE LEVEL: 1.5 AHD
EASTING: 382360.3
NORTHING: 6367294.4
DIP/AZIMUTH: 90°/--

BORE No: MW105
PROJECT No: 39920.09
DATE: 11/4/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	SANDY SILT - fine to medium grained, dark brown, with rootlets, wet		D	0.0 0.1				Stickup = 0.55 From 0m to 0.1m, concrete From 0.1m to 0.3m, bentonite From 0m to 0.5m, 50mm diameter Class 18 PVC Casing
		SAND - fine to medium grained, brown, wet		D	0.5				
		at 1.4m - colour change to grey		D	1.5				
				D	2.5				
		at 3.0m - colour change to brown							From 0.3m to 6.0m, 2mm sand From 0.5m to 6.0m, 50mm diameter Class 18 Machine Slotted PVC Screen
				D	3.5				
				D	4.5				
				D	5.5				
	6.0	Bore discontinued at 6.0m Limit of investigation							End cap

RIG: Geoprobe Dual Tube **DRILLER:** Tucker **LOGGED:** Krebs **CASING:** None

TYPE OF BORING: Push tube with disposable liners

WATER OBSERVATIONS: Free groundwater observed at 0.2m during drilling

REMARKS: Top of PVC casing level 2.05 AHD

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Stage 3 Northbank Enterprise Hub
LOCATION: Lot 210 Westrac Drive, Tomago

SURFACE LEVEL: 0.7 AHD
EASTING: 382929.3
NORTHING: 6367067
DIP/AZIMUTH: 90°/--

BORE No: MW106
PROJECT No: 39920.09
DATE: 17/5/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SILTY CLAY (CH) - High plasticity, dark brown to brown with rootlets, fine to medium grained sand, W > PL		D	0.0				Stickup = 0.8m
					0.1				From 0m to 0.3m, bentonite
	0.3	SILTY CLAY (CH) - High plasticity, grey, W=PL							From 0m to 0.5m, 50mm Class 18 blank PVC
0		From 0.5m, grey mottled brown		D	0.4			▼	
	1			D	1.0				1
									From 0.3m to 2m, 2mm sand
									From 0.5m to 2m, 50mm diameter Class 18 machine slotted PVC screen
-1				D	1.5				
				D	1.9				End cap
	2	2.0 Bore discontinued at 2.0m Limit of investigation							2
-2									

RIG: Hand Tools **DRILLER:** Lambert/Krebs **LOGGED:** Lambert/Krebs **CASING:** None

TYPE OF BORING: 90mm hand auger 0m to 2m

WATER OBSERVATIONS: Free groundwater observed at 0.7m during drilling

REMARKS: Top of PVC casing level 1.49 AHD

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Stage 3 Northbank Enterprise Hub
LOCATION: Lot 210 Westrac Drive, Tomago

SURFACE LEVEL: 3.1 AHD
EASTING: 382303.7
NORTHING: 6367395.9
DIP/AZIMUTH: 90°/--

BORE No: MW8A
PROJECT No: 39920.09
DATE: 12/4/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.25	SILTY SAND - fine to medium grained, dark grey, trace rootlets, moist		D	0.01				Stickup = 0.76 From 0m to 0.1m, concrete From 0.1m to 0.3m, bentonite From 0m to 0.5m, 50mm diameter Class 18 PVC Casing
		SAND - fine to medium grained, dark grey, trace rootlets, moist at 0.7m - colour change to brown		D	0.5				
	1.2	SAND - fine to medium grained, pale brown, trace sub-angular to sub-rounded gravel, moist at approximately 1.8m, wet		D	1.5				
				D	2.5				
				D	3.5				From 0.3m to 7.0m, 2mm sand From 0.5m to 7.0m, 50mm diameter Class 18 Machine Slotted PVC Screen
				D	4.5				
				D	5.5				
				D	6.5				
	7.0	Bore discontinued at 7.0m Limit of investigation							End cap

RIG: Geoprobe Dual Tube **DRILLER:** Tucker **LOGGED:** Krebs **CASING:** None

TYPE OF BORING: Push tube with disposable liners

WATER OBSERVATIONS: Free groundwater observed at 1.9m during drilling

REMARKS: Top of PVC casing level 3.86 AHD

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⊻	Water level	V	Shear vane (kPa)

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Engineering Log - Piezometer

Borehole No. MW 1

Sheet 1 of 1

Project No: GEOTSGTE20301AA

Client: ASQUITH & de WITT PTY LTD

Date started: 16.8.2007

Principal:

Date completed: 16.8.2007

Project: PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO

Logged by: CW

Borehole Location: REFER TO FIGURE 1

Checked by:

drill model & mounting: Truck Mounted | Easting: 383658 | slope: -90° | R.L. Surface: 2.31

hole diameter: 200mm | Northing: 6367969 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	structure and additional observations
HF		C	▼			2.0	0.5		SM	Silty SAND: fine to coarse grained, black.	D		ALLUVIAL
						1.5	1.0		SC	Clayey SAND: grey	M		
						1.0					W		
						0.5	1.5						
						0.0	2.0						
						-0.5	2.5						
						-1.0	3.0						
						-1.5	3.5						
							4.0			Borehole terminated at 3.85m			

PIEZOMETER 20301AA LOGS MW1-5 GPJ COFFEY GDT 1 7 08

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method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g ADT

support

C casing N nil

penetration

1 2 3 4 no resistance ranging to refusal

water

▼ 10/1/98 water level on date shown

► water inflow

◄ water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

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

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Piezometer

Borehole No. *MW 2*

Sheet 1 of 1

Project No: *GEOTSGTE20301AA*

Client: *ASQUITH & de WITT PTY LTD*

Date started: *17.8.2007*

Principal:

Date completed: *17.8.2007*

Project: *PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO*

Logged by: *CW*

Borehole Location: *REFER TO FIGURE 1*

Checked by:

drill model & mounting: Truck Mounted | Easting: 383725 | slope: -90° | R.L. Surface: 0.74

hole diameter: 200mm | Northing: 6367488 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type; plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	structure and additional observations
HF		C	10:30am			0.5	0.5		CI	Silty CLAY: medium plasticity, dark brown-black, with rootlets.	M>Wp		TOPSOIL Root affected
						0.0	1.0		Ci	CLAY: medium plasticity, grey.			ALLUVIAL / ESTUARINE
						-0.5	1.5						
						-1.0	2.0						
						-1.5	2.5						
						-2.0	3.0						
						-2.5	3.5			Borehole terminated at 3.5m			
						-3.0	4.0						

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g. ADT

support

C casing N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description based on unified classification system

moisture

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

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Piezometer

Borehole No.	MW 3
Sheet	1 of 1
Project No:	GEOTSGTE20301AA
Client:	ASQUITH & de WITT PTY LTD
Date started:	17.8.2007
Principal:	
Date completed:	17.8.2007
Project:	PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO
Logged by:	CW
Borehole Location:	REFER TO FIGURE 1
Checked by:	

drill model & mounting: Truck Mounted | Easting: 382895 | slope -90° | R.L. Surface: 2.91

hole diameter: 200mm | Northing: 6367789 | bearing | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle charactenstics, colour, secondary and minor components	moisture condition	consistency/ density index	structure and additional observations
HF		C	11:55am			2.5	0.5		SM	**Silty SAND:** fine to coarse grained, black mottled white, with rootlets	M		TOPSOIL
						2.0	1.0		SM	**Silty SAND:** fine to coarse grained, dark grey	W		AEOLIAN
						1.5	1.5			Becoming dark brown			
						1.0	2.0			Trace of fine grained rounded gravel			Alluvial?
						0.5	2.5						
						0.0	3.0						
						-0.5	3.5						
						-1.0	4.0			Borehole terminated at 3 8m			

PIEZOMETER 20301AA LOGS MW1-5 GPJ COFFEY GDT 1 7 08

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method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g. ADT

support

C casing N nil

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

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

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Piezometer

Borehole No.	MW 4
Sheet	1 of 1
Project No:	GEOTSGTE20301AA
Date started:	17.8.2007
Date completed:	17.8.2007
Logged by:	CW
Checked by:	

Client: ASQUITH & de WITT PTY LTD

Principal:

Project: PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO

Borehole Location: REFER TO FIGURE 1

drill model & mounting: Truck Mounted | Easting: 383345 | slope: -90° | R.L. Surface: 0 35

hole diameter: 200mm | Northing: 6366996 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	structure and additional observations
HF		C	1:51pm			0.0	0.5		CH	CLAY: high plasticity, grey-brown some orange mottled, with rootlets.	M>Wp		ALLUVIAL
						-0.5	1.0			Becoming grey.			
						-1.0	1.5						
						-1.5	2.0						
						-2.0	2.5						
						-2.5	3.0						
						-3.0	3.5						
						-3.5	4.0			Borehole terminated at 3.9m			

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g. ADT

support: C casing; N nil

penetration: 1 2 3 4 — no resistance ranging to refusal

water: 10/1/98 water level on date shown; water inflow; water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description based on unified classification system

moisture

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

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Piezometer

Borehole No. *MW 5*

Sheet 1 of 1

Project No: *GEOTSGTE20301AA*

Client: *ASQUITH & de WITT PTY LTD*

Date started: *18.8.2007*

Principal:

Date completed: *18.8.2007*

Project: *PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO*

Logged by: *CW*

Borehole Location: *REFER TO FIGURE 1*

Checked by:

drill model & mounting: Truck Mounted | Easting: 382251 | slope: -90° | R.L. Surface: 0.71

hole diameter: 200mm | Northing: 6367165 | bearing: | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	structure and additional observations
HF		C	8:15am			0.5	0.5		CI	Silty CLAY: medium plasticity, dark brown	M>Wp		ALLUVIAL
						0.0	1.0			Becoming dark grey-grey			
						-0.5	1.5						
						-1.0	2.0		SC	Clayey SAND / Sandy CLAY: fine to medium grained			
						-1.5	2.5						
						-2.0	3.0						
						-2.5	3.5						
						-3.0	4.0			Borehole terminated at 3.8m			

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
DT	diatube
B	blank bit
V	V bit
T	TC bit
TBX	Tubex

*bit shown by suffix e.g. ADT

support

C casing N nil

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
P	pressure meter
Bs	bulk sample
R	refusal
E	environmental sample
PID	PID measurement
WS	water sample
PZ	piezometer
ALT	air lift test

classification symbols and soil description

based on unified classification system

moisture

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

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Table A1: Monitoring Well Summary

Bore ID	Easting	Northing	Elevation Ground Level (AHD)	Elevation top of PVC Casing Level (AHD)	Depth (m bgl)	Screened interval (m bgl)	Target lithology	Comment	Proposed in monitoring program for Stage 3
MW1	383552	6368062	2.0	2.84	3.8	0.8-3.8	Sand, clayey		No
MW2	383721	6367483		1.25	3.5	0.5-3.5	Clay, silty		No
MW3	382900	6367780		3.56	3.0	0.5-3.0	Sand, fine to coarse, silty	Damaged/lost	No
MW4	383360	6367013	0.5	1.28	3.7	0.7-3.8	Clay	High EC readings assumed to be associated with elevated suspended solids (clay particles)	Yes
MW5	382225	6367156			3.8	0.8-3.8	Clay and sand	Damaged/lost	No
MW6	383516	6367333	0.6	1.26	9.0	6.0-9.0	Sand, fine to med		No
MW7	382804	6366932	0.4	1.41	2.6	0.6-2.6	Clay, silty	Collapsed strata 6-9m - no gravel pack High EC readings assumed to be associated with elevated suspended solids (fine sand due to absence of gravel pack)	No
MW8	382351	6367460	3.4	4.72	5.5	2.5-5.5	Sand, fine to med	Damaged/lost	No
MW8A	382304	6367396	3.1	3.86	7.0	0.5-7.0	Sand, fine to med	Replacement for MW8	Yes
MW9	383165	6367492	0.6	1.54	10.6	4.6-8.3	Sand, fine to med	Damaged/lost	No
MW10	383464	6367677	0.8	2.11	10.6	4.6-8.3	Sand, fine to med		No
MW11	383293	6367584	1.2	2.27	10.6		Sand, fine to med		No
MW101	382657	6367619	3.2	4.09	7.0	0.3-7.0	Sand, fine to med		Yes
MW102	382678	6367506	1.8	2.52	4.0	0.3-4.0	Sand, fine to med		Yes
MW103	382853	6367614	2.3	3.31	7.0	0.3-7.0	Sand, fine to med		Yes
MW104	383148	6367292	0.7	1.16	1.5	0.5-1.5	Clay	High EC readings assumed to be associated with elevated suspended solids (clay particles)	Yes
MW105	382360	6367294	1.5	2.05	6.0	0.3-6.0	Sand, fine to med		Yes
MW106	382929	6367067	0.7	1.35	2.0	0.5-2.0	Clay	High EC readings assumed to be associated with elevated suspended solids (clay particles)	Yes
MW107	To be installed								Yes

Notes:
AHD = metres Australian Height Datum
m bgl = metres below ground level
EC = electrical conductivity

Appendix B

Table B1: Groundwater Quality Assessment Criteria for bores in the Tomago Sandbeds (i.e. MW8A, MW101, MW102, MW103, MW105)

Table B2: Groundwater Quality Assessment Criteria for bores in the clay aquitard (i.e. MW04, MW104, MW106, MW107)

Table B1: Groundwater Quality Assessment Criteria for bores in the Tomago Sandbeds (i.e. MW8A, MW101, MW102, MW103, MW105)

