

Hydrogeological Impact Assessment

3631 Nelson Bay Road, Bobs Farm, NSW

Final Report

P2511038JR07V02

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For Newcastle Sand C/- ADW Johnson

environmental science & engineering

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1 Introduction

1.1 Overview

Martens & Associates Pty Ltd (**MA**) has been engaged by Newcastle Sand (the **Client**), through ADW Johnson, to undertake a Hydrogeological Impact Assessment (**HIA**) for a proposed sand quarry (the **quarry**) located at 3631 Nelson Bay Road, Bobs Farm, NSW (the **Site**).

The HIA has been prepared to support a State Significant Development Application (**SSDA**) SSD-99860959 to the NSW Department of Planning, Housing and Infrastructure (**DPHI**), and will form part of an Environmental Impact Statement (**EIS**) to address the Secretary's Environmental Impact Assessment Requirements (**SEARs**) for the proposed development.

1.2 Project Background

MA has previously completed several hydrogeological assessments for the Site between 2013 and 2020, the most recent of which was prepared in support of a former SSDA (SSD 6395) that proposed extraction of sand below the water table, which has since been withdrawn.

The current SSDA proposes extraction of sand above the water table only and therefore does not involve pit dewatering or intersection with the water table, which materially reduces the hydrogeological risk profile compared to the previous application.

A summary of the previous hydrogeological investigations and relevant findings has been provided in Section 2, and relevant data has been incorporated into the current assessment.

1.3 Proposed Development

The proposal involves the establishment of a sand quarry at the Site to extract and process up to 530,000 tonnes of sand per year for up to 10 years. The quarry is to include the following key components and activities:

- Establishment of site infrastructure including internal access/haul roads, operational sheds and ancillary facilities, and a weighbridge.
- Vegetation clearing.
- Topsoil stripping and stockpiling.
- Staged extraction of sand within the approved disturbance area, undertaken 0.7 m above the existing groundwater table using conventional quarrying methods.
- Onsite processing through screening and washing to produce construction and glass-grade sand products.

- Water management associated with sand washing, including water recycling and filter press systems to minimise potable water demand.
- Stockpiling of raw and processed material prior to dispatch.
- Use of mobile plant and equipment (e.g. excavators, loaders, articulated haul trucks, conveyors and water carts) and associated fuel/chemical handling (refuelling and maintenance arrangements to be confirmed).
- Progressive rehabilitation of extracted areas.

Proposed quarry plans are provided in Appendix A.

1.4 Study Area

The study area adopted for this HIA is bounded by Tilligerry Creek to the north and the Pacific Ocean to the south. Boundary lines to the east and west were assigned as perpendicular lines between the ocean and Tilligerry Creek at approximately 3 km from the Site.

The study area extents are shown in Map 01 (Appendix B).

1.5 Scope of Works

Our scope of works for this HIA is summarised as follows:

- Review existing hydrogeological data for the site and surrounding area, including previous investigations completed by MA in 2020 for the previous SSDA.
- Identify nearby groundwater users and groundwater sensitive environments.
- Collect and analyse field hydrogeological investigation data, including groundwater levels, groundwater water quality and aquifer hydraulic properties.
- Develop three-dimensional numerical groundwater models for the following scenarios:
 - **Existing** – representing the groundwater system as it exists prior to quarrying operations, calibrated to median Site groundwater monitoring data.
 - **Proposed** – representing the future groundwater system as it is expected to exist following completion of proposed quarrying.
- Assess potential impacts of quarry operations on the local groundwater system, particularly in relation to nearby groundwater dependent environments and receptors.
- Provide recommendations for impact mitigation where necessary.
- Provide preliminary monitoring recommendations for quarry operations.

1.6 Secretary's Environmental Assessment Requirements

The SEARs which relate to water resources, including relevant report sections, are provided in Table 1.

Table 1: Secretary's Environmental Assessment Requirements.

Authority	Description / Comment	Section
Department of Planning, Housing and Infrastructure Planning	<i>5. Water resources impact assessment, including;</i>	
	<i>identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000;</i>	Section 7.6
	<i>a conceptual groundwater model that assesses the potential groundwater hazards and impacts associated with the development in accordance with the Australian Groundwater Modelling Guidelines (Commonwealth, 2012) having regard to the NSW Aquifer Interference Policy (2012).</i>	Section 5, Section 6, Section 8
	<i>an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives;</i>	Section 6
	<i>an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and</i>	Section 6
	<i>Include a detailed consideration of any potential impacts on sensitive downstream receiving environments.</i>	Section 6

2 Previous Hydrogeological Assessments

2.1 Overview

MA has previously completed three hydrogeological assessments for the Site, documented in the following reports:

- *Preliminary Groundwater Assessment*, February 2014, ref. P1303897JR01V01 (**MA, 2014**).
- *Groundwater Management Plan*, June 2015, ref. P1303897JR03V02 (**MA, 2015**).
- *Hydrogeological Assessment and Management Plan*, November 2020, ref. P1303897JR08V02 (**MA, 2020**).

A summary of collective findings from these assessments are provided in the following sections, and relevant data has been incorporated into this HIA.

2.2 Field Investigations

Field investigations across the previous assessments are summarised below:

- 26 boreholes drilled between 2013 and 2019, terminating at elevations between -17.5 mAHD and 17 mAHD.
- Five groundwater monitoring wells installed by VGT in 2013 (MW1–MW5), with four additional wells installed by MA as part of the 2020 assessment (MW101–MW104)
- 15-minute interval groundwater level monitoring across two periods: MW1 – MW5 between August 2013 and October 2014 (monitoring period 1), and MW1 – MW5 and MW101 – MW104 between February and June 2020 (monitoring period 2).
- Falling head slug tests at MW1 – MW5 to estimate aquifer hydraulic conductivity.
- Four rounds of groundwater quality sampling at MW1 – MW5 between 2014 and 2015.
- Two rounds of groundwater quality sampling at all monitoring wells in 2020.

The previous groundwater monitoring network (as reported in MA, 2020) is shown in Map 02 (Appendix B).

2.3 Groundwater Level Monitoring

Median groundwater levels ranged from approximately 1.0 mAHD (MW104) to 2.8 mAHD (MW5) across both monitoring periods, with levels during monitoring period 2 generally around 0.5 m lower than during monitoring period 1. Groundwater levels during monitoring period 1 were generally stable, consistent with near-average rainfall

conditions. A general rising trend was observed during monitoring period 2, in response to increased rainfall in May and June 2020.

Statistical summaries of groundwater levels (in mAHD) recorded during previous assessments are provided in Table 2 – Table 4.

Table 2: Summary of groundwater monitoring statistics for monitoring period 1 (22/08/2013 to 13/10/2014).