Parameter	Unit	Ecological Guidelines (Note A)	Human Health Guidelines (Note A)	Most Sensitive Beneficial Use (i.e. lower of ANZG or DWG)	Background Quality (Note E)		Laboratory LOR	Adopted trigger Level
		ANZG (2018) 95% Freshwater protection criteria (Note A)	Drinking Water Guidelines (Note B)	Corresponding Guideline	UCL_{95}-mean	80th Percentile		Higher of Most Sensitive Beneficial Use Criteria and 80th Percentile of Background Quality (or LOR where applicable)
Physio chemical parameters								
pH	pH units	pH 6.5-8.5	NC	ANZG (2018)	5.89	5.17 (P20) - 6.38 (P80)	0.1	5.2 - 8.5
Electrical Conductivity	µS/cm	NC	NC	NC	357	529	1	529
Dissolved oxygen	mg/L	NC	NC	NC	11.3	9.62	0.1	-
Total suspended solids	mg/L	NC	0.6	NHMRC (2021)	253	251	1	-
Anions and non-metallic inorganics								
Chloride (Cl)	mg/L	NC	250	NHMRC (2021)	47	57	1	250
Sulphate (SO_4^{2-})	mg/L	NC	500	NHMRC (2021)	15	23	1	500
Fluoride	mg/L	NC	1.5	NHMRC (2021)	0.1	0.1	0.1	1.5
Hydroxide Alkalinity	mg/L	NC	NC	NC	1	1	5	1
Carbonate (CO_3^{2-})	mg/L	NC	NC	NC	6	5	5	5
Bicarbonate (HCO_3^-)	mg/L	NC	NC	NC	56	37	5	37
Total Alkalinity	mg/L	NC	NC	NC	25	32	5	32
Nutrients								
Ammonia (NH_3) as N	mg/L	0.9	0.5	NHMRC (2021)	0.4	0.5	0.005	0.5
Nitrite + Nitrate as N	mg/L	NC	NC	NC	0.07	0.04	0.05	0.04
Nitrite as N	mg/L	NC	3	NHMRC (2021)	0.2	0.1	0.05	3
Nitrate as N	mg/L	0.7	50	ANZG (2018)	0.014	0.02	0.005	0.7
Total Kjeldahl Nitrogen as N	mg/L	NC	NC	NC	0.85	1.1	0.1	1.1
Total Phosphorus	mg/L	0.025	NC	ANZG (2018)	0.14	0.086	0.05	0.086
Cations								
Calcium	mg/L	NC	NC	NC	12	13	0.5	13
Magnesium	mg/L	NC	NC	NC	5	6	0.5	6
Potassium	mg/L	NC	NC	NC	3	4	0.5	4
Sodium	mg/L	NC	180	NHMRC (2021)	45	66	0.5	180
Total / dissolved metals								
Aluminium	mg/L	**0.055 (pH>6.5) (M) 0.0008 pH <6.5 (L)**	0.2 (C)	ANZG (2018)	NR	NR	0.01	0.055 (pH>6.5) 0.0008 (pH <6.5)
Arsenic	mg/L	0.013	0.01	NHMRC (2021)	0.002	0.002	0.001	0.01
Cadmium	mg/L	0.0002	0.002	ANZG (2018)	0.0001	0.0001	0.0001	0.0002
Chromium	mg/L	0.001	0.05	ANZG (2018)	0.002	0.002	0.001	0.002
Copper	mg/L	0.0014	2	ANZG (2018)	0.001	0.001	0.001	0.001
Iron	mg/L	0.7	0.3 (C)	NHMRC (2021)	0.6	0.8	0.01	0.8
Manganese	mg/L	1.9	0.5	NHMRC (2021)	0.07	0.07	0.01	0.50
Molybdenum	mg/L	NC	0.05	NHMRC (2021)	0.001	0.001	0.001	0.05
Nickel	mg/L	0.011	0.02	ANZG (2018)	0.001	0.001	0.001	0.011
Lead	mg/L	0.0034	0.01	ANZG (2018)	0.001	0.001	0.001	0.0034
Zinc	mg/L	0.008	3	ANZG (2018)	0.007	0.010	0.001	0.01
Mercury	mg/L	**0.00006**	1	ANZG (2018)	0.0001	0.0001	0.00005	0.0001
Total Recoverable Hydrocarbons (Note D)								
C6 - C10 Fraction	mg/L	NC	NC	NC	<LOR	<LOR	0.01	0.01
C6 - C10 Fraction minus BTEX (F1)	mg/L	NC	NC	NC	<LOR	<LOR	0.01	0.01
>C10 - C16 Fraction	mg/L	NC	NC	NC	<LOR	<LOR	0.05	0.05
>C16 - C34 Fraction	mg/L	NC	NC	NC	<LOR	<LOR	0.1	0.1
>C34 - C40 Fraction	mg/L	NC	NC	NC	<LOR	<LOR	0.1	0.1
>C10 - C40 Fraction (sum)	mg/L	LOR	NC	NC	<LOR	<LOR	0.1	0.1
>C10 - C16 Fraction minus Naphthalene (F2)	mg/L	NC	NC	NC	<LOR	<LOR	0.05	0.05
Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene (BTEXN)								
Benzene	mg/L	0.95	0.001	NHMRC (2021)	<LOR	<LOR	0.001	0.001
Toluene	mg/L	*0.18*	0.8	ANZG (2018)	0.0009	0.0011	0.001	0.18
m- & p-Xylene	mg/L	*0.08*	0.3	ANZG (2018)	<LOR	<LOR	0.001	0.08
ortho-Xylene	mg/L	0.075	NC	ANZG (2018)	<LOR	<LOR	0.002	0.075
Total xylenes	mg/L	NC	0.6	NHMRC (2021)	<LOR	<LOR	0.002	0.6
Naphthalene	mg/L	0.0016	NC	ANZG (2018)	<LOR	<LOR	0.001	0.0016
Polycyclic Aromatic Hydrocarbons (PAH)								
Naphthalene	mg/L	0.0016	NC	ANZG (2018)	<LOR	<LOR	0.0001	0.0016
Phenanthrene	mg/L	**0.0006**	NC	ANZG (2018)	<LOR	<LOR	0.0001	0.0006
Anthracene	mg/L	***0.00001***	NC	ANZG (2018)	<LOR	<LOR	0.0001	0.00001
Fluoranthene	mg/L	***0.001***	NC	ANZG (2018)	<LOR	<LOR	0.0001	0.001
Benzo(a)pyrene	mg/L	***0.0001***	0.00001	NHMRC (2021)	<LOR	<LOR	0.0001	0.00001
Phenols								
Total Phenol	mg/L	0.32	NC	ANZG (2018)	0.1610	0.0125	0.001	0.32
2-Chlorophenol	mg/L	0.34	0.3	NHMRC (2021)	<LOR	<LOR	0.001	0.30
2-Methylphenol	mg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
3- & 4-Methylphenol	mg/L	NC	NC	NC	<LOR	<LOR	0.002	0.002
2-Nitrophenol	mg/L	0.002	NC	ANZG (2018)	<LOR	<LOR	0.001	0.002
2.4-Dimethylpheno	mg/L	0.002	NC	ANZG (2018)	<LOR	<LOR	0.001	0.002

Parameter	Unit	Ecological Guidelines (Note A)	Human Health Guidelines (Note A)	Most Sensitive Beneficial Use (i.e. lower of ANZG or DWG)	Background Quality (Note E)		Laboratory LOR	Adopted trigger Level
		ANZG (2018) 95% Freshwater protection criteria (Note A)	Drinking Water Guidelines (Note B)	Corresponding Guideline	UCL_{95}-mean	80th Percentile		Higher of Most Sensitive Beneficial Use Criteria and 80th Percentile of Background Quality (or LOR where applicable)
2.4-Dichlorophenol	mg/L	0.12	0.2	ANZG (2018)	<LOR	<LOR	0.001	0.12
2.6-Dichlorophenol	mg/L	0.034	NC	ANZG (2018)	<LOR	<LOR	0.001	0.034
4-Chloro-3-methylphenol	mg/L	NC	NC	NC	<LOR	<LOR	0.005	0.005
2.4.6-Trichlorophenol	mg/L	0.003	0.02	ANZG (2018)	<LOR	<LOR	0.001	0.003
2.4.5-Trichlorophenol	mg/L	0.00005	NC	ANZG (2018)	<LOR	<LOR	0.001	0.00005
Pentachlorophenol	mg/L	0.0036	0.01	ANZG (2018)	<LOR	<LOR	0.005	0.0036
Organophosphorous Pesticides (OPP)								
Dichlorvos	µg/L	NC	5	NHMRC (2021)	<LOR	<LOR	0.00005	5
Dimethoate	µg/L	0.15	7	ANZG (2018)	<LOR	<LOR	0.0001	0.15
Diazinon	µg/L	0.01	4	ANZG (2018)	<LOR	<LOR	0.00001	0.01
Chlorpyrifos-methyl	µg/L	NC	NC	NC	<LOR	<LOR	0.00005	0.00005
Parathion-methyl	µg/L	NC	0.7	NHMRC (2021)	<LOR	<LOR	0.00005	0.7
Malathion	µg/L	0.05	70	ANZG (2018)	<LOR	<LOR	0.00005	0.05
Fenthion	µg/L	NC	7	NHMRC (2021)	<LOR	<LOR	0.00005	7
Chlorpyrifos	µg/L	0.01	10	ANZG (2018)	<LOR	<LOR	0.00005	0.01
Parathion	µg/L	0.004	20	ANZG (2018)	<LOR	<LOR	0.000004	0.004
Chlorfenvinphos	µg/L	NC	2	NHMRC (2021)	<LOR	<LOR	0.000009	2
Bromophos-ethyl	µg/L	NC	NC	NC	<LOR	<LOR	0.00005	0.00005
Fenamiphos	µg/L	NC	0.5	NHMRC (2021)	<LOR	<LOR	0.00005	0.5
Ethion	µg/L	NC	4	NHMRC (2021)	<LOR	<LOR	0.00005	4
Azinphos Methyl	µg/L	**0.01**	30	ANZG (2018)	<LOR	<LOR	0.0002	0.01
Organochlorine Pesticides (OCP)								
alpha-BHC	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Hexachlorobenzene (HCB)	µg/L	***0.05***	NC	ANZG (2018)	<LOR	<LOR	0.001	0.05
beta-BHC	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
gamma-BHC	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
delta-BHC	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Heptachlor	µg/L	***0.01***	0.3	ANZG (2018)	<LOR	<LOR	0.001	0.01
Aldrin	µg/L	*0.001*	NC	ANZG (2018)	<LOR	<LOR	0.001	0.001
Heptachlor epoxide	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
trans-Chlordane	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
alpha-Endosulfan	µg/L	*0.0002*	NC	ANZG (2018)	<LOR	<LOR	0.002	0.0002
cis-Chlordane	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Dieldrin	µg/L	*0.01*	NC	ANZG (2018)	<LOR	<LOR	0.001	0.01
4.4`-DDE	µg/L	*0.03*	NC	ANZG (2018)	<LOR	<LOR	0.001	0.03
Endrin	µg/L	**0.01**	NC	ANZG (2018)	<LOR	<LOR	0.001	0.01
beta-Endosulfan	µg/L	*0.007*	NC	ANZG (2018)	<LOR	<LOR	0.002	0.007
4.4`-DDD	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Endrin aldehyde	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Endosulfan sulfate	µg/L	**0.03**	20	ANZG (2018)	<LOR	<LOR	0.001	0.03
4.4`-DDT	µg/L	0.006	9	ANZG (2018)	<LOR	<LOR	0.001	0.006
Methoxychlor	µg/L	0.005	300	ANZG (2018)	<LOR	<LOR	0.001	0.005
Total chlordane	µg/L	**0.03**	0.2	ANZG (2018)	<LOR	<LOR	0.001	0.03
Sum of DDD + DDE + DDT	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Sum of Aldrin + Dieldrin	µg/L	NC	0.3	NHMRC (2021)	<LOR	<LOR	0.001	0.3
Polychlorinated Biphenyls (PCB)								
Aroclor 1016	µg/L	*0.001*	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.001
Aroclor 1221	µg/L	*1*	NC	ANZG (2018)	<LOR	<LOR	0.00001	1
Aroclor 1232	µg/L	*0.3*	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.3
Aroclor 1242	µg/L	***0.3***	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.3
Aroclor 1248	µg/L	*0.03*	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.03
Aroclor 1254	µg/L	***0.01***	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.01
Aroclor 160	µg/L	*25*	NC	ANZG (2018)	<LOR	<LOR	0.00001	25
Per- and polyfluoroalkyl substances (PFAS)								
Perfluorooctanesulfonic acid (PFOS)	µg/L	0.00023	NC	ANZG (2018)	-	-	0.001	0.00023
Perfluorooctanoic acid (PFOA)	µg/L	19	0.56	NHMRC (2021)	-	-	0.001	0.56
Sum of PFHxS and PFOS	µg/L	NC	0.07	NHMRC (2021)	-	-	0.001	0.07

Notes:

A Guidelines values can be applied to surface water quality.
B ANZG (2018) suggest use of ANZECC & ARMCANZ (2000) DGVs
C NHMRC Australian Drinking Water Guidelines, 2011
D TRH only detected in the first sample of some bores, could be attributed to residual drilling fluids
E Background data is expressed as <LOR as the LOR at times has varied between monitoring events in the indicative range of +/- one order of magnitude. Higher LORs were mostly associated with historical data. With improvements in laboratory techniques, more consistent LORs are routinely achieved.
DGV Default guideline value
LOR Limit of reporting
NC No current criteria
NHMRC arsenic guidelines are based on total arsenic
Guidelines for chromium are based on Cr (VI)
Total Phenolics guideline based on Phenol
Guidelines for mercury are based on inorganic mercury.
NHMRC guideline for TSS are based on TDS in the absence of a TSS value.
NHMRC guidelines for mercury are based on total mercury.
Default trigger values for TP and TN are for NSW & Vic. east flowing coastal rivers for slightly disturbed ecosystems (ANZECC 2000)
Guidelines in *italics* are low level reliability guidelines
Guidelines in **bold** indicates the 99% protection level should be adopted for slightly-moderately disturbed ecosystems protection level due to potential for bioaccumulation or acute toxicity to particular species PFAS criteria based for human health based on HEPA (2020)

Table B2: Groundwater Quality Assessment Criteria for bores in the clay aquitard (i.e. MW4, MW104, MW106, MW107)