Well ID	Ground Level	Min.	10 %-ile	Median	Mean	90 %-ile	Max	Range (m)
MW1	5.82	2.29	2.36	2.54	2.57	2.88	3.10	0.81
MW2	11.72	1.94	2.03	2.28	2.27	2.50	2.64	0.71
MW3	15.48	2.07	2.10	2.19	2.21	2.33	2.40	0.33
MW4	9.45	1.95	2.00	2.10	2.09	2.18	2.21	0.26
MW5	18.25	2.68	2.71	2.84	2.83	2.91	2.95	0.27

Table 3: Summary of groundwater monitoring statistics for monitoring period 1 (21/02/2020 to 25/06/2020).

Well ID	Ground Level	Min.	10 %-ile	Median	Mean	90 %-ile	Max	Range (m)
MW1	5.82	1.65	1.72	1.81	1.85	2.09	2.23	0.57
MW2	11.72	2.10	2.20	2.29	2.30	2.40	2.50	0.39
MW3	15.48	1.45	1.85	1.88	1.87	1.90	1.92	0.47
MW4	9.45	1.48	1.51	1.54	1.56	1.64	1.96	0.48
MW5	18.25	2.22	2.43	2.47	2.49	2.56	2.61	0.40
MW101	6.77	1.49	1.56	1.63	1.67	1.89	1.96	0.47
MW102	25.63	2.39	2.44	2.50	2.49	2.52	2.57	0.18
MW103	31.35	2.27	2.30	2.32	2.33	2.35	2.39	0.13
MW104	11.83	0.88	0.96	1.02	1.03	1.11	1.15	0.27

Table 4: Summary of groundwater monitoring statistics for both monitoring periods.

Well ID	Ground Level	Min.	10 %-ile	Median	Mean	90 %-ile	Max	Range (m)
MW1	5.82	1.65	1.79	2.46	2.41	2.84	3.10	1.45
MW2	11.72	1.94	2.04	2.29	2.28	2.49	2.64	0.71
MW3	15.48	1.54	1.93	2.17	2.18	2.33	2.40	0.86
MW4	9.45	1.48	1.52	1.97	1.84	2.16	2.21	0.73
MW5	18.25	2.23	2.45	2.69	2.67	2.91	2.95	0.72
MW101	6.77	1.49	1.56	1.63	1.67	1.89	1.96	0.47
MW102	25.63	2.39	2.44	2.50	2.49	2.52	2.57	0.18
MW103	31.35	2.27	2.31	2.33	2.33	2.35	2.39	0.13
MW104	11.83	0.88	0.96	1.02	1.03	1.08	1.15	0.27

2.4 Hydraulic Conductivity

Saturated hydraulic conductivity testing was undertaken at MW1 – MW5 on 1 October 2013. Data indicates that subsoil conditions are generally consistent with clean to silty sand, with results summarised in Table 5.

Table 5: Summary of monitoring well construction details.

Well ID	Results (m/day)
MW1	6.8
MW2	17.2
MW3	9.0
MW4	2.4
MW5	4.0

2.5 Groundwater Quality

Six rounds of groundwater quality sampling were completed between 2013 and 2020, with key findings summarised as follows:

- Groundwater is acidic, with pH ranging from 3.5 – 6.7.
- Groundwater is generally fresh, with a 90th percentile salinity of 478 mg/L, though a maximum of 1,200 mg/L indicates saline intrusion is possible.
- Total nitrogen concentrations were elevated at MW1, MW2 and MW101 (up to 43 mg/L), likely attributable to agricultural sources including fertiliser application.
- Total phosphorus concentrations were similarly elevated at MW1 and MW101 (up to 5.3 mg/L), also likely reflecting agricultural influence.

2.6 Groundwater Modelling and Impact Assessment

A numerical groundwater model was developed using MODFLOW as part of the MA (2020) assessment. The model was calibrated to mean groundwater levels across the full monitoring record, achieving an absolute residual mean of 0.287 m, and was classified as a Class 2 model in accordance with the Australian Groundwater Modelling Guidelines (2012).

Post-development modelling simulated below water table sand extraction, predicting maximum on-site and offsite drawdown of 0.65 m and 0.35 m respectively, which was well within the range of natural groundwater level fluctuation recorded at the site. The assessment concluded that modelled groundwater level changes would not impact high-priority GDEs, nearby registered bores, or basic landholder rights, and that ASS risks associated with drawdown were negligible and manageable through the groundwater and ASS management plans. Groundwater quality risks were assessed as manageable with appropriate engineering controls, and the development was found to comply with the NSW Aquifer Interference Policy. Sufficient water share allocation was identified within the Stockton Groundwater Source to support the proposed development.

It is noted that the current SSDA proposes above water table sand extraction only, and therefore the post-development scenario modelled in MA (2020) is not directly applicable to the current assessment. The pre-development model parameters and calibration approach have however informed the current groundwater model, as described in Section 5.

3 Site and Regional Information

3.1 General Site Details

General site details are summarised in Table 6.

Table 6: General site details.

Item	Description
Site address	3631 Nelson Bay Road, Bobs Farm, NSW
Legal identification	Lot 254 DP753204
Local Government Area	Port Stephens Council (Council)

3.2 Environmental Setting

Site environmental setting is summarised in Table 7.

Table 7: Site environmental setting.

Item	Description
Site description	Predominantly bushland / undeveloped land with vehicle tracks. A cleared area adjacent to the south-eastern boundary (near Nelson Bay Road) comprises agricultural uses (including olive and fig plantings), farm sheds, a farm-hand residence and a primary residence. An overhead electricity easement traverses the southern corner of the Site.
Surrounding land description	Rural residential allotments border the Site to the north, west, southwest, and northeast. Nelson Bay Road borders the Site to the southeast, with Worimi National Park located on the southern side of the road. The Australian Shark and Ray Centre is located along the western end of the northern boundary of the Site.
Topography	A large dune system runs through the northern and western portions of the Site, with an elevation of up to approximately 35 metres Australian Height Datum (mAHD), grading to lower lying flat agricultural land to the south and east at an elevation of approximately 6 mAHD. Slopes are typically low (0 – 5 %) in the southern and eastern portions of the Site and are higher (approximate 10 – 50 %) over the remainder of the Site on dune knolls. Refer to the shaded relief map provided in Map 03 (Appendix B).
Geology	Geological mapping produced by the NSW Geological Survey (Colquhoun, et al., 2022) as provided on the web platform MinView (GSNSW, 2024a), indicates geology at the Site consists of Holocene marine deposited and aeolian reworked coastal sand dunes. Geology of surrounding land includes: Estuarine swamp to the north of the Site, comprising organic-rich mud, peat, clay, silt, very fine to fine grained marine deposited sand and fine to medium grained fluvially deposited sand. Mobile dune facies to the south of the Site, comprising marine deposited and aeolian reworked fine to coarse grained quartz-lithic sand with abundant carbonate material. Refer to geology mapping provided in Map 04 (Appendix B).