Parameter	Unit	Ecological Guidelines (Note A)	Background Quality (Note E)		Laboratory LOR	Adopted trigger Level
		ANZG (2018) 95% Freshwater protection criteria (Note A)	UCL_{95}-mean	80th Percentile		Higher of DGVs and 80th Percentile of Background Quality
Physio chemical parameters						
pH	pH units	pH 6.5-8.5	7.12	6.56 (P20) - 7.38 (P80)	0.1	6.5 - 7.4
Electrical Conductivity	(µS/cm)	NC	17100	24500	1	24500
Dissolved oxygen	mg/L	NC	25	5.77	0.1	-
Total suspended solids	mg/L	NC	-	-	1	-
Anions and non-metallic inorganics						
Chloride (Cl)	mg/L	NC	6200	8560	1	8560
Sulphate (SO_4^{2-})	mg/L	NC	2540	3690	1	3690
Fluoride	mg/L	NC	0.6	0.7	0.1	0.7
Hydroxide Alkalinity	mg/L	NC	1	1	5	1
Carbonate (CO_3^{2-})	mg/L	NC	290	18	5	18
Bicarbonate (HCO_3^-)	mg/L	NC	609	808	5	808
Total Alkalinity	mg/L	NC	798	949	5	949
Nutrients						
Ammonia (NH_3) as N	mg/L	0.9	8.7	2.0	0.005	2.0
Nitrite + Nitrate as N	mg/L	NC	0.12	0.07	0.05	0.07
Nitrite as N	mg/L	NC	0.02	0.03	0.05	0.03
Nitrate as N	mg/L	0.7	0.08	0.04	0.005	0.7
Total Kjeldahl Nitrogen as N	mg/L	NC	6.6	4.6	0.1	4.6
Total Phosphorus	mg/L	0.025	1.4	2.1	0.05	2.1
Cations						
Calcium	mg/L	NC	349	478	0.5	478
Magnesium	mg/L	NC	684	977	0.5	977
Potassium	mg/L	NC	147	208	0.5	208
Sodium	mg/L	NC	3760	5310	0.5	5310
Total / dissolved metals						
Aluminium	mg/L	**0.055 (pH>6.5) (M) 0.0008 pH <6.5 (L)**	NR	NR	0.01	0.055 (pH>6.5) 0.0008 (pH <6.5)
Arsenic	mg/L	0.013	0.017	0.009	0.001	0.013
Cadmium	mg/L	0.0002	0.0001	0.0001	0.0001	0.0002
Chromium	mg/L	0.001	0.005	0.004	0.001	0.004
Copper	mg/L	0.0014	0.007	0.005	0.001	0.005
Iron	mg/L	0.7	60.8	55.2	0.01	55.2
Manganese	mg/L	1.9	7.25	10.10	0.01	10.10
Molybdenum	mg/L	NC	0.004	0.003	0.001	0.003
Nickel	mg/L	0.011	0.021	0.011	0.001	0.011
Lead	mg/L	0.0034	0.002	0.002	0.001	0.0034
Zinc	mg/L	0.008	1.14	0.14	0.001	0.14
Mercury	mg/L	**0.00006**	<LOR	<LOR	0.00005	0.00006
Total Recoverable Hydrocarbons (Note C)						
C6 - C10 Fraction	mg/L	NC	0.018	0.018	0.01	0.01
C6 - C10 Fraction minus BTEX (F1)	mg/L	NC	0.013	0.017	0.01	0.01
>C10 - C16 Fraction	mg/L	NC	0.14	0.12	0.05	0.05
>C16 - C34 Fraction	mg/L	NC	0.21	0.17	0.1	0.1
>C34 - C40 Fraction	mg/L	NC	0.09	0.12	0.1	0.1
>C10 - C40 Fraction (sum)	mg/L	LOR	0.28	0.19	0.1	0.1
>C10 - C16 Fraction minus Naphthalene (F2)	mg/L	NC	0.17	0.14	0.05	0.05
Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene (BTEXN)						
Benzene	mg/L	0.95	<LOR	<LOR	0.001	0.95
Toluene	mg/L	*0.18*	0.003	0.003	0.001	0.18
m- & p-Xylene	mg/L	*0.08*	<LOR	<LOR	0.001	0.08
ortho-Xylene	mg/L	0.075	<LOR	<LOR	0.002	0.075
Total xylenes	mg/L	NC	<LOR	<LOR	0.002	0.002
Naphthalene	mg/L	0.0016	<LOR	<LOR	0.001	0.0016
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	mg/L	0.0016	<LOR	<LOR	0.0001	0.0016
Phenanthrene	mg/L	**0.0006**	<LOR	<LOR	0.0001	0.0006
Anthracene	mg/L	***0.00001***	<LOR	<LOR	0.0001	0.0000
Fluoranthene	mg/L	***0.001***	<LOR	<LOR	0.0001	0.0010
Benzo(a)pyrene	mg/L	***0.0001***	<LOR	<LOR	0.0001	0.0001
Phenols						
Total Phenol	mg/L	0.32	0.0198	0.0044	0.001	0.32
2-Chlorophenol	mg/L	0.34	<LOR	<LOR	0.001	0.34
2-Methylphenol	mg/L	NC	<LOR	<LOR	0.001	0.001
3- & 4-Methylphenol	mg/L	NC	0.039	0.006	0.002	0.002
2-Nitrophenol	mg/L	0.002	<LOR	<LOR	0.001	0.002
2.4-Dimethylpheno	mg/L	0.002	<LOR	<LOR	0.001	0.002
2.4-Dichlorophenol	mg/L	0.12	<LOR	<LOR	0.001	0.12
2.6-Dichlorophenol	mg/L	0.034	<LOR	<LOR	0.001	0.034

Parameter	Unit	Ecological Guidelines (Note A)	Background Quality (Note E)		Laboratory LOR	Adopted trigger Level
		ANZG (2018) 95% Freshwater protection criteria (Note A)	UCL_{95}-mean	80th Percentile		Higher of DGVs and 80th Percentile of Background Quality
4-Chloro-3-methylphenol	mg/L	NC	<LOR	<LOR	0.005	LOR
2.4.6-Trichlorophenol	mg/L	0.003	<LOR	<LOR	0.001	0.003
2.4.5-Trichlorophenol	mg/L	0.00005	<LOR	<LOR	0.001	0.00005
Pentachlorophenol	mg/L	0.0036	<LOR	<LOR	0.005	0.0036
Organophosphorous Pesticides (OPP)						
Dichlorvos	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Dimethoate	µg/L	0.15	<LOR	<LOR	0.0001	0.15
Diazinon	µg/L	0.01	<LOR	<LOR	0.00001	0.01
Chlorpyrifos-methyl	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Parathion-methyl	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Malathion	µg/L	0.05	<LOR	<LOR	0.00005	0.05
Fenthion	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Chlorpyrifos	µg/L	0.01	<LOR	<LOR	0.00005	0.01
Parathion	µg/L	0.004	<LOR	<LOR	0.000004	0.004
Chlorfenvinphos	µg/L	NC	<LOR	<LOR	0.000009	0.000009
Bromophos-ethyl	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Fenamiphos	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Ethion	µg/L	NC	<LOR	<LOR	0.00005	0.000009
Azinphos Methyl	µg/L	**0.01**	<LOR	<LOR	0.0002	0.01
Organochlorine Pesticides (OCP)						
alpha-BHC	µg/L	NC	<LOR	<LOR	0.001	0.001
Hexachlorobenzene (HCB)	µg/L	***0.05***	<LOR	<LOR	0.001	0.05
beta-BHC	µg/L	NC	<LOR	<LOR	0.001	0.001
gamma-BHC	µg/L	NC	<LOR	<LOR	0.001	0.001
delta-BHC	µg/L	NC	<LOR	<LOR	0.001	0.001
Heptachlor	µg/L	***0.01***	<LOR	<LOR	0.001	0.01
Aldrin	µg/L	*0.001*	<LOR	<LOR	0.001	0.001
Heptachlor epoxide	µg/L	NC	<LOR	<LOR	0.001	0.001
trans-Chlordane	µg/L	NC	<LOR	<LOR	0.001	0.001
alpha-Endosulfan	µg/L	*0.0002*	<LOR	<LOR	0.002	0.0002
cis-Chlordane	µg/L	NC	<LOR	<LOR	0.001	0.001
Dieldrin	µg/L	*0.01*	<LOR	<LOR	0.001	0.01
4.4`-DDE	µg/L	*0.03*	<LOR	<LOR	0.001	0.03
Endrin	µg/L	**0.01**	<LOR	<LOR	0.001	0.01
beta-Endosulfan	µg/L	*0.007*	<LOR	<LOR	0.002	0.007
4.4`-DDD	µg/L	NC	<LOR	<LOR	0.001	0.001
Endrin aldehyde	µg/L	NC	<LOR	<LOR	0.001	0.001
Endosulfan sulfate	µg/L	**0.03**	<LOR	<LOR	0.001	0.03
4.4`-DDT	µg/L	0.006	<LOR	<LOR	0.001	0.006
Methoxychlor	µg/L	0.005	<LOR	<LOR	0.001	0.005
Total chlordae	µg/L	**0.03**	<LOR	<LOR	0.001	0.03
Sum of DDD + DDE + DDT	µg/L	NC	<LOR	<LOR	0.001	0.001
Sum of Aldrin + Dieldrin	µg/L	NC	<LOR	<LOR	0.001	0.001
Polychlorinated Biphenyls (PCB)						
Aroclor 1016	µg/L	*0.001*	<LOR	<LOR	0.00001	0.001
Aroclor 1221	µg/L	*1*	<LOR	<LOR	0.00001	1
Aroclor 1232	µg/L	*0.3*	<LOR	<LOR	0.00001	0.3
Aroclor 1242	µg/L	***0.3***	<LOR	<LOR	0.00001	0.3
Aroclor 1248	µg/L	*0.03*	<LOR	<LOR	0.00001	0.03
Aroclor 1254	µg/L	***0.01***	<LOR	<LOR	0.00001	0.01
Aroclor 160	µg/L	*25*	<LOR	<LOR	0.00001	25
Per- and polyfluoroalkyl substances (PFAS)						
Perfluorooctanesulfonic acid (PFOS)	µg/L	0.00023	-	-	0.001	0.00023
Perfluorooctanoic acid (PFOA)	µg/L	19	-	-	0.001	19
Sum of PFHxS and PFOS	µg/L	NC	-	-	0.001	0.001

Notes:

A Guidelines values can be applied to surface water quality.

B ANZG (2018) suggest use of ANZECC & ARMCANZ (2000) DGVs

C TRH only detected in the first sample of some bores, could be attributed to residual drilling fluids

E Background data is expressed as <LOR as the LOR at times has varied between monitoring events in the indicative range of +/- one order of magnitude. Higher LORs were mostly associated with historical data. With improvements in laboratory techniques, more consistent LORs are routinely achieved.

LOR Limit of reporting

NC No current criteria

DVGs for TP and TN are for NSW & Vic. east flowing coastal rivers for slightly disturbed ecosystems (ANZECC & ARMCANZ 2000).

Guidelines for chromium are based on Cr (VI)

Total Phenolics guideline based on Phenol

Guidelines for mercury are based on inorganic mercury.

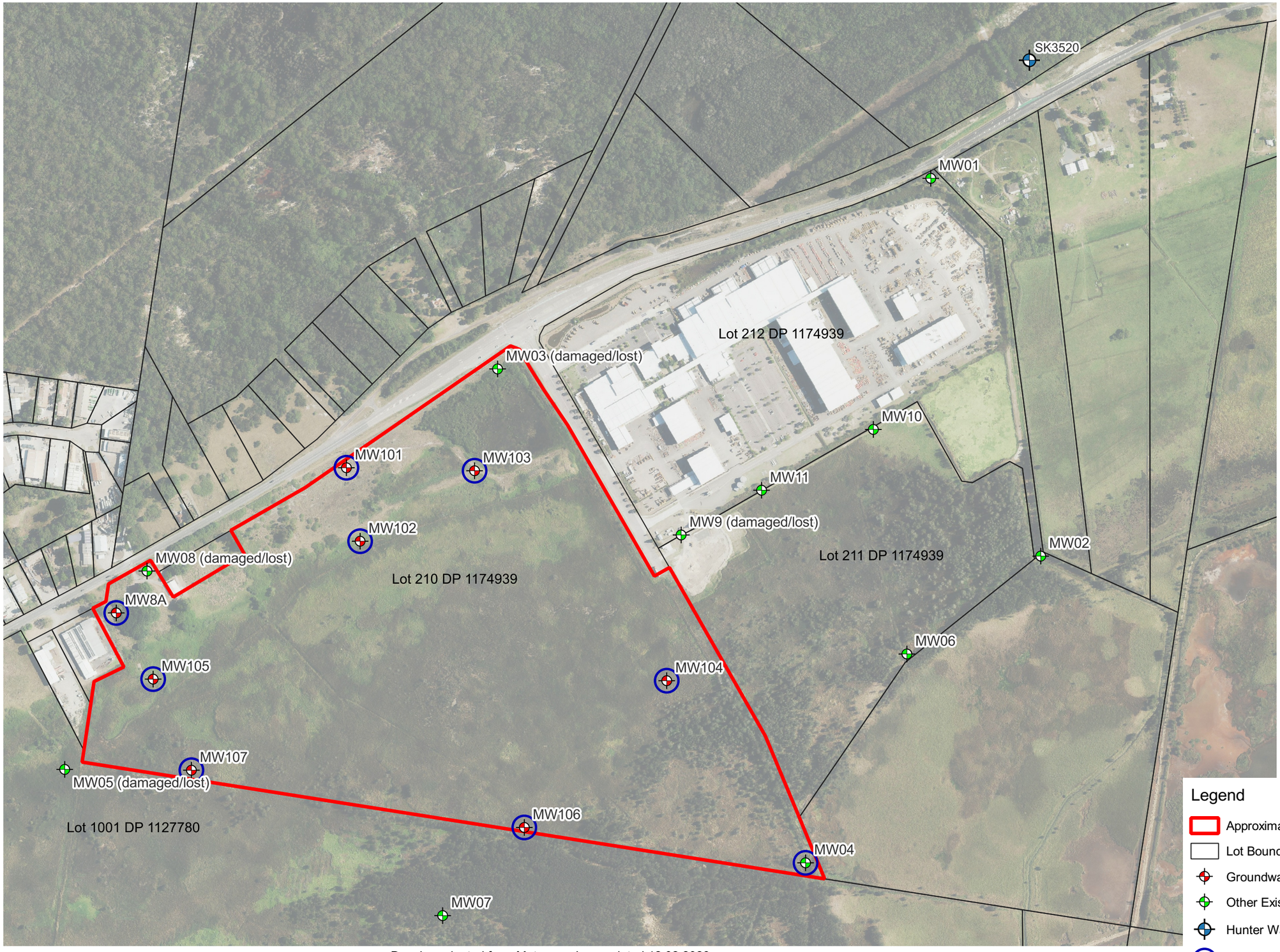
Guidelines in *italics* are low level reliability guidelines

Guidelines in **bold** indicates the 99% protection level should be adopted for slightly-moderately disturbed ecosystems protection level due to potential for bioaccumulation or acute toxicity to particular species

Appendix C

Drawing 1 – Monitoring Well Location Plan

WRM (2024) – Figure 4.1: Proposed Development Site Layout, Bulk Earthworks Plan, Developed Catchments and Drainage Configuration



Site Location

Legend

- Approximate Site Boundary
- Lot Boundary
- Groundwater Monitoring Well (installed April/May 2023)
- Other Existing Groundwater Monitoring Wells
- Hunter Water Monitoring Bore
- Indicates Monitoring Well Proposed for Stage 3 Monitoring

0 100 200 m

Drawing adapted from Metromap Image dated 12.02.2023.
Test locations are approximate only.
MW8A and MW100 series wells located using differential GPS

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Northbank Enterprise Hub Pty Ltd		TITLE: Groundwater Monitoring Well Location Plan Stage 3 Northbank Enterprise Hub Lot 210 D.P 1174939, Westrac Drive, Tomago	PROJECT No:39920.09
OFFICE: Newcastle	DRAWN BY: JCL		DRAWING No: 1
SCALE: 1:6000 @ A3	DATE:28.November.2023		REVISION: 2

Figure 4.1 – Proposed development site layout, bulk earthworks plan, developed catchments and drainage configuration

Appendix D

Groundwater Quality Plots
(pH, EC, Ammonia, Nitrate, Phosphorus, Metals)