Item	Description
Soil Landscapes	The Soil and Land Resources of Central and Eastern NSW data set identifies the following main soil landscapes within the study area: • Boyces Track (bt): Steep stable Holocene transgressive dunes • Hawks Nest (hn): Stable low Holocene beach ridges and windblown sand sheets on the Tomago Coastal Plain. • Fullerton Cove (fc): Tidal flats of the lower Myall River and embayments of Port Stephens on the Tomago Coastal Plain. • Bobs Farm (bf): Drained Holocene estuarine flat on the Tomago Coastal Plain. • Stockton Beach (sk): Beaches and unstable dunes and blowouts of Quaternary Holocene sand along the coastal fringe of the Tomago Coastal Plain. Refer to soil landscapes mapping provided in Map 05 (Appendix B).

3.3 Climate Data

3.3.1 Rainfall and Evapotranspiration

Local rainfall and evapotranspiration data recorded from 2010 to 2025 was obtained from the BoM rainfall station at Williamtown RAAF (station no. 61078).

A summary of mean monthly rainfall, evapotranspiration and calculated surplus is shown in Table 8.

Table 8: Mean monthly climate data summary.

Month	Rainfall (mm) ¹	Evapotranspiration (mm)	Rainfall Surplus Rainfall – Evap. (mm)
Jan	107	173	-66
Feb	97	141	-44
Mar	153	118	35
Apr	134	90	44
May	122	74	48
Jun	122	59	63
Jul	95	70	26
Aug	64	90	-26
Sep	58	120	-62
Oct	77	148	-70
Nov	85	155	-70
Dec	58	178	-119
Annual	1172	1414	-242

3.3.2 Cumulative Residual Rain

Cumulative residual rainfall is the running total of recorded rainfall minus average rainfall and indicates whether conditions over preceding months / years have been average, drier than average or wetter than average.

A plot showing annual rainfall and cumulative residual rainfall from 2010 to 2025 is provided in Figure 1 (Appendix D). A plot showing monthly rainfall and cumulative residual rainfall since January 2020 is provided in Figure 2 (Appendix D).

Plots indicate that historically high rainfall conditions have been recorded in recent years, in 2020 – 2022 and 2024. Significant rainfall was also recorded in early to mid-2025, with conditions becoming drier in the late spring to summer months.

3.4 Sea Level Data

A tidal gauge station operated by the Manly Hydraulics Laboratory (**MHL**, NSW Government) is located at Mallabula Point, approximately 6km to the north of the Site. MHL harmonic analysis of tidal data from 2001 – 2020 (MHL, 2023) shows that the mean water level at this station is 0.017 mAHd.

3.5 Water Sharing Plans

The site is subject to the North Coast Coastal Sands Groundwater Sources 2016 water sharing plan (**WSP**) and is located within the Stockton Groundwater Source.

3.6 Groundwater Receptors

3.6.1 Licensed Groundwater Users

Based on the WaterNSW (2025) Real-time Water Database, there are six registered groundwater monitoring bores within 1 km of the Site. Available data is summarised in Table 9, and bore locations are shown in Map 06 (Appendix B).

Table 9: Registered bore data within 1 km of the Site.

Bore ID	Registered Use	Status	Groundwater Depth (mbgl)	Water bearing Zone Information
GW080296	Stock and domestic	Functional	Unknown	No Information provided
GW056098	Irrigation	Functional	3.0	Clayey sand – 3.0 to 7.0 mbgl
GW079677	Unknown	Functional	Unknown	Yield – 6.31 L/s
GW067296	Domestic	Unknown	0.5	No Information provided
GW079396	Unknown	Unknown	Unknown	Yield – 2.5 L/s
GW067269	Stock	Unknown	Unknown	No Information provided

3.6.2 Groundwater Dependent Ecosystems

Potential groundwater dependent ecosystem (**GDE**) areas within the study area include those mapped by the NSW Department of Industry in accordance with the High Ecological Value Aquatic Ecosystems (**HEVAE**) framework, as well as GDEs identified in the WSP. These datasets identify areas of potential groundwater dependence at a regional scale.

A site-specific assessment of GDEs was initially undertaken by Wildthing Environmental Consultants (**WEC**) for the previous SSDA, documented in the Biodiversity Assessment Report (WEC, 2020), which identified several vegetation communities in the vicinity of the Site that are potentially groundwater dependent. Of these, the 'Swamp Oak Forest' and 'Freshwater Wetland' communities were assessed to exhibit obligate groundwater dependency.

We understand that GDEs within the Site boundary have been reassessed by the current project ecological consultant, Wedgetail Project Consulting (**WPC**). WPC identifies the 'Northern Paperbark-Swamp Mahogany Saw-sedge Forest' community (hereafter referred to as 'Paperbark Swamp Forest') as the primary GDE of concern at the Site, which is broadly consistent with the 'Swamp Oak Forest' previously identified in WEC (2020). GDE mapping outside the Site boundary is retained from WEC (2020).

These GDEs are located to the northwest and northeast of the proposed extraction area, as shown in Map 06 (Appendix B).

3.6.3 Coastal Wetlands

The State Environmental Planning Policy (Resilience and Hazards) 2021 maps a coastal wetland area to the north of the Site adjacent to Tilligerry Creek, approximately 500 m north of the proposed extraction area.

Coastal wetland locations are shown in Map 06 (Appendix B).

4 Field Investigation Data

4.1 Subsurface Conditions

Borehole investigations previously completed by MA and VGT at the Site indicate that subsurface conditions typically comprise a thin layer of organic topsoil overlying loose aeolian sands extending to approximately 10 m depth. Beneath these sands, localised layers of marine and clayey sands with organic material are present, interpreted as deposits associated with the former tidal environment of Tilligerry Creek, as well as deeper, dense marine sands encountered below the groundwater table.

Available borehole logs are provided in Appendix C.

4.2 Groundwater Level Monitoring

4.2.1 Monitoring Methodology

Groundwater monitoring for the current assessment was undertaken at seven monitoring wells, including:

- Two wells (MW1 and MW5) installed by VGT in 2013, forming part of the monitoring network established during previous assessments (refer Section 2.2).
- Two wells (MW101 and MW104) installed by MA in 2019, also forming part of the previous monitoring network.
- Three new wells (MW201, MW202 and MW203) installed by VGT in 2026.

Monitoring was completed using data loggers recording continuously at 15-minute intervals, supplemented by regular manual dip meter measurements for data logger calibration. Monitoring at MW1, MW101, MW104 and MW5 commenced on 6 November 2025, while monitoring at MW201, MW202 and MW203 commenced on 27 February 2026.

Well details are presented in Table 10, with locations shown in Map 07 (Appendix B) and well construction logs provided in Appendix C.

Table 10: Summary of monitoring well construction details.

Well ID	Surface Level (mAHD) ¹	Elevation of Top of Screen (mAHD)	Elevation of Bottom of Screen (mAHD)	Length of Open Screen (m)
MW1	5.74	-10.54	-12.54	2.00
MW101	6.55	0.90	-11.10	12.00
MW104	11.75	-5.25	-14.25	9.00
MW201	11.49	6.49	-2.41	8.90
MW202	9.45	3.95	-5.05	9.00
MW203	6.40	5.10	-1.54	6.64
MW5	18.18	4.59	2.59	2.00

¹. Surface levels from survey of monitoring wells (VGT, 2026).

4.2.2 Monitoring Results

Monitoring results indicate the following:

- Median groundwater elevations during the monitoring period ranged between 1.4 and 3.4 mAHD, corresponding to depths to groundwater of approximately 2.6 to 15.1 mbgl, depending on local ground surface elevation. Relatively shallow groundwater was generally observed in lower lying areas of the Site.
- 90th percentile groundwater elevations ranged from approximately 1.6 to 3.8 mAHD, representing likely high groundwater conditions during the monitoring period.
- Groundwater levels have gradually declined by approximately 0.5 to 1.0 m since monitoring commenced in November 2025, likely reflecting the wetter conditions experienced earlier in 2025 followed by relatively drier conditions over the summer months.
- Current median groundwater levels at MW1, MW101, MW104 and MW5 are generally higher than those recorded during previous monitoring (refer Section 2.3) by up to approximately 1 m, consistent with wetter than average conditions experienced in 2025.

A statistical summary of continuous monitoring is provided in Table 11, and time series plots showing groundwater levels in relation to daily rainfall are provided in Figure 3 (Appendix D).

Table 11: Summary of groundwater monitoring statistics (all levels in mAHD).

Well ID	Min.	10 %-ile	Median	Mean	90 %-ile	Max	Range (m)
MW1	2.89	2.99	3.34	3.37	3.76	3.91	1.02
MW101	2.06	2.11	2.40	2.41	2.68	2.80	0.74
MW104	1.21	1.26	1.39	1.40	1.56	1.64	0.43
MW201	2.92	2.93	2.96	2.96	3.00	3.00	0.08
MW202	2.34	2.35	2.39	2.39	2.43	2.44	0.09
MW203	2.75	2.76	2.80	2.80	2.84	2.86	0.11
MW5	2.80	2.83	3.17	3.15	3.39	3.52	0.72

4.3 Hydraulic Conductivity

Saturated hydraulic conductivity (K_{sat}) of the underlying geology was estimated using falling head testing, with repeat testing undertaken to assess repeatability. Average K_{sat} at each well ranged from 1.25 – 7.65 m/day, consistent with fine to medium grained sand encountered at the site, and broadly consistent with results from previous slug testing (refer Section 2.4)

K_{sat} results for each well are provided in Table 12 below and calculation sheets are provided in Appendix E.

Table 12: Saturated hydraulic conductivity test data.

Well ID	Test 1 (m/day)	Test 2 (m/day)	Test 3 (m/day)	Test 4 (m/day)	Test 5 (m/day)	Average
MW1	1.37	1.27	2.20	1.18	-	1.51
MW101	8.00	5.97	8.99	-	-	7.65
MW104	2.18	1.94	1.92	2.01	-	2.01
MW201	1.86	0.88	1.01	-	-	1.25
MW202	3.39	3.09	3.27	-	-	3.25
MW203	3.78	2.92	2.31	2.48	2.06	2.71
Average	3.43	2.68	3.28	1.89	2.06	3.06

4.4 Groundwater Quality

4.4.1 Testing Methodology

Groundwater quality sampling was completed at the Site as follows:

- MW1, MW5 and MW101 sampled on 6 November 2025 in conjunction with the MA (2026) Detailed Site Investigation (**DSI**).
- MW201, MW202 and MW203 sampled on 3 March 2026 for the current assessment. Note that these are referenced as BH201, BH202 and BH303 in laboratory documentation.

All wells were sampled after purging, using laboratory supplied bottles with appropriate preservatives and no headspace. Samples were dispatched to a NATA accredited laboratory (Envirolab Pty Ltd) under chain of custody (**COC**) documentation and within appropriate holding times, and analysed for various physical parameters, nutrients, dissolved heavy metals ionic balance, and contaminants. Previous groundwater quality sampling completed during earlier assessments is summarised in Section 2.5.

4.4.2 Laboratory Results

A preliminary assessment of groundwater quality for a range of analytes was completed with reference to the ANZG (2018) 95% default guideline values (**DGV**) for marine water, reflecting the marine receiving environments of the Pacific Ocean and Tilligerry Creek. Groundwater quality results are summarised below:

- Groundwater is generally acidic, with pH values reported between 4.5 – 6.5, and fresh, with EC values reported between 150 – 360 $\mu\text{S} / \text{cm}$. These results are broadly consistent with previous groundwater quality sampling summarised in Section 2.5.
- Concentrations of various heavy metals exceeded DGV in all wells, including for aluminium, cobalt, copper, iron, lead, and zinc.

Given that the excavation is not proposed to intercept groundwater, potential risk to sensitive receptors posed by groundwater is expected to be low. A detailed

contamination assessment for groundwater is included in the MA (2026) DSI report (ref. P2511038JR05V01).

A summary table showing laboratory results is provided in Appendix F, and full laboratory documentation (including testing results from previous assessments) is provided in Appendix G.

4.5 Groundwater System Productivity

The NSW Department of Primary Industries Office of Water NSW Aquifer Interference Policy (2012) (**AIP**) defines groundwater systems as 'highly productive' or 'less productive', with highly productive groundwater systems characterised by:

1. Groundwater quality – total dissolved solids (**TDS**) less than 1500 mg/L; and
2. Groundwater supply – yield greater than 5 L/s.

Based on measured hydraulic conductivities, abstraction of 5L/s from the aquifer is likely to be readily achievable. EC results indicate low to moderate levels of salinity across the Site, with an average EC of 233.3 $\mu\text{S}/\text{cm}$ reported across sampled monitoring wells, corresponding to a TDS of approximately 149 mg/L using a conversion factor of 0.64 (Dahaan *et al*, 2016).

The aquifer is therefore assessed as a 'highly productive coastal sands groundwater source' in accordance with the AIP, consistent with the classification adopted in the previous hydrogeological assessment (MA, 2020).