Douglas Partners
Geotechnics / Environment / Groundwater

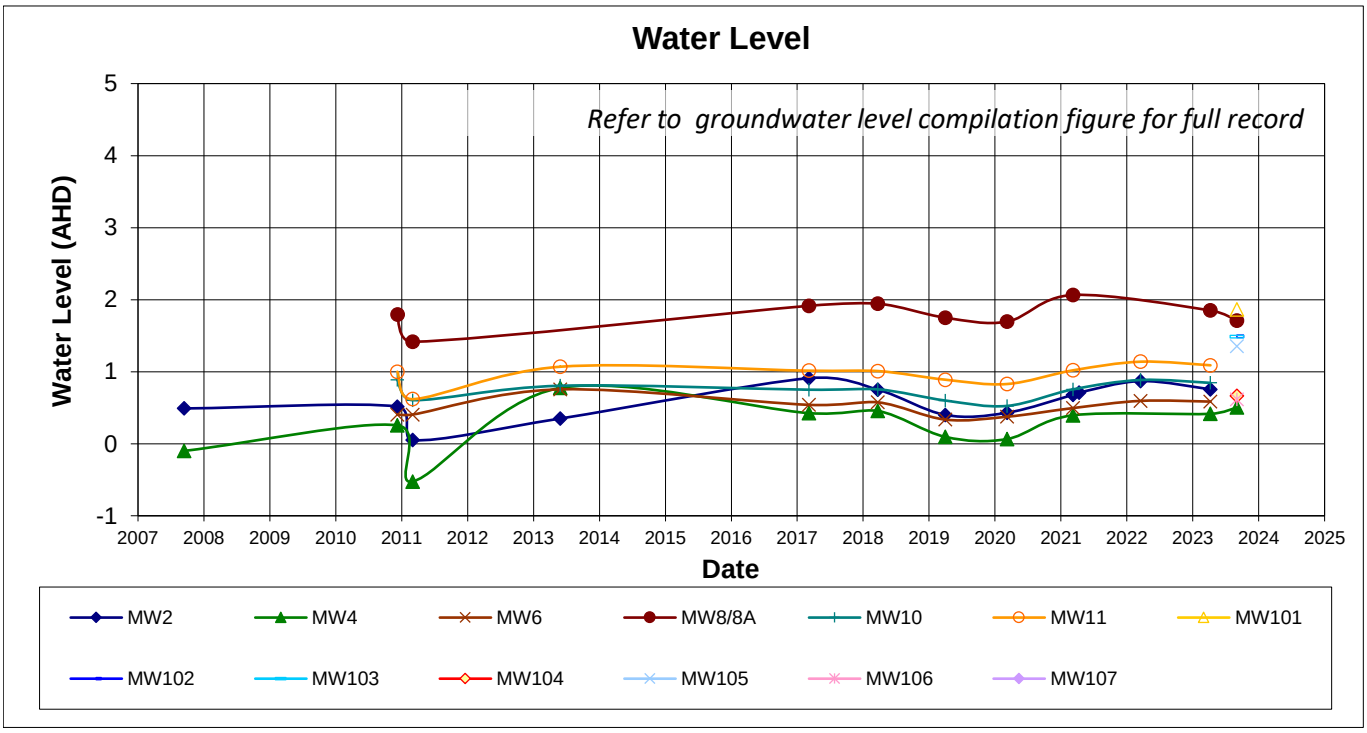
GROUNDWATER QUALITY MONITORING

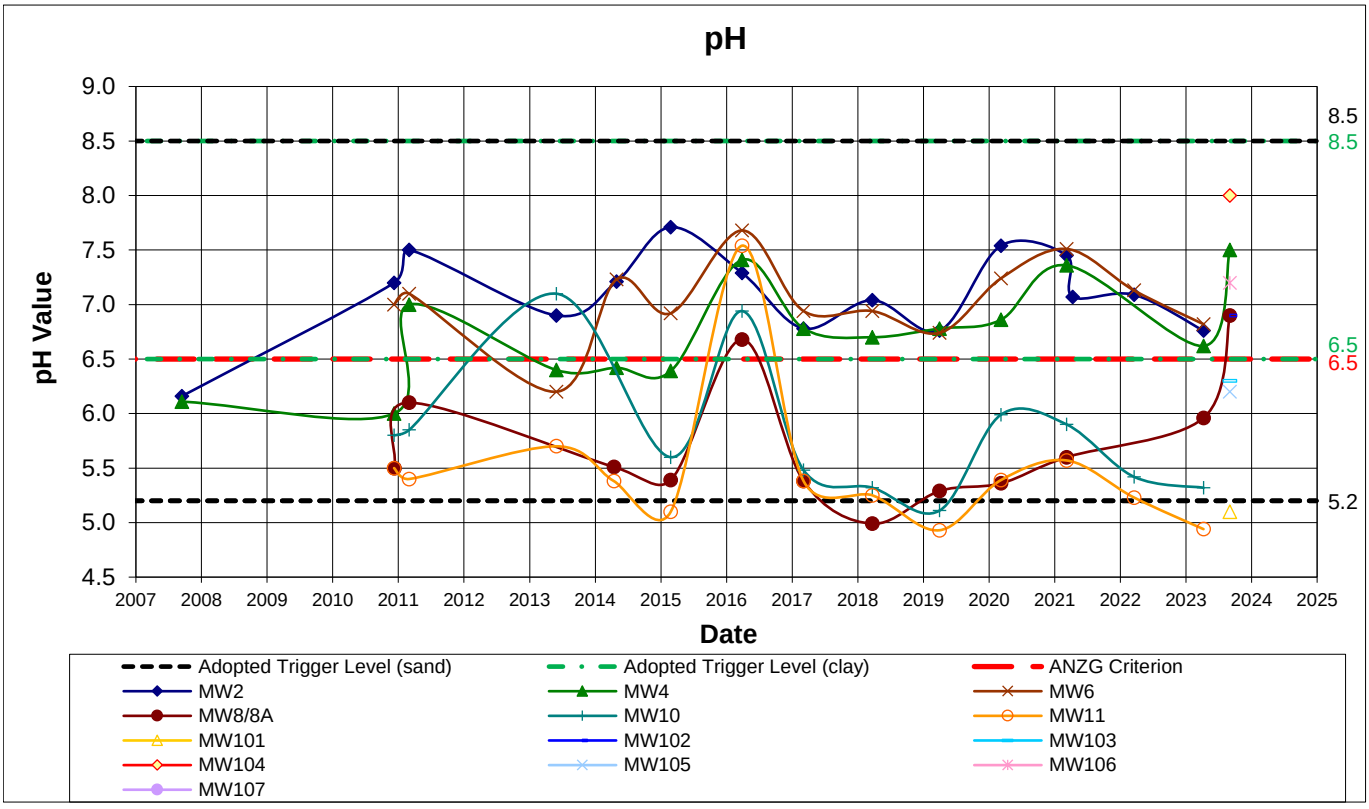
Tomago Northbank Enterprise Hub

Data Period: 2007 to Sept 2023

Data set: All data **Project: 39920.09**

Trigger Levels Data Period: 2007 to Sept 2023





1. Values reported below LOR are plotted as half of LOR
2. If a Criterion line is not plotted, there is no criteria for the parameter
3. Trigger Level - Sands (MW8A, MW101, MW102, MW103, MW105)
4. Trigger Level - Clays (MW4, MW104, MW106, MW107)

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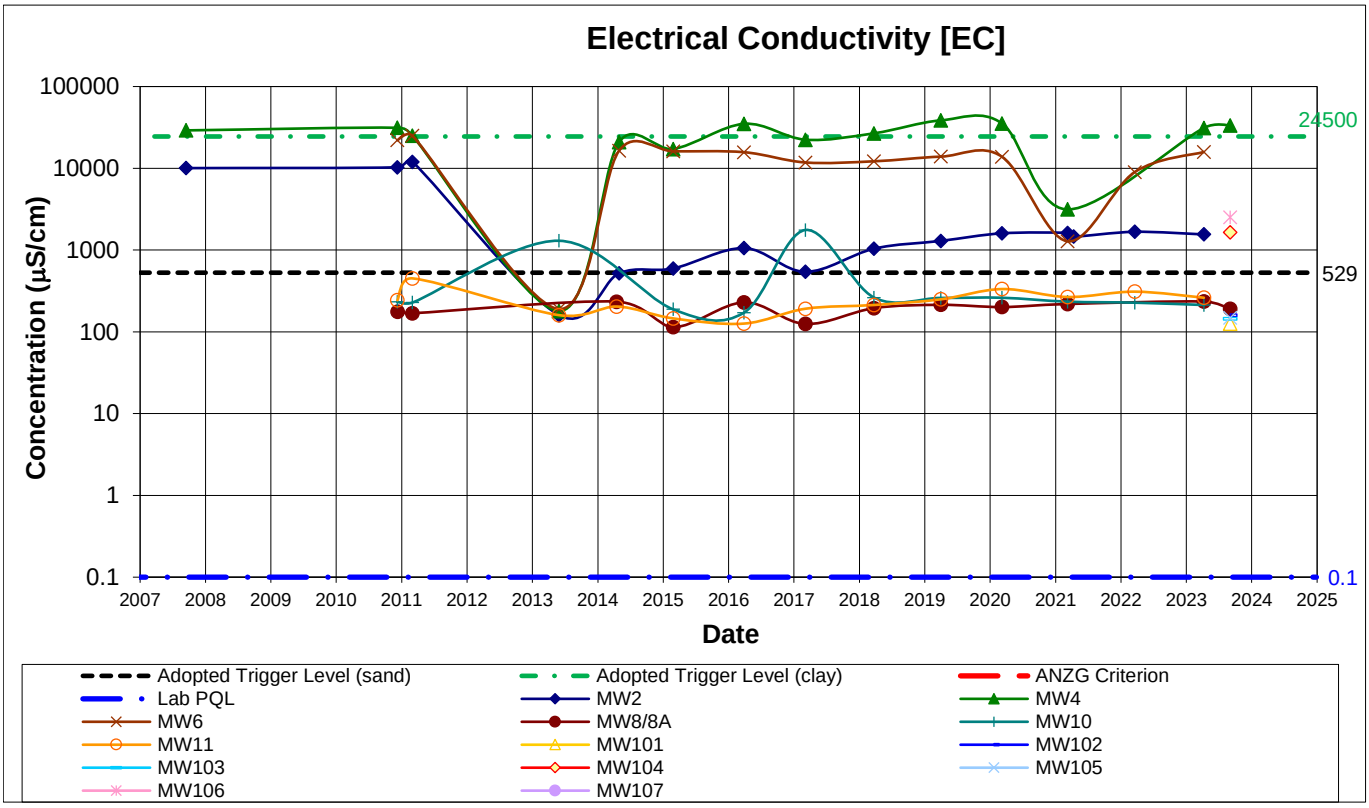
GROUNDWATER QUALITY MONITORING

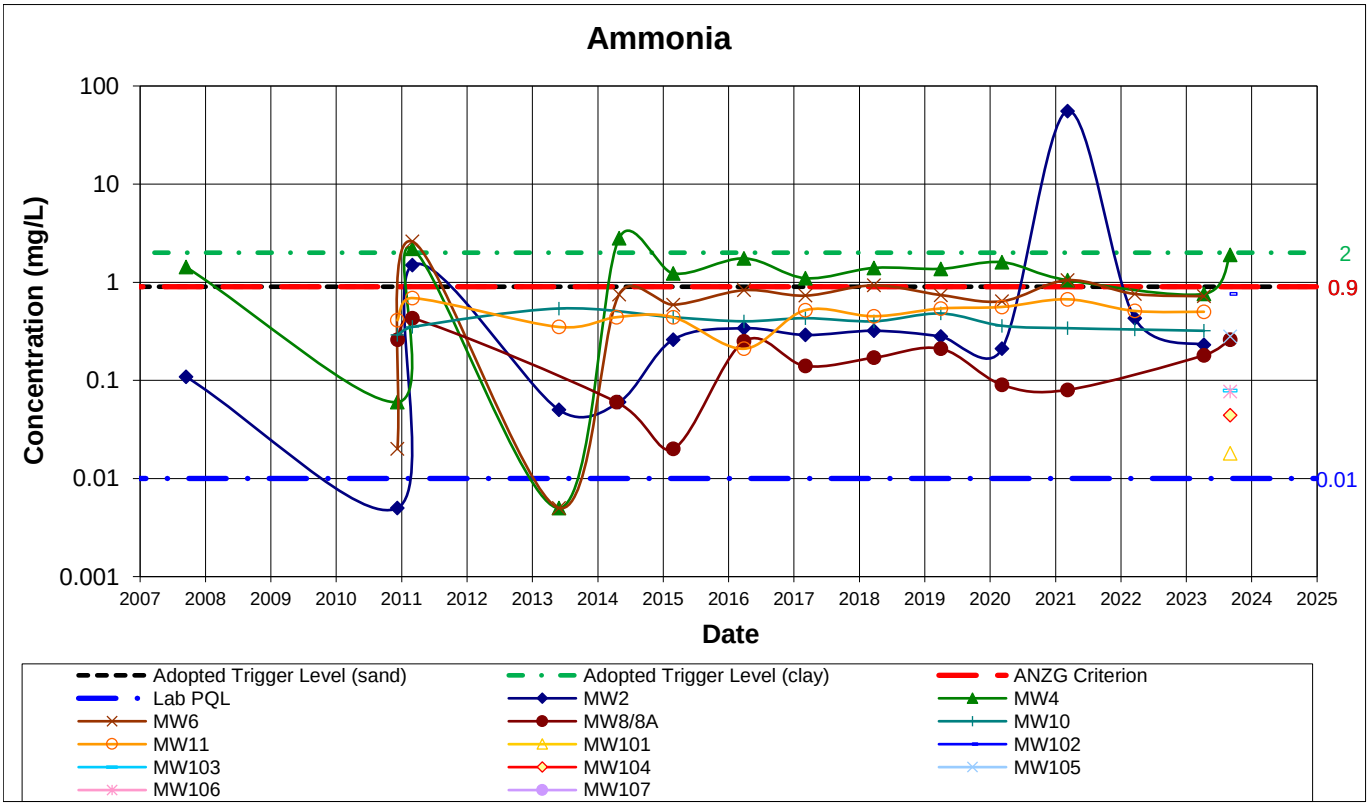
Tomago Northbank Enterprise Hub

Data Period: 2007 to Sept 2023

Data set: All data **Project: 39920.09**

Trigger Levels Data Period: 2007 to Sept 2023





1. Values reported below LOR are plotted as half of LOR
2. If a Criterion line is not plotted, there is no criteria for the parameter
3. Trigger Level - Sands (MW8A, MW101, MW102, MW103, MW105)
4. Trigger Level - Clays (MW4, MW104, MW106, MW107)