5 Existing Conditions Groundwater Model

5.1 Groundwater Model Conceptualisation

5.1.1 Groundwater Flow Interpretation

Model conceptualisation is generally consistent with the conceptual model developed in MA (2020). Groundwater within the study area is expected to flow towards areas of lower topography, flowing towards Tilligerry Creek to the north and the Pacific Ocean to the south. Groundwater depth is highly variable due to the varying land surface.

5.1.2 Sources and Sinks

Recharge to the groundwater system is primarily from rainfall infiltration.

The groundwater model domain can be broadly zoned into rural agricultural land, forest, swamp and dune environments with differing groundwater interactions influenced by vegetation type, root zone depth and land use. Accordingly, spatial variation in recharge and evapotranspiration behaviour is expected across the model domain.

Groundwater discharge is expected to occur at Tilligerry Creek to the north and the Pacific Ocean to the south, as well as through evapotranspirative losses.

5.1.3 Hydraulic Conductivity and Confinement

Hydraulic conductivity within the Site is characterised by moderate to high permeability aeolian and marine sands, 1 – 9 m/day based on the results of ksat testing (see Section 4.3).

Across the broader groundwater domain area, hydraulic conductivity is expected to be higher within the aeolian dune environment to the south of the Site (towards Stockton Beach), and lower within the alluvial landscape to the north (towards Tilligerry Creek).

Groundwater is likely to occur under unconfined conditions within the groundwater domain area.

5.2 Software

The MODFLOW NWT Solver was utilised within the GMS 10.8.12 (2025) graphical user interface for this model.

5.3 Settings and Water Balance Error Criteria

The NWT solver options were kept at the recommended settings as per the *USGS Online Guide to MODFLOW-NWT* (2022).

A model water balance error threshold of 1% was used which represents the typically adopted industry threshold value provided in the Australian *Groundwater Modelling Guidelines* (2012). This water balance error is the percentage difference between the total water entering and leaving the model and is a measure of the reliability of the

groundwater model. An error of greater than 1% would require a reduction in the model's convergence criteria (closure criterion) to ensure the model water balance error fell below 1%.

5.4 Model Extents and Grid Configuration

The model domain and layering have been refined from the previous assessment (MA, 2020) to better represent local subsurface conditions.

A groundwater model domain of 7,500 m east to west by 6,600 m north to south, with a 20 m grid resolution, was used for the assessment of groundwater conditions and impacts. Of this domain, approximately 55% comprised the active model area with the remaining portion remaining inactive.

Local geology was modelled using six layers, with surface topography represented by the top of layer 1 and defined using 1 m LIDAR data (NSW DFSI, 2014) and survey information from the Site. The bottom of layer 6 was set at a nominal constant value of -40 mAHD.

5.5 Boundary Conditions

Constant head boundaries were applied at the Pacific Ocean to the south and Tilligerry Creek to the north, based on sea level data reviewed in Section 3.4.

Constant head boundaries are shown in Map 08 (Appendix B).

5.6 Pre-Calibration Model Parameters

5.6.1 Hydraulic Conductivity

Further to the discussion in Section 5.1.3, hydraulic conductivities in the model were adjusted within the upper and lower bounds listed in Table 13 to achieve calibration.

Table 13: Horizontal hydraulic conductivity calibration ranges.

Hydraulic Conductivity Zone	Calibration Range (m/day)
Active dunes and beach sand	10 – 30
Stable dunes	0.5 – 10
Estuarine sediments	0.01 – 2

5.6.2 Recharge and Evapotranspiration

Calibration was achieved by adjusting hydraulic conductivity, recharge, and evapotranspiration depth parameters within the ranges provided in Table 14. Zoning was developed based on groundwater model conceptualisation and is shown in Map 09 (Appendix B).

Table 14: Calibration range of existing conditions model parameters.

Parameter	Unit	Calibration Range
Recharge Rates		
Agriculture	% rainfall ¹	15 – 30
Dunes		40 – 60
Forest		15 – 25
Forest (Upslope)		10 – 20
Swamp		20 – 40
Evapotranspiration Extinction Depth		
Agriculture	m	1 – 2
Dunes		0.1 – 0.5
Forest		2 – 4
Forest (Upslope)		3 – 5
Swamp		0.5 – 1.5

¹. Rainfall data collected from Williamtown RAAF BOM weather station.

5.7 Calibration

5.7.1 Calibration Procedure

To maintain a consistent calibration dataset across the monitoring network, model calibration was undertaken using the 16-day period (2/03/2026 – 18/03/2026) during which groundwater data was available simultaneously for all seven existing monitoring wells. While additional data was available at MW1, MW5, MW101 and MW104, these levels were elevated and likely reflective of temporary wet weather response associated with heavy rainfall in mid-2025 and were therefore considered less representative of holistic groundwater conditions.

Nevertheless, the adopted calibration period reflects consistently higher groundwater levels than the long-term average recorded during historical investigations (summarised in Section 2). This approach is considered conservative, as it represents a higher water table and a more restrictive constraint on excavation depth.

Hydraulic conductivity, recharge rates, and evapotranspiration extinction depth values were adjusted within the ranges identified in Section 5.6 to achieve model calibration to median groundwater levels observed during the selected period. For modelling purposes, hydraulic conductivity zoning was assigned based on regional soil landscape units (summarised in Table 7).

Following manual calibration, the PEST parameter estimation package in GMS was used to further optimise and confirm model parameters.

At the completion of calibration, model parameters were as summarised in Table 15.

Table 15: Calibrated existing conditions model parameters.

Parameter	Unit	Calibrated Value
Hydraulic Conductivity		
Bobs Farm	m/day	2
Hawks Nest		15
Stockton Beach		10
Fullerton Cove		0.05
Boyces Track		0.5
Recharge Rates		
Agriculture	% rainfall	20%
Dunes		60%
Forest		15%
Forest (Upslope)		15%
Swamp		40%
Evapotranspiration Extinction Depth		
Agriculture	m	1.1
Dunes		0.5
Forest		3.0
Forest (Upslope)		15.0
Swamp		0.5

5.7.2 Calibration Results

A calibration scatter plot of modelled and observed heads along with key calibration statistics is provided in Figure 4 (Appendix D).

The model achieved an absolute residual mean of 0.3 m and a residual mean of -0.002 m, indicating negligible bias and a marginal tendency towards under-prediction of groundwater levels. The mass balance discrepancy was -0.0009%, which is well below the acceptable threshold of 1.0 %.

Although the normalised root mean squared (**NRMS**) of 18.8% exceeds the commonly adopted threshold of 10%, this is attributed to the relatively small range of observed groundwater levels across the modelling network. Absolute residuals are low, with all wells simulated to within 0.35 m of the median observed levels, except for MW5, which is simulated to within 0.5 m. On this basis, the model is considered to provide an acceptable representation of groundwater conditions and is suitable for predictive purposes.

5.8 Existing Conditions Model Results

The calibrated heads for the existing conditions groundwater model are provided in Map 10 (Appendix B).