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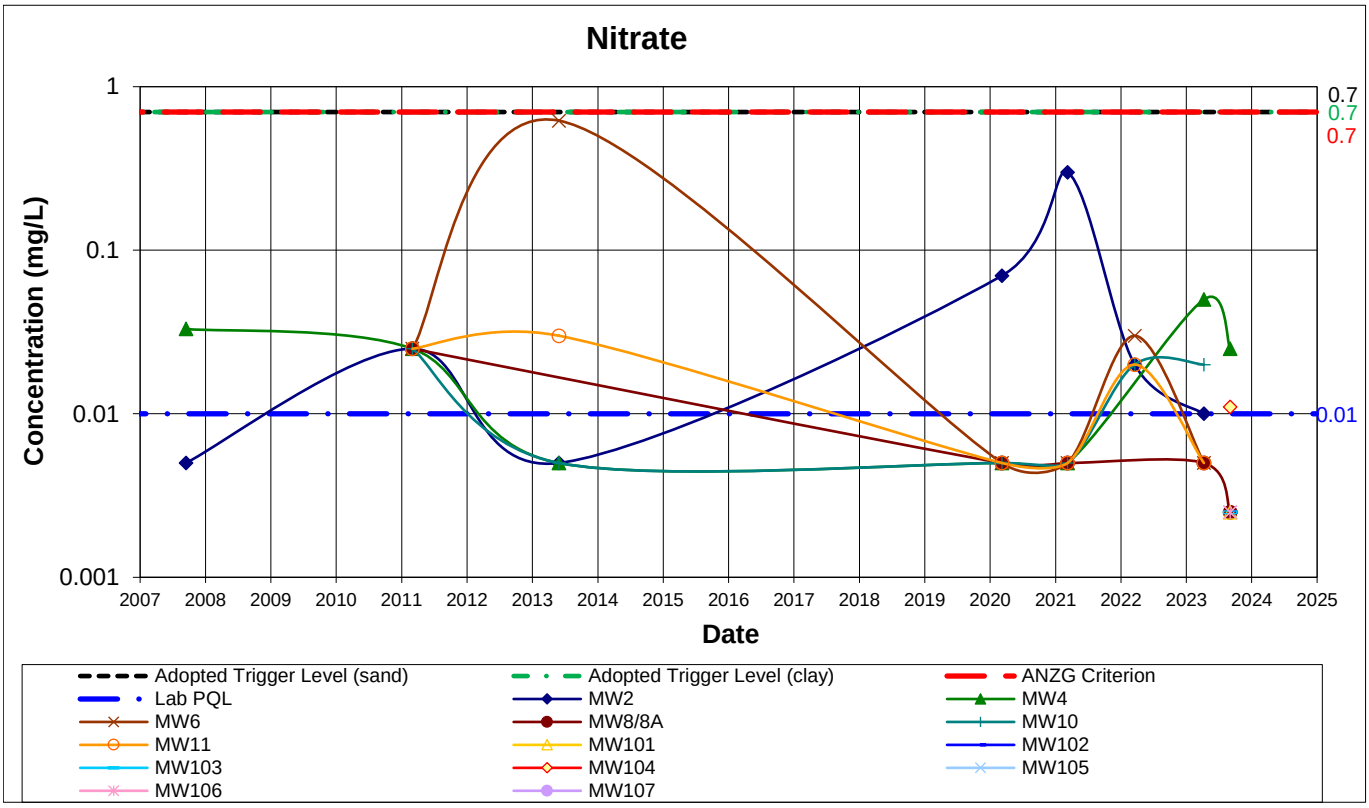
GROUNDWATER QUALITY MONITORING

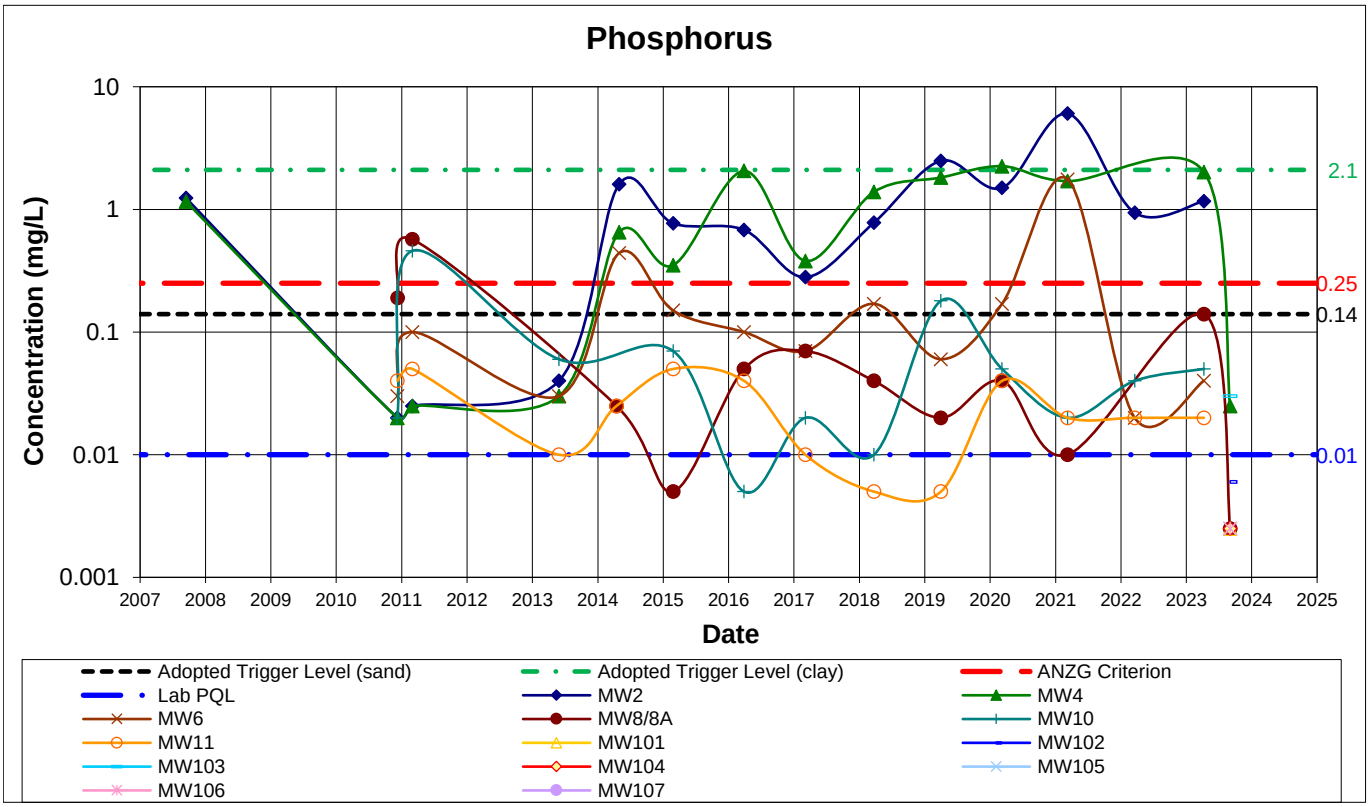
Tomago Northbank Enterprise Hub

Data Period: 2007 to Sept 2023

Data set: All data **Project: 39920.09**

Trigger Levels Data Period: 2007 to Sept 2023





1. Values reported below LOR are plotted as half of LOR
2. If a Criterion line is not plotted, there is no criteria for the parameter
3. Trigger Level - Sands (MW8A, MW101, MW102, MW103, MW105)
4. Trigger Level - Clays (MW4, MW104, MW106, MW107)

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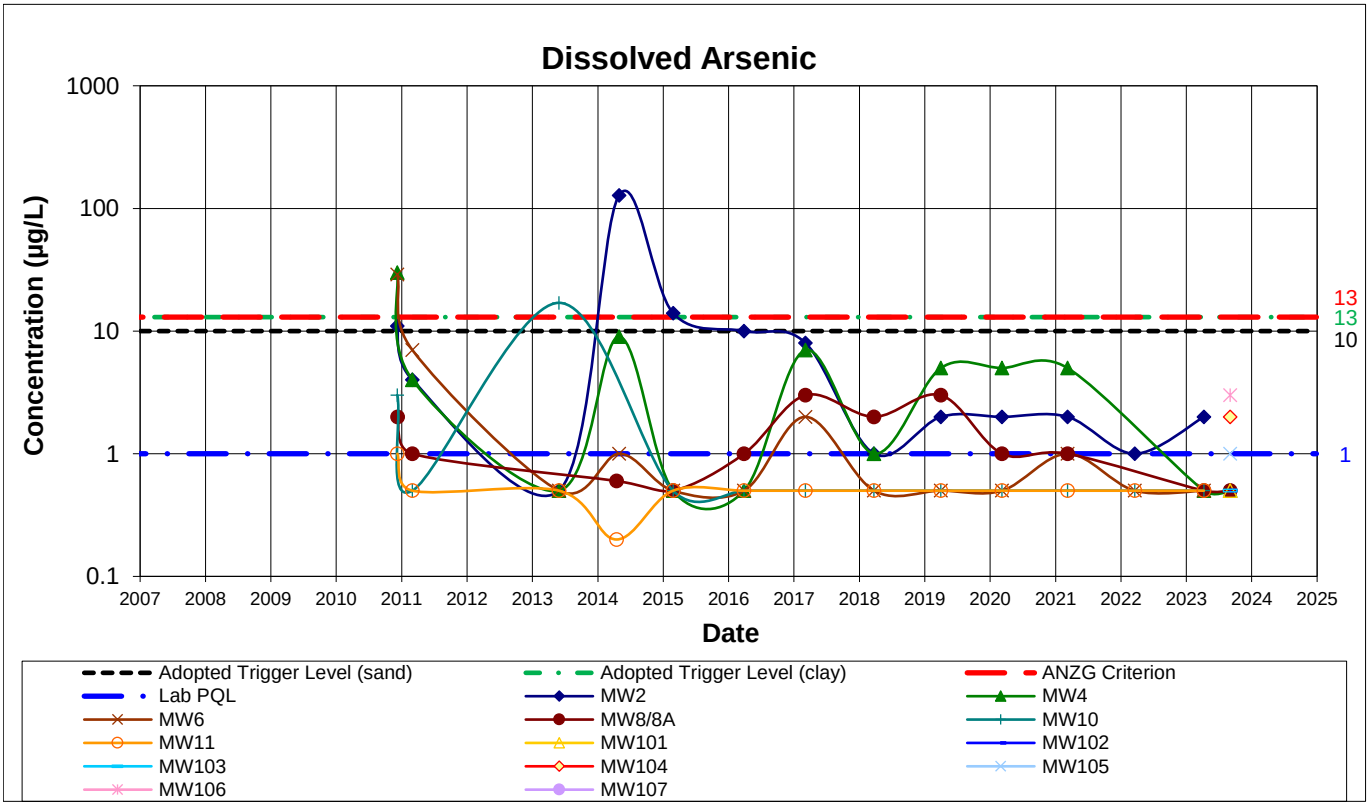
GROUNDWATER QUALITY MONITORING

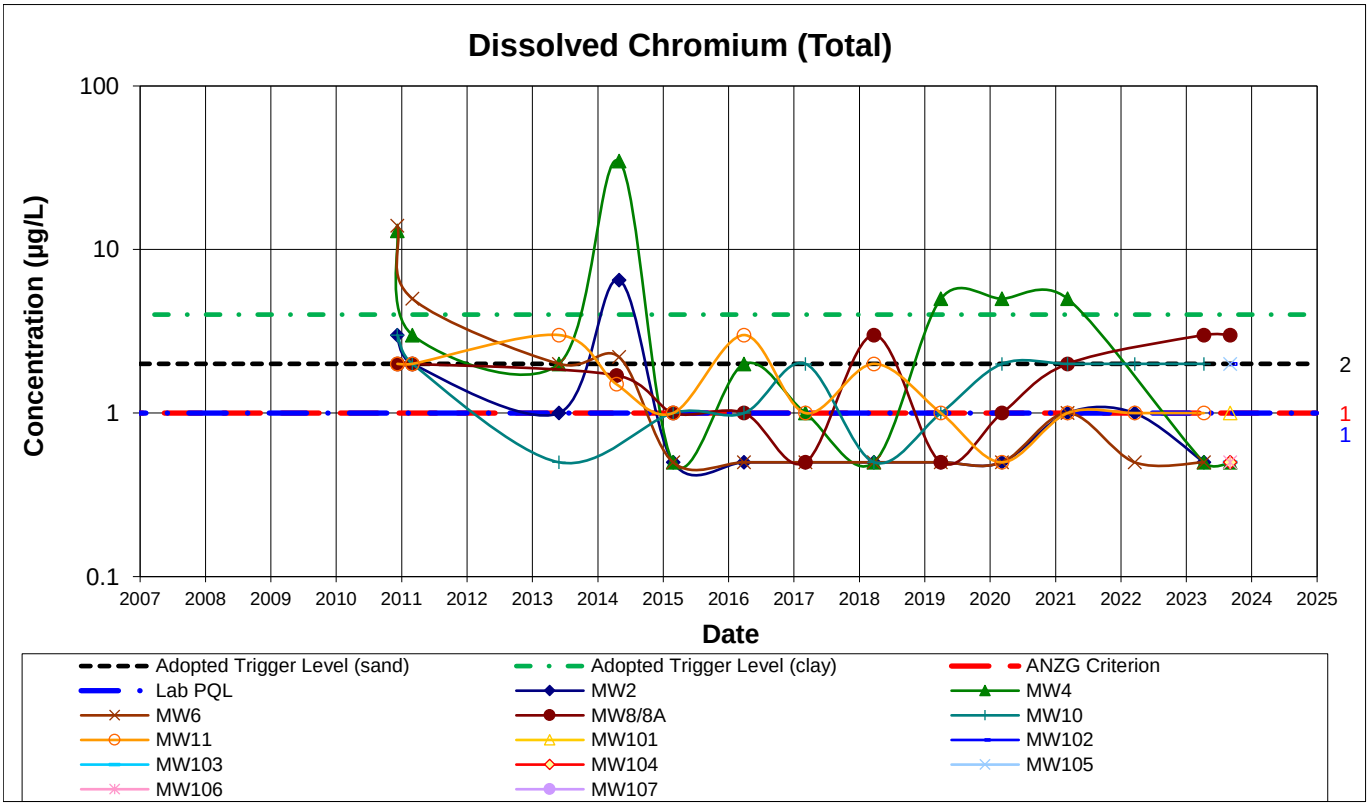
Tomago Northbank Enterprise Hub

Data Period: 2007 to Sept 2023

Data set: All data **Project: 39920.09**

Trigger Levels Data Period: 2007 to Sept 2023





1. Values reported below LOR are plotted as half of LOR
2. If a Criterion line is not plotted, there is no criteria for the parameter
3. Trigger Level - Sands (MW8A, MW101, MW102, MW103, MW105)
4. Trigger Level - Clays (MW4, MW104, MW106, MW107)