5.9 Model Confidence Level Classification

In accordance with the *Australian Groundwater Modelling Guidelines* (2012), the model is considered to generally represent a 'Class 2' model confidence level classification, suitable for impact assessment.

A 'Class 2' classification is justified based on the following:

- Calibration statistics are acceptable and within recommended criteria.
- Mass balance error is less than 1.0% of total.
- Groundwater head observations and geotechnical data coverage are reasonable in the vicinity of the proposed development.
- Model parameters are generally consistent with conceptualisation.

5.10 Modelling Uncertainty

There are inherent uncertainties in any numerical model arising from simplifications of complex natural systems into a set of computational parameters. The following factors may contribute to uncertainty within the model:

- Groundwater investigation data is limited to within Site boundaries with relatively limited offsite groundwater level information available.
- Hydraulic conductivity is likely to vary both laterally and vertically within the subsurface profile.

Notwithstanding the above, the model has been calibrated against observed groundwater levels with an absolute residual mean of 0.3 m and all monitoring wells simulated to within 0.5 m of observed levels. Although the NRMS of 18.8% exceeds the commonly adopted threshold, this reflects the relatively small range of observed groundwater levels across the monitoring network rather than a poor model fit.

On this basis, the model is considered to provide an acceptable representation of groundwater conditions for the purposes of this assessment, with uncertainty addressed through the adoption of conservative and sensitivity-based modelling scenarios.

5.11 Model Sensitivity

Model sensitivity refers to the extent to which model results vary due to changes to model inputs. The model is sensitive to parameters including:

- Hydraulic conductivity.
- Recharge rates.
- Evapotranspiration rates and extinction depths.

The potential variance of these parameters has been considered as part of the calibration process with the final parameters selected to achieve the best overall fit to observed groundwater levels.

This assessment is primarily concerned with predicted groundwater levels and drawdown associated with the proposed development. Sensitivity to key parameters, particularly recharge, has been assessed through the adoption of low and high-recharge cases over the proposed excavation area in the proposed conditions assessment (Section 6).

6 Proposed Conditions Groundwater Model

6.1 Proposed Excavation Surface

The proposed excavation was modelled by setting the ground level within the excavation footprint to an indicative 'top of cut' surface. This surface was developed by applying a 0.7 m offset above the calibrated existing conditions groundwater head, as well as appropriate batters (provided by VGT, 2026) at the excavation perimeter.

6.2 Assessment Methodology

Recharge across the excavation area is expected to vary depending on surface disturbance, compaction and site water management practices. Updated recharge zoning is shown in Map 11 (Appendix B).

To account for this uncertainty, three potential post-quarry scenarios were considered:

- **Scenario 1 – baseline rehabilitation scenario:** Recharge of 20% of rainfall was adopted, consistent with calibrated rural / agricultural land conditions and representing rehabilitation with vegetation broadly comparable with existing conditions.
- **Scenario 2 – low recharge scenario:** Recharge was reduced to 5% of rainfall, representing disturbed, compacted, or actively managed conditions where effective infiltration is limited. This scenario provides a conservative estimate of potential groundwater drawdown.
- **Scenario 3 – high recharge sensitivity scenario:** Recharge was increased to 40% of rainfall, representing conditions where exposed sandy materials allow increased infiltration following removal of vegetation.

6.3 Proposed Conditions Model Results

Model results indicate that predicted groundwater change at the nearest GDE (Paperbark Swamp Forest) is negligible (<0.1 m) under both baseline and low recharge scenarios (scenarios 1 and 2).

Under the high recharge scenario (scenario 3), groundwater levels are predicted to increase by up to approximately 0.2 m in the corner of the GDE. This increase is not expected to result in adverse impacts, as groundwater levels remain well below the ground surface, and Paperbark Swamp Forest is generally tolerant of fluctuations in groundwater levels.

On this basis, changes in groundwater levels are not expected to adversely affect the health or function of identified GDEs, and impacts are considered acceptable.

Modelled drawdown for scenarios 1, 2 and 3 are shown in Maps 12 – 14 (Appendix B).

6.4 Impact and Risk Assessment

Potential hydrogeological impacts and risks arising from the proposed quarry development are assessed in Table 16 and found to be negligible and acceptable.

Table 16: Impact assessment of proposal on groundwater related systems.

Potential Impact / Risk	Assessment
Groundwater drawdown	- Modelled drawdown is largely confined to the quarry footprint, with negligible predicted offsite impacts. - To verify model predictions, a groundwater monitoring plan (Section 7) will be implemented as part of on-going quarrying operations.
Loss of water to groundwater dependent ecosystems	No material drawdown is predicted at nearby groundwater bores or potential GDEs.
Degradation of groundwater quality	- Stormwater within the quarry will be collected, treated and reused in accordance with standard engineering practice, limiting potential groundwater interaction - A pump-out system for effluent will be adopted in accordance with Council and/or NSW Department of Health requirements. - Potential contamination risks (e.g. hydrocarbons) will be managed through appropriate storage, handling procedures, and spill response measures to prevent impacts to groundwater.
Loss of water supply to groundwater users	- Groundwater drawdown is not expected to extend significantly beyond the quarry and is unlikely to impact any nearby registered groundwater bores or groundwater users. - Confinement of groundwater drawdown to an area close to the proposed quarry pit will ensure that future potential groundwater users in the groundwater domain area are not impacted.
Cumulative impacts on environment	- Groundwater impacts are predicted to be localised and are not expected to contribute to any cumulative impacts. - No other developments have been identified that would result in cumulative groundwater impacts.

7 Groundwater Monitoring Plan

7.1 Overview

The following sections provide an outline of monitoring recommendations for the proposed quarry. The objective of ongoing monitoring is to detect and assess changes in groundwater levels and quality in response to quarrying operations.

7.2 Monitoring Locations

Of the existing seven monitoring wells, MW104, MW202 and MW203 are located outside of the proposed disturbance area and can be used for the life of the project. The remaining wells are located within or adjacent to the proposed disturbance area and will be progressively decommissioned as required as quarrying advances.

7.3 Groundwater Level Monitoring

7.3.1 Monitoring Methodology

Groundwater levels should be dipped six-weekly at all available monitoring wells. Continuous monitoring at 1-hour intervals should be undertaken at MW104, MW202 and MW203, with data downloaded at least quarterly and compiled for reporting along with manual dip measurements.

7.3.2 Trigger Value Development

Preliminary groundwater level trigger values have been developed for the existing monitoring network, with reference to recent monitoring statistics (Section 4.2), and are summarised in Table 17 and Table 18. Although historical monitoring data (Section 2.3) has not been used as a primary basis for trigger value development due to generally lower groundwater levels during previous monitoring periods, historical levels have been used to inform lower trigger values where appropriate.

Lower and upper trigger values were set at baseline median groundwater levels minus and plus the maximum modelled drawdown and uplift at each well location. Where the historically observed 10th percentile exceeded the model-predicted lower trigger, the historical 10th percentile has been adopted instead. Similarly, where the 90th percentile of recent monitoring data exceeds the model-predicted upper trigger, the 90th percentile has been adopted. These adjustments reflect that the aquifer has previously sustained such conditions under natural climatic variation.

Trigger values should be reviewed and refined following a minimum of three to six months of additional pre-quarrying monitoring to confirm baseline conditions.

Table 17: Preliminary groundwater level lower trigger values.

Well ID	Baseline Median Groundwater Level (mAHD)	10 th %ile Groundwater Level (mAHD)	Modelled Lower Trigger (mAHD)	Adopted Lower Trigger (mAHD)
MW1	3.34	2.99	2.81	2.81
MW101	2.40	2.11	2.64	2.11
MW104	1.39	1.26	1.38	1.26
MW201	2.96	2.93	2.22	2.22
MW202	2.39	2.35	2.61	2.35
MW203	2.80	2.76	2.71	2.71
MW5	3.17	2.83	2.48	2.48

Note: MW104, MW202 and MW203 are expected to be retained over the entire quarrying timeframe.

Table 18: Preliminary groundwater level upper trigger values.

Well ID	Baseline Groundwater Level (mAHD)	90 th %ile Groundwater Level (mAHD)	Modelled Upper Trigger (mAHD)	Adopted Upper Trigger (mAHD)
MW1	3.34	3.76	2.96	3.76
MW101	2.40	2.68	2.70	2.70
MW104	1.39	1.56	1.66	1.66
MW201	2.96	3.00	2.69	3.00
MW202	2.39	2.43	2.70	2.70
MW203	2.80	2.84	2.99	2.99
MW5	3.17	3.39	2.89	3.39

Note: MW104, MW202 and MW203 are expected to be retained over the entire quarrying timeframe.

7.4 Groundwater Quality Monitoring

7.4.1 Monitoring Methodology

Groundwater samples should be collected from all available monitoring wells after purging, using laboratory supplied bottles with appropriate preservatives and no headspace.

Samples should be dispatched to a NATA accredited laboratory under COC documentation and within appropriate holding times.

7.4.2 Water Quality Parameters

Table 19 outlines recommended water quality analytes to be monitored during quarry operations. A minimum of three baseline sampling rounds should be taken prior to commencement of works to establish trigger values for these analytes.

Table 19: Recommended water quality monitoring analytes.

Parameter Group	Analytes	Sampling Frequency
Physical parameters	pH, EC, temperature, dissolved oxygen	Quarterly
Major ions	Chloride, sulphate, carbonate / bicarbonate alkalinity, sodium, potassium, magnesium, calcium	Quarterly
Nutrients	Oxidised nitrogen, total Kjeldahl nitrogen, total nitrogen, total phosphorus, ammonia	Quarterly
Heavy metals (dissolved)	Al, As, Cd, Cr, Cu, Co, Fe, Mn, Ni, Zn	Quarterly
Hydrocarbons	TRH, BTEX	Quarterly

7.5 Analysis and Reporting

A recommended protocol for data analysis and reporting is summarised as follows:

- All groundwater level and quality data should be recorded and maintained by the hydrogeological consultant.
- Data should be reviewed on a quarterly basis to assess trends and identify unexpected or unacceptable impacts.
- In the event that trigger values are exceeded, additional monitoring should be undertaken to confirm the exceedance and assess potential causes. Where required, mitigation measures should be implemented following appropriate consultation.
- Results should be summarised in annual reporting and provided to Council and DPHI.
- Reports should include comparison against trigger values, identification of any exceedances, documentation of any corrective actions taken.

7.6 Licensing Requirements

We understand that the Client currently holds a Water Access Licence (WAL5960) and associated Water Supply Works and Water Use approval (20CA202365) for the Site.

As the proposed excavation is not expected to intercept the groundwater table, additional works approvals or licences under the Water Management Act 2000 relating to aquifer interference are not expected to be required beyond those already held.

8 Aquifer Interference Policy

The NSW Aquifer Interference Policy (**AIP**) details the role and requirements of the Minister administering the *Water Management Act 2000* regarding water licencing and assessment processes for aquifer interference activities under the Act.

The AIP applies to all activities that penetrate, interfere with, obstruct, abstract water from, or dispose of water to, an aquifer. The AIP requires that proponents demonstrate that the minimal impact considerations specified under the AIP can be met.

An assessment of the proposal's compliance with the AIP is provided in Table 20 and is based on the groundwater modelling reported in Sections 5 and 6, noting that the groundwater source category at the Site is defined as being a 'highly productive coastal sands groundwater source' (see Section 4.5).

Table 20: NSW Aquifer Interference Policy assessment.

Minimal Impact Consideration	MA Assessment
Water Table	
1. Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: a) high priority groundwater dependent ecosystem; or b) high priority culturally significant site listed in the schedule of the relevant water sharing plan; or A maximum of a 2m decline cumulatively at any water supply work.	Complies. No high-priority GDEs listed in the water sharing plan suffers a 10% cumulative variation in the water table as a result of the proposal. No high-priority culturally significant sites listed in the water sharing plan are within the affected area. No water supply work within the affected area suffers a decline in head of more than 2m caused by the proposal. A water monitoring plan will be prepared and implemented to continuously monitor and resolve any unexpected changes in the water table.
2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: a) high priority groundwater dependent ecosystem; or b) high priority culturally significant site listed in the schedule of the relevant water sharing plan then appropriate studies (including the hydrogeology, ecological condition and cultural function) will need to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than 2m decline cumulatively at any water supply work, then make good provisions should apply.	N/A
Water Pressure	
1. A cumulative pressure head decline of not more than 40% of the "post-water sharing plan" pressure head above the base of	Complies.

Minimal Impact Consideration	MA Assessment
the water source to a maximum of a 2m decline, at any water supply work.	No water supply work within the affected area suffers a decline in head of more than 40% caused by the proposal.
2. If the predicted pressure head decline is greater than requirement 1. Above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	N/A
Water Quality	
1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity.	Complies. The proposal will not significantly impact groundwater or surface water quality as: • No interception of the groundwater table is proposed; and • A groundwater monitoring plan will be implemented to continuously monitor and resolve any unexpected changes in water quality.
2. If condition 1 is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.	N/A

The assessment has found that groundwater drawdown caused by the proposal will comply with the minimal groundwater impact considerations set out by the AIP for a 'highly productive coastal sands groundwater source'.