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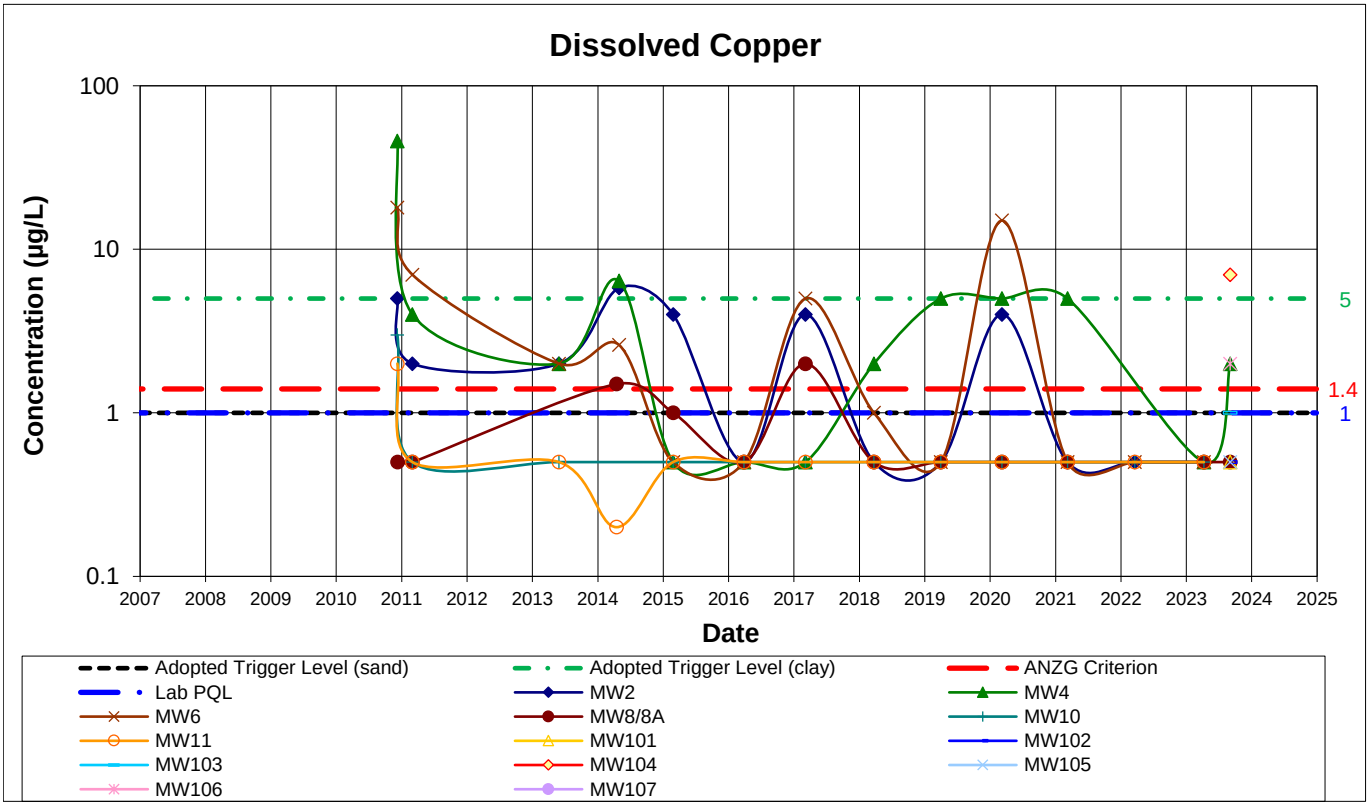
GROUNDWATER QUALITY MONITORING

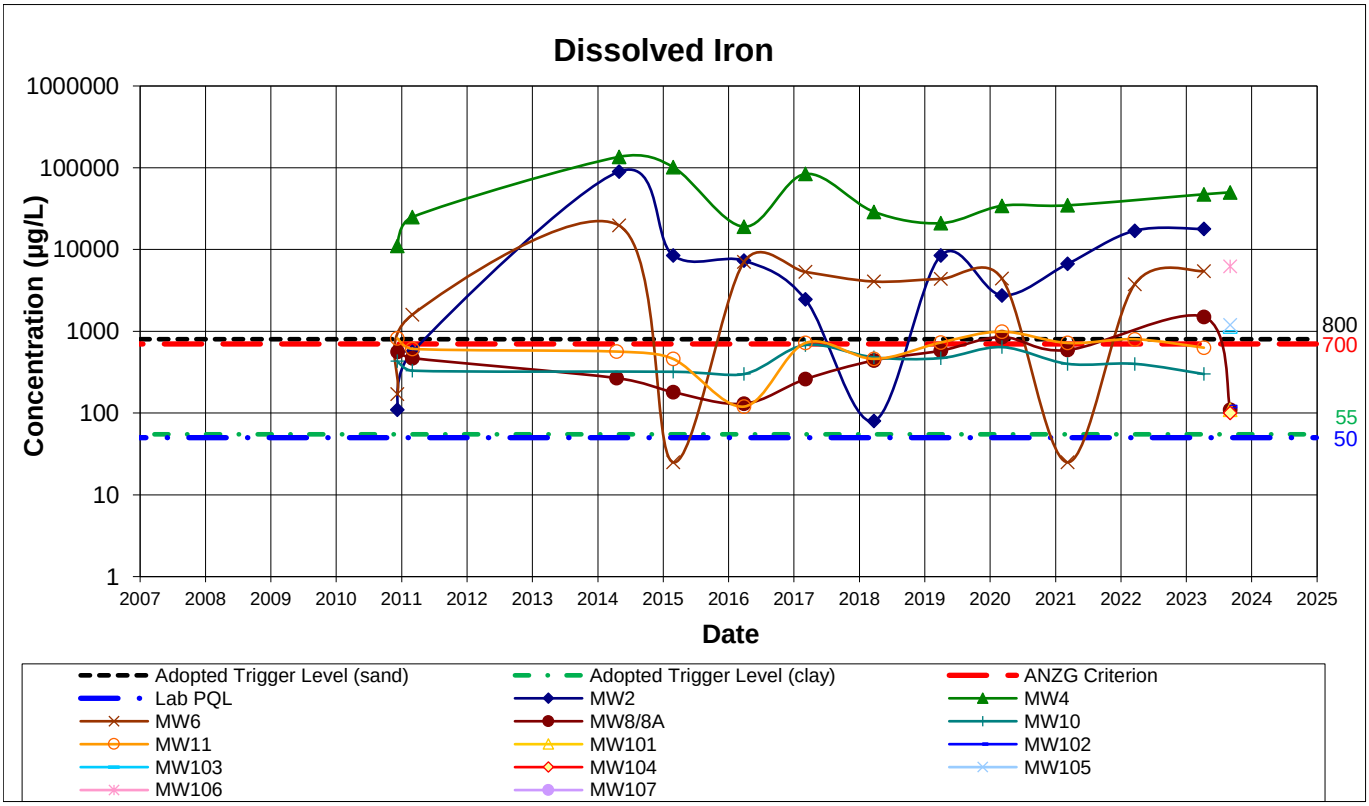
Tomago Northbank Enterprise Hub

Data Period: 2007 to Sept 2023

Data set: All data **Project: 39920.09**

Trigger Levels Data Period: 2007 to Sept 2023





1. Values reported below LOR are plotted as half of LOR
2. If a Criterion line is not plotted, there is no criteria for the parameter
3. Trigger Level - Sands (MW8A, MW101, MW102, MW103, MW105)
4. Trigger Level - Clays (MW4, MW104, MW106, MW107)

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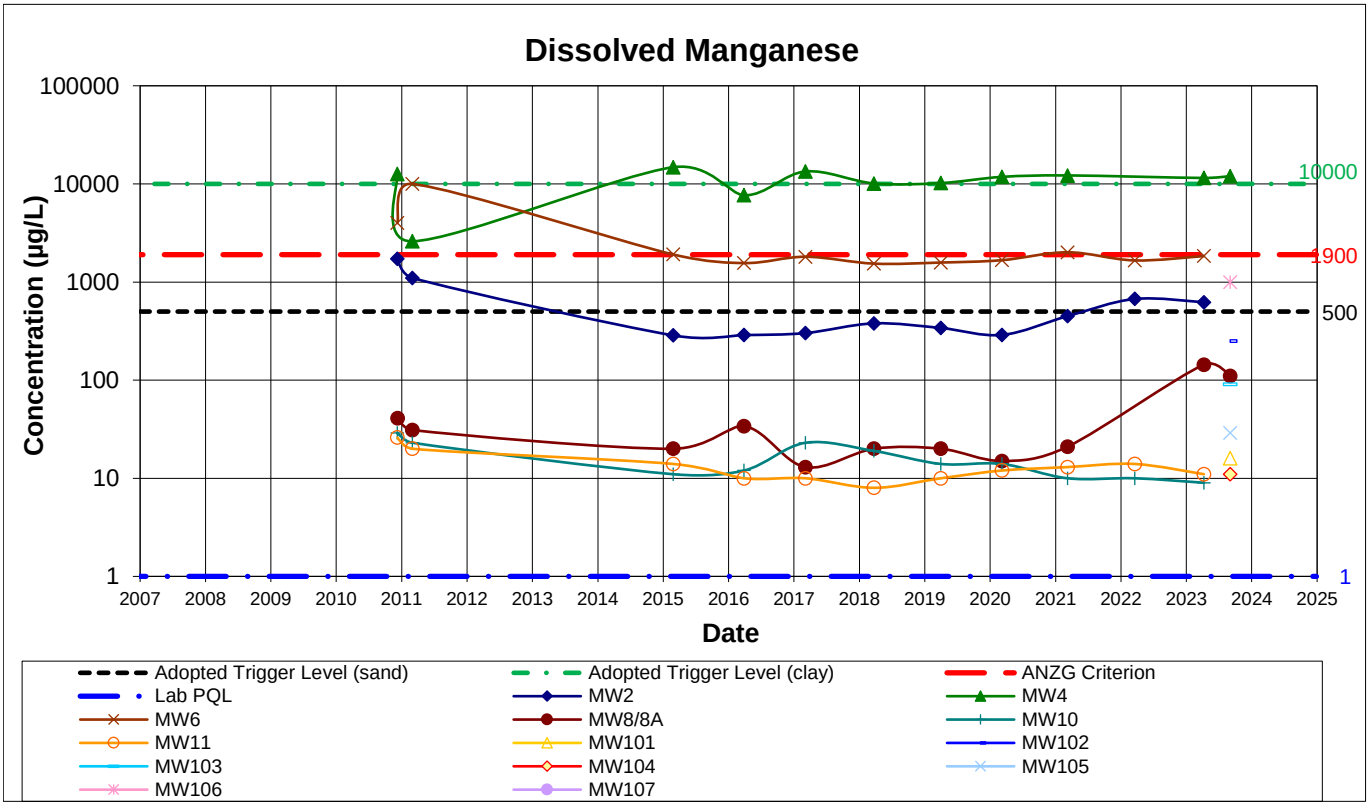
GROUNDWATER QUALITY MONITORING

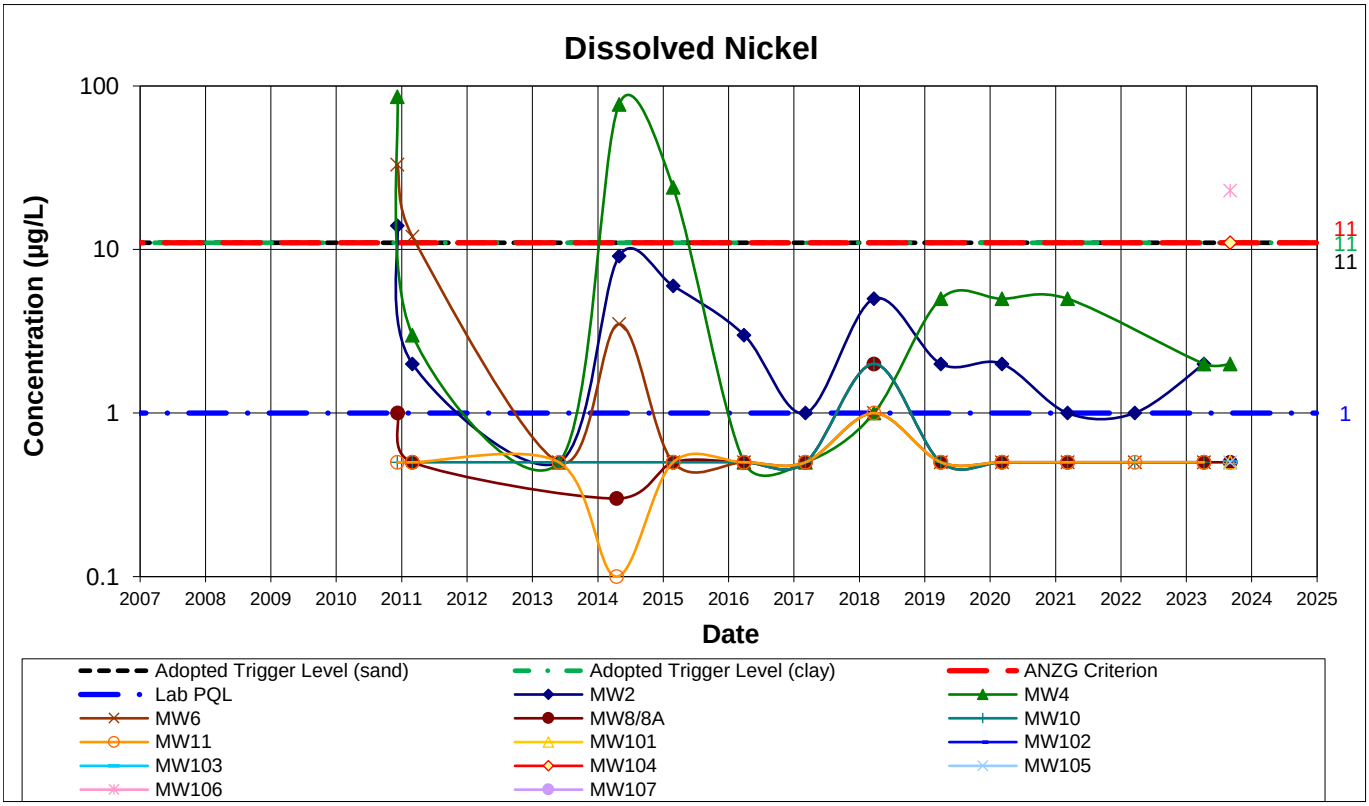
Tomago Northbank Enterprise Hub

Data Period: 2007 to Sept 2023

Data set: All data **Project: 39920.09**

Trigger Levels Data Period: 2007 to Sept 2023





1. Values reported below LOR are plotted as half of LOR
2. If a Criterion line is not plotted, there is no criteria for the parameter
3. Trigger Level - Sands (MW8A, MW101, MW102, MW103, MW105)
4. Trigger Level - Clays (MW4, MW104, MW106, MW107)

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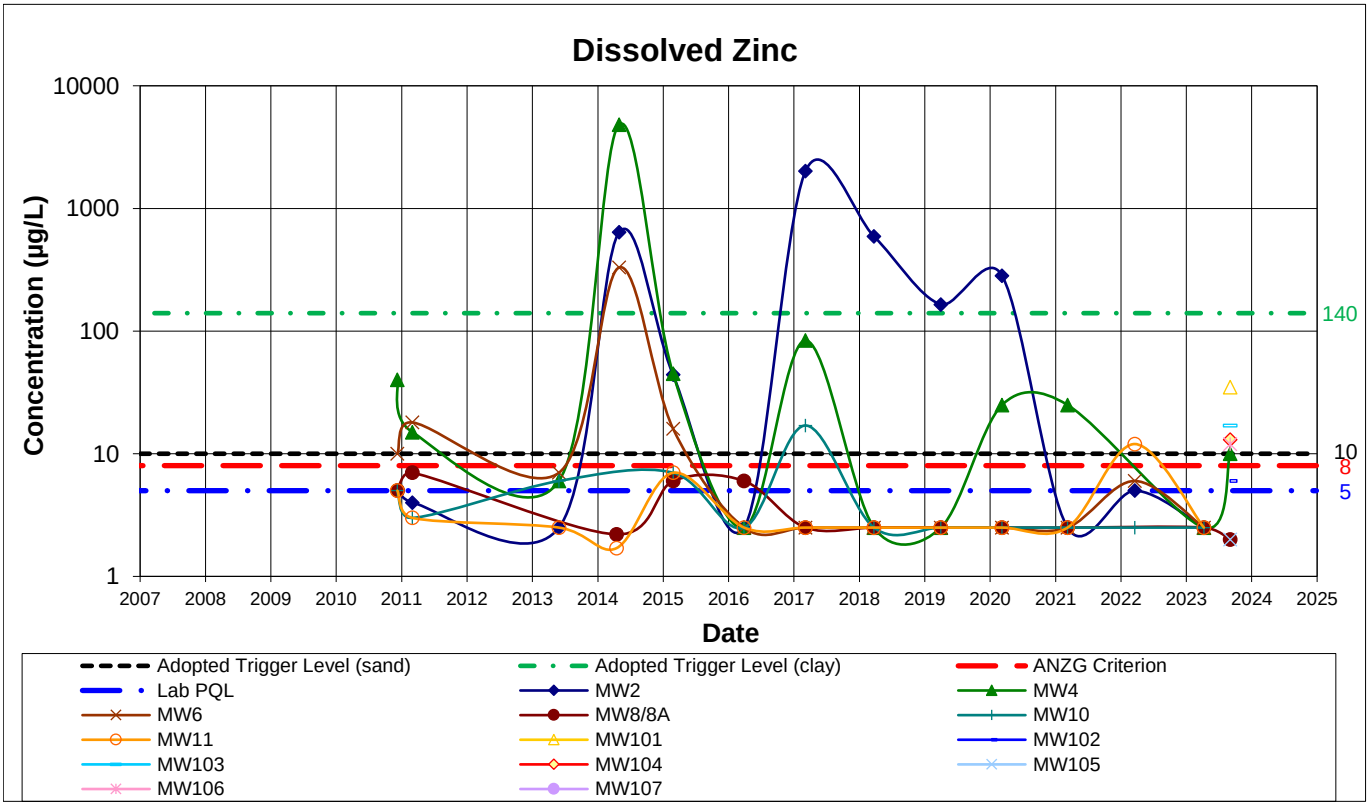
GROUNDWATER QUALITY MONITORING

Tomago Northbank Enterprise Hub

Data Period: 2007 to Sept 2023

Data set: All data **Project: 39920.09**

Trigger Levels Data Period: 2007 to Sept 2023



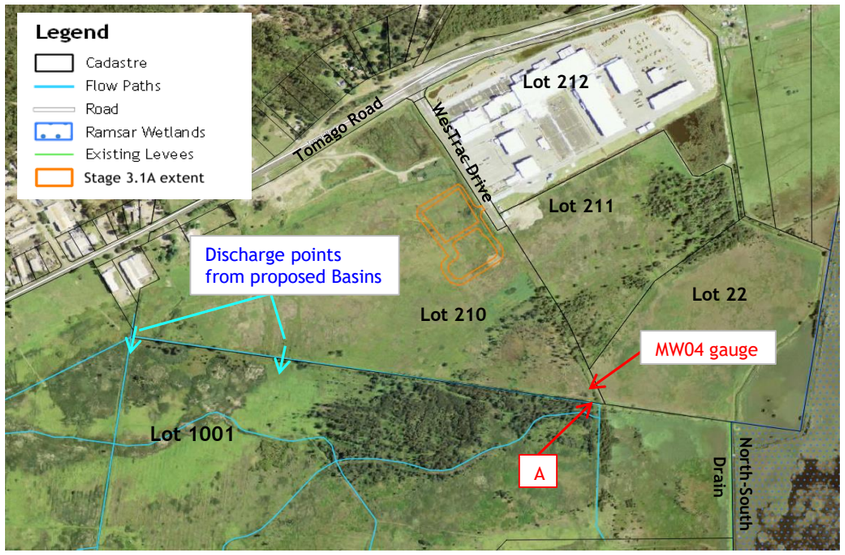
1. Values reported below LOR are plotted as half of LOR
2. If a Criterion line is not plotted, there is no criteria for the parameter
3. Trigger Level - Sands (MW8A, MW101, MW102, MW103, MW105)
4. Trigger Level - Clays (MW4, MW104, MW106, MW107)

Appendix E

Trigger Action Response Plan

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Locality and drainage map



Estate Layout Plan

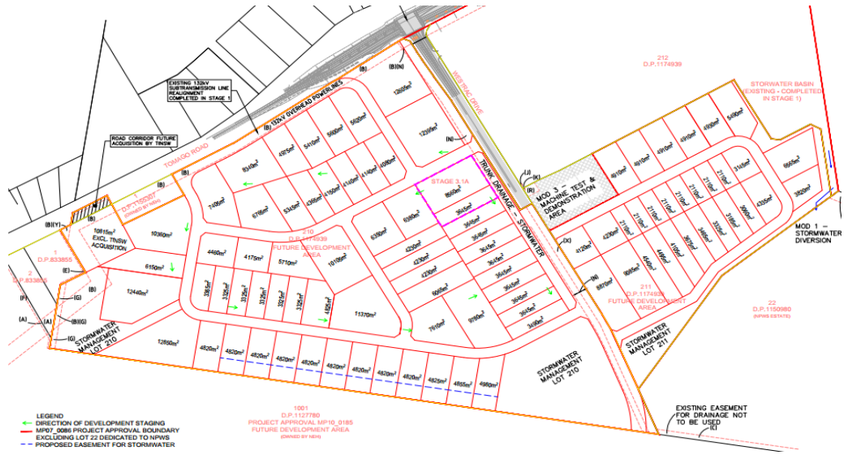


Photo of Location "A"

Purpose of this TARP (TARP #1)

TARP #1 describes the adopted triggers, proposed actions and responses to identify and mitigate the potential impacts of the Project due to changes in groundwater quality and quanity downstream of the Project (i.e. the potential impact to the environmental receptors).

Commitments and monitoring

1) The following will be undertaken prior to the commencement of Stage 3 works:
- Existing drains will be cleared as per the drain clearing plan (refer to Figure 1 on Page 4).
- Assessment of water level data at MW04 and the downstream data provided by NPWS to establish baseline water level trends.
- Monitoring of observation areas to establish baseline site conditions (refer to Figure 2 on Page 5 for potential observation areas).
- Installation of live water level monitoring device at MW04 (telemetry).

2) The following will be undertaken during the first 3 months from the commencement of Stage 3 works:
- Continued monitoring and assessment of water level data at MW04 to establish baseline water level trends.
- Continued site observations on the ground and/or by drone.
- Continued observations of the cleared drains for integrity and function.

3) The following will be assessed and reported to NPWS every 6 months from the commencement of Stage 3 works:
- Observation area monitoring results.
- Water level monitoring results at MW04.
- Observations on the integrity and function of the cleared drains.

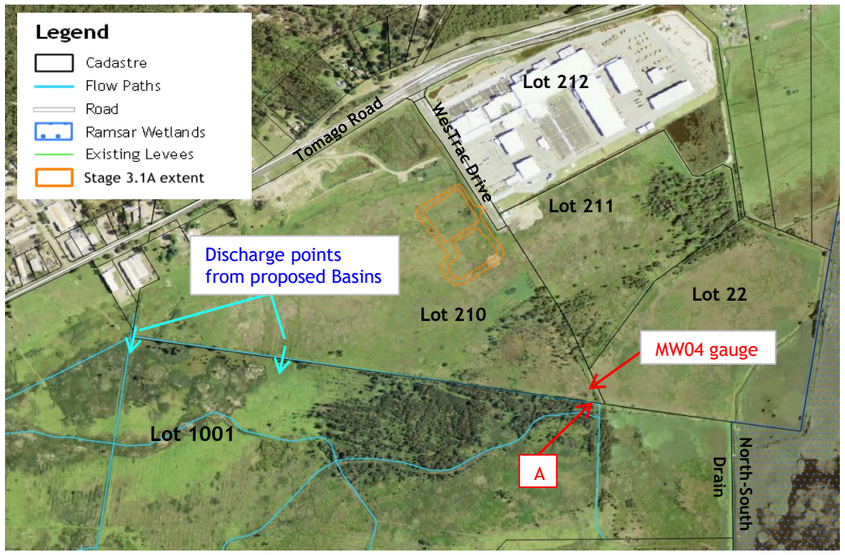
TARP

Level	Trigger (see note [a])	Action	Response
Level 1 (Normal)	• Trend in peak water levels at MW04 is not adversely increased compared to the baseline.	• Continue to monitor water level at MW04 and NPWS Floodgate.	• No further response required.
Level 2 (Mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS drains. • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate.	• Response 1 - Undertake capping of the existing culvert at the southeastern corner of Lot 210 (refer to Figure 2 on Page 5).
Level 3 (Additional mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline. • Level 3 trigger applies if: o Culvert at the southeastern corner of Lot 210 has been capped in response to Level 2 trigger.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS drains. • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate.	• Response 2 - Grade fill layer for runoff control across Lot 210 towards the south and southwestern boundaries of Lot 210 to direct runoff to Lot 1001 DP1127780, including berms to control runoff from any interim basins within Lot 210 (refer to Figure 3 on Page 6).
Level 4 (Additional mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline. • Level 4 trigger applies if: o Culvert at the southeastern corner of Lot 210 has been capped in response to Level 2 trigger; and o Graded fill layer across Lot 210 is in place in response to Level 3 trigger.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS drains. • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate.	• Response 3 - Undertake additional drain clearing along the existing drainage easement further south within Lot 1001 to reinstate the drains from Lot 210 to the more deeply incised drains within Lot 1001 (refer to Figure 4 on Page 7).
Level 5 (Additional mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline. • Level 5 trigger applies if: o Culvert at the southeastern corner of Lot 210 has been capped in response to Level 2 trigger; o Graded fill layer across Lot 210 is in place in response to Level 3 trigger; and o Additional drain clearing on Lot 1001 has been undertaken in response to Level 4 trigger.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS drains. • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate. • Review the observation area monitoring results and assess any correlations with the recorded water level data at MW04.	• Initiate an investigation on the reasons for increased water levels at MW04 and develop additional mitigation measures for further catchment diversions to the Hunter River.

[a] - The criteria for what would be considered an "adverse increase" in peak water level trends will be confirmed based on analysis of recorded water level data to date. This criteria will be reviewed on a quarterly basis and updated if required as additional monitoring data becomes available.

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Locality and drainage map



Estate Layout Plan

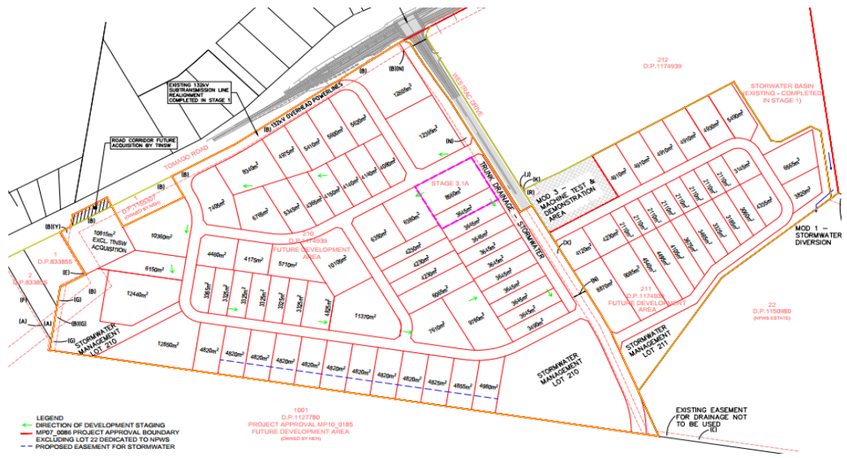


Photo of Location "A"

Purpose of this TARP (TARP #2)

TARP #2 describes the adopted triggers, proposed actions and responses to identify and mitigate the potential impacts of the Project on the drinking water supply (Hunter Water Corporation) due to changes in groundwater quanity in the Tomago Sandbeds.

Commitments and monitoring

1) The following will be undertaken prior to the commencement of Stage 3 works:
   - Installation of live water level monitoring device at MW101 and SK3520 (refer to Figure 5 on Page 8 for monitoring locations).
   - Assessment of baseline conditions at MW101 screened in the Tomago Sandbeds and located near the upstream boundary of the site.
   - Collection and review of monitoring data collected at the HWC bore (SK3520) screened in the Tomago Sandbeds and located about 1 km northeast of the project to assess baseline conditions at this location.

2) The following will be undertaken during the first 3 months from the commencement of Stage 3 works:
   - Continued monitoring and assessment of water level data at MW101 and SK3520 to establish baseline water level trends.

3) The following will be assessed and reported to NPWS every 6 months from the commencement of Stage 3 works:
   - Review of water level monitoring results at both MW101 and SK3520.

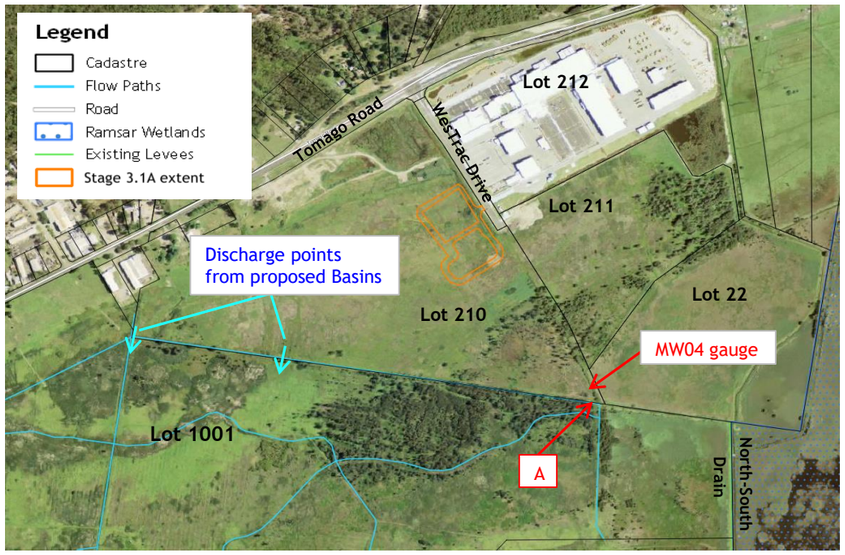
MW101 and SK3520 are both screened in the Tomago Sandbeds. The purpose of monitoring both MW101 located within the site and SK3520 located outside of the site is to assess whether any observed trends are attributable to the project or to regional stressors.

TARP

Level	Trigger	Action	Response
Level 1	• Groundwater levels at MW101 are within the baseline range; and • any noticeable trends are attributed to external stressors (e.g. climate, pumping).	• Continue to monitor as planned.	• No response required.
Level 2	• Groundwater levels at MW101 are outside baseline range; and • trends can be noticed that are not obviously attributable to external stressors.	• Review recorded data at SK3520 to check if trend is general. If so, trend would be considered not attributable to the project.	• Response 1 - investigate possible causes for the change.
Level 3	• Groundwater levels at MW101 are outside baseline range; • trends can be noticed that are not attributable to external stressors; • similar change is not observed at SK3520.	• If increase in water level (mounding): review drainage requirements in northern part of the site. • If decrease in water level (drawdown): review groundwater inflows in excavations.	• Response 2 (if mounding): installation of a drain at the northern boundary of the project to divert any runoff to Lot 210 (stormwater management basin area). • Response 2 (if drawdown): control and reduce inflows in excavation areas, discharge clean surplus water to the northern part of the site (on the sand beds) for infiltration and recharge.
Level 4	• Same as above; and • Response 2 was implemented but trends are still observed.	• Review performance of measures implemented as part of Response 2. • If increase in water level (mounding): review drainage system in northern part of the site. • If decrease in water level (drawdown): review groundwater inflows in excavations.	• Response 3 (if mounding): additional drain to divert water to Lot 210 (stormwater management basin area). • Response 3 (if drawdown): increased control to reduce inflows in excavation areas, discharge clean surplus water to the northern part of the site (on the sand beds) for infiltration and recharge.
Level 5	• Same as above; and • Response 3 was implemented but trends are still observed.	• Review performance of measures implemented as part of Response 3. • If increase in water level (mounding): review drainage system in northern part of the site • If decrease in water level (drawdown): review groundwater inflows in excavations.	• Response 4 - Stop work, initiate detailed investigations to understand the cause(s) of the changes in water levels, develop additional mitigation measures.

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Locality and drainage map



Estate Layout Plan

Photo of Location "A"

Purpose of this TARP (TARP #3)

TARP #3 describes the adopted triggers, proposed actions and responses to identify and mitigate the potential impacts of contamination/changes in groundwater and/or surface water quality as a result of the Project.

Commitments and monitoring

Monitoring of water quality will be implemented as outlined in the groundwater and surface water management plans.

TARP

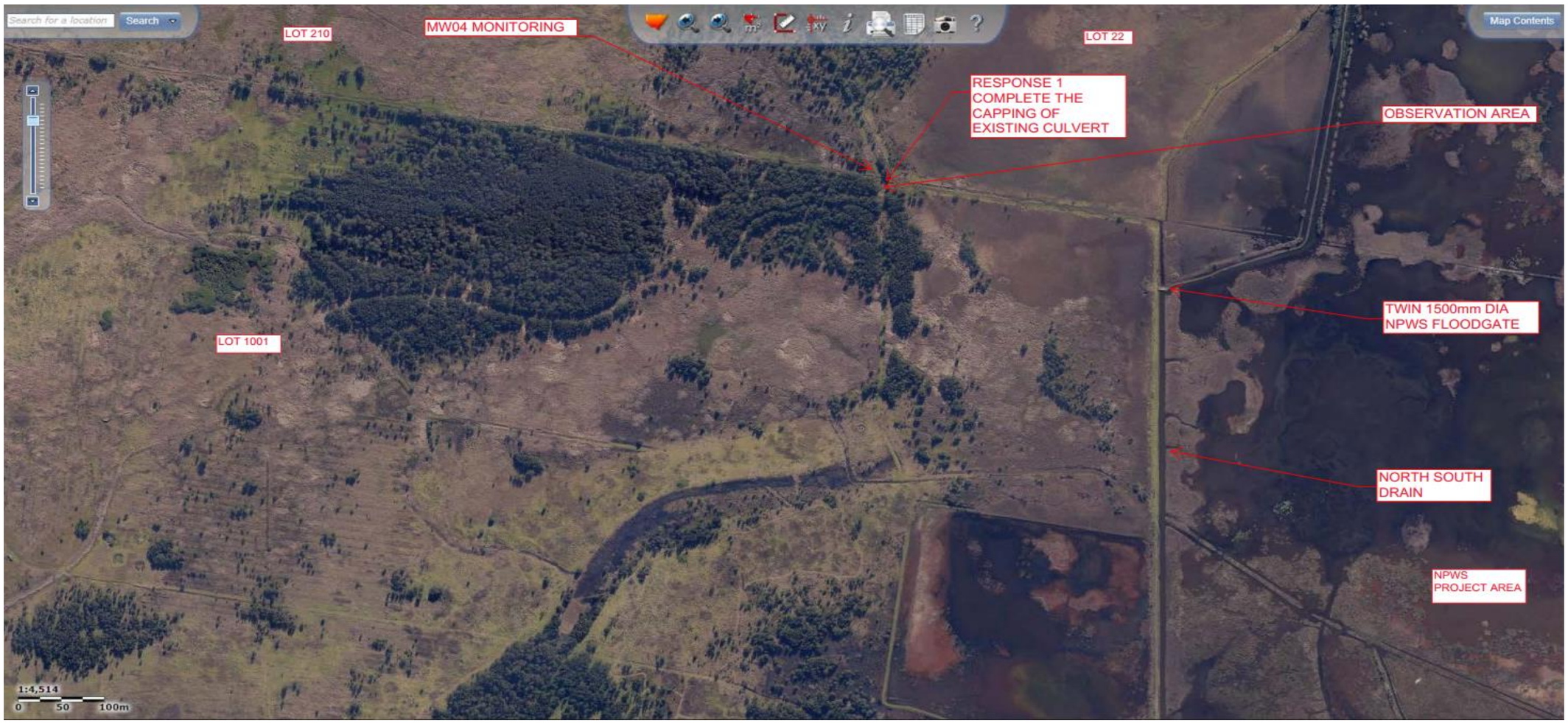
Level	Trigger (see note [a])	Action	Response
Level 1	• Groundwater quality is within baseline range; and • any noticeable trends are attributed to external stressors (e.g. climate, pumping).	• Continue to monitor as planned.	• No response required.
Level 2	• Single exceedance for any one analyte and bore; or • Any noticeable trends / changes in water quality.	• Review water quality data for all analytes. • Organise additional monitoring rounds to confirm the exceedances / change in water quality	• Response 1 - keep monitoring water quality and assessing trends.
Level 3	• Three consecutive results exceeding trigger levels for any one bore and analyte.	• Advise and seek advice from DPE Water. • Review water quality data for all analytes. • Organise additional monitoring rounds to confirm the exceedances / change in water quality.	• Response 2 - investigate possible causes for the change.
Level 4	• Exceedances continue and cannot be attributed to external factors.	• Collect water quality data outside of the project area (e.g. at monitoring locations at other projects). • Compare site-specific data to those collected from surrounding areas. • If change in water quality appears to be caused by the project, advise relevant authorities, adjacent water users and conduct detailed investigations to plan for remediation.	• Response 3 (If change in water quality appears to be caused by the project) - Prepare remediation plan based on results of investigations. • Response 3 (if change is regional and not caused by project) - review and update trigger values.
Level 5	• Response 3 (if change is regional and not caused by project) - review and update trigger values; and • More analytes exceed their trigger levels.	• Review performance of measures implemented as part of Response 3.	• Response 4 - Stop work, develop additional remediation measures if consultation with experts.

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 1: Drain clearing plan (for TARP#1 on Page 1)

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 2: Response 1 (for TARP#1 on Page 1) - Capping of the existing culvert at the southeastern corner of Lot 210

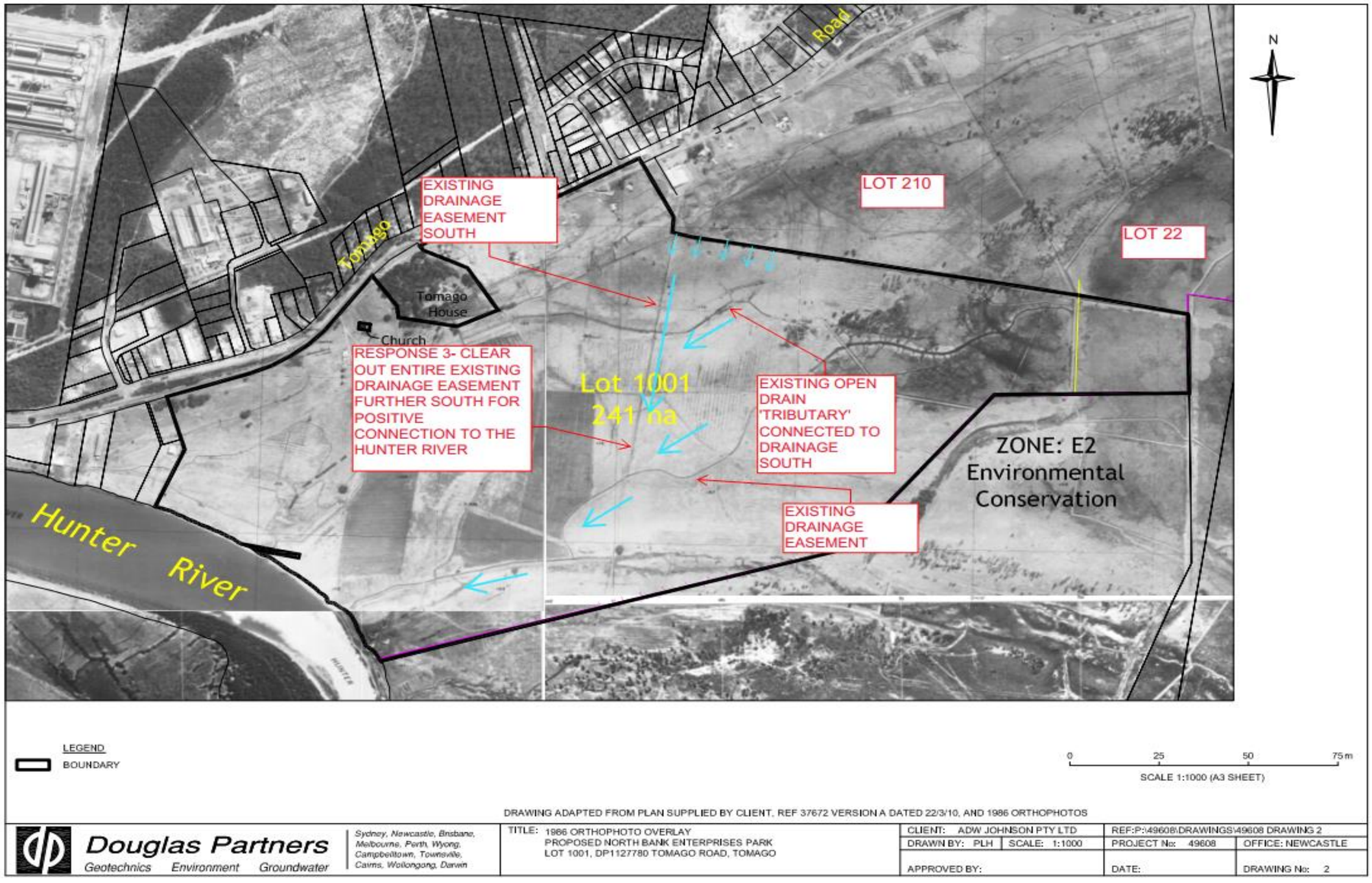


Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 3: Response 2 (for TARP#1 on Page 1) - Extent of proposed initial fill layer, graded towards the south and southwestern boundaries of Lot 210

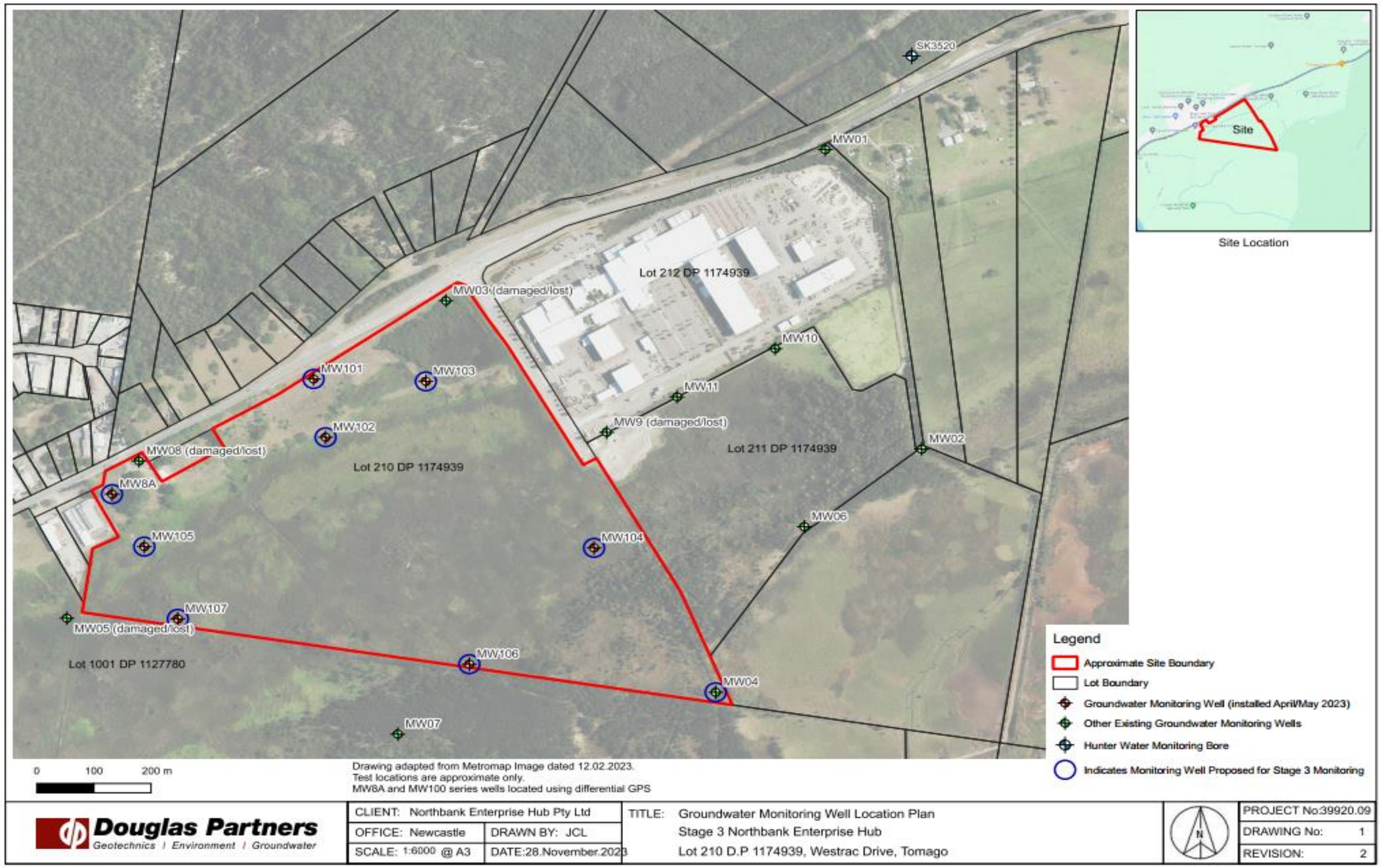
Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 4: Response 3 (for TARP#1 on Page 1) - Additional drain clearing along the existing drainage easement at Lot 1001



Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 5: Groundwater monitoring well location plan



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Northbank Enterprise Hub Pty Ltd		TITLE: Groundwater Monitoring Well Location Plan	PROJECT No:39920.09
OFFICE: Newcastle	DRAWN BY: JCL	Stage 3 Northbank Enterprise Hub	DRAWING No: 1
SCALE: 1:6000 @ A3	DATE:28.November.2023	Lot 210 D.P 1174939, Westrac Drive, Tomago	REVISION: 2

Appendix F

Declaration of Accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed 

Full name (please print) Bryant Stokes

Organisation (please print) Northbank Enterprises Hub Pty Ltd

Date 22 / 04 / 2024