9 Conclusions

This study has assessed the hydrological regime and potential impacts of a proposed sand quarry located at 3631 Nelson Bay Road, Bobs Farm, NSW, in support of SSD-99860959. The current proposal involves the extraction of sand above the water table only, representing a material reduction in hydrogeological risk compared to a previous SSDA for the Site, which proposed below water table extraction and has since been withdrawn.

The potential hydrogeological impacts of the development were assessed through development of a detailed groundwater model using the MODFLOW NWT Solver within the GMS 10.8.12 modelling system. The assessment found that there would be no significant detrimental hydrogeological impacts arising from the proposal, notably:

- The existing conditions model achieved a good calibration to observed groundwater levels, with low absolute residuals and negligible bias, and is considered suitable for predictive impact assessment purposes. The model was calibrated to recent monitoring data, which reflects higher groundwater levels than the long-term average recorded during previous investigations, and is therefore considered a conservative approach.
- Residual modelling uncertainty was addressed by adopting a robust assessment approach considering conservative and sensitivity-based modelling scenarios.
- Predicted groundwater level impacts at nearby GDEs are minimal (less than 0.1 m) under baseline and low-recharge scenarios and considered negligible.
- Under the high-recharge scenario, groundwater levels may increase locally (up to approximately 0.2 m), however this is not expected to adversely affect the GDE, as groundwater remains below ground surface and the vegetation community is tolerant of natural fluctuations.
- No material impacts to groundwater users or other environmental groundwater receptors are anticipated.
- Groundwater quality risks are expected to be low and will be managed through standard environmental controls. The excavation is not anticipated to intercept the groundwater table.
- A groundwater monitoring plan will be implemented during quarry operations, including routine level and quality monitoring, defined trigger levels, and response actions to verify model predictions and manage any unforeseen impacts.
- Additional pre-quarrying monitoring is recommended to support the development of final site-specific trigger values prior to commencement of works.

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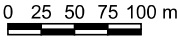
Appendix A – Quarry Staging Plan

Plan of:	Bobs Farm Sand Quarry Proposal - Extraction Staging Plan to Final Landform
Figure:	Four
Version/ Date:	V2 10/04/2026
Our Ref:	12786_BF_ExtStgtoFinal2026_Q004_V2_F4

Location:	3631 Nelson Bay Road, Bobs Farm, NSW
Council:	Port Stephens
Tenure:	Not Applicable
Client:	Newcastle Sand

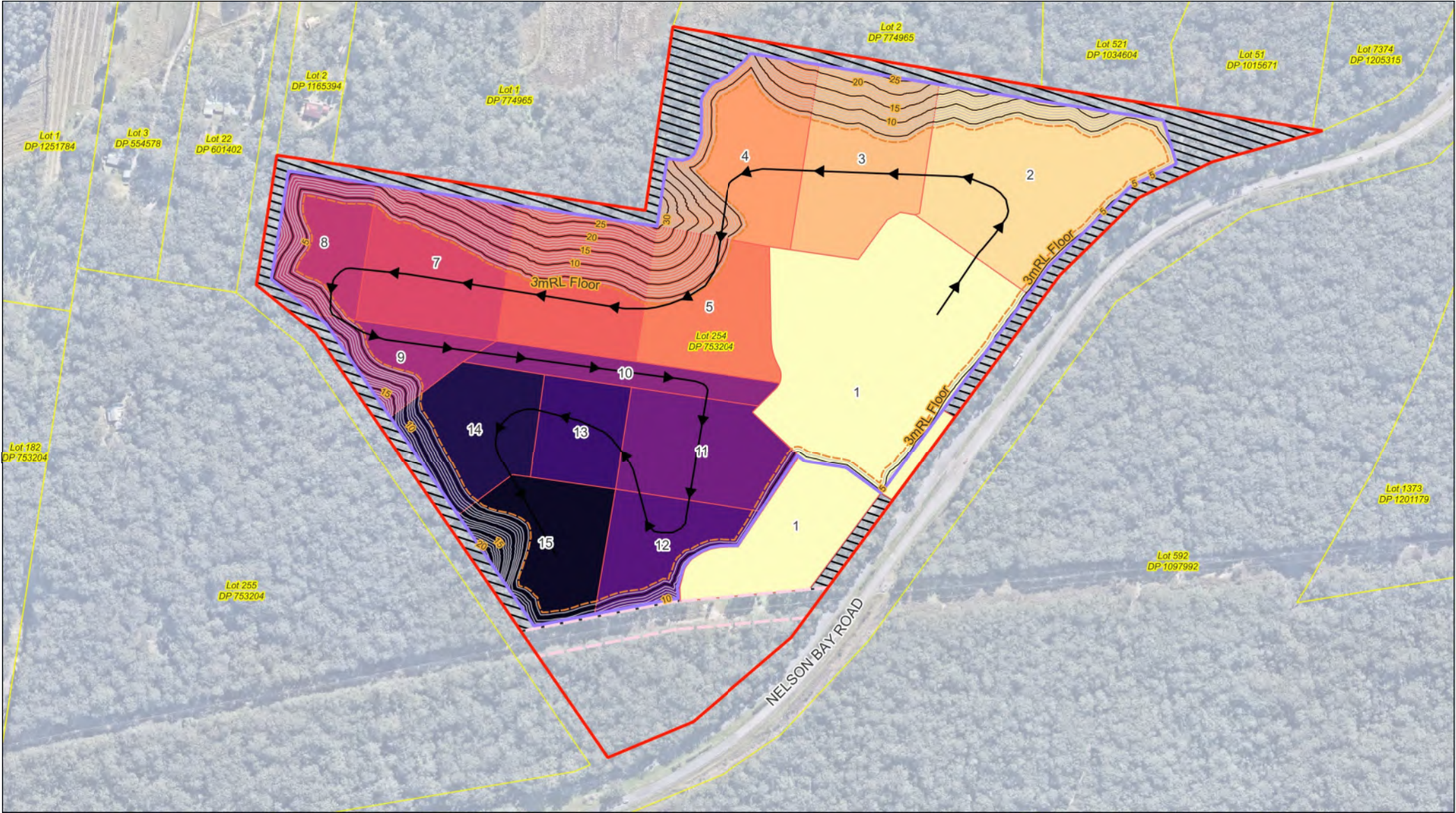
Source:	Nearmap 24/07/2025
Survey:	2025 Centurion Survey Pty Ltd
Projection:	GDA2020/MGA Zone 56 EPSG:7856
Contour Interval:	1m

Plan By:	SK
Project Manager:	GT



This figure may be based on third party data which has not been verified by vgt and may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and vgt does not warrant its accuracy.



Legend

- Lot Boundaries
- Project Boundary
- Buffers
- Electricity Easement

Extraction Design 3H1V to 3mRL

- Top of Final Cut
- Base of Cut (3mRL)

Extraction Path

- Extraction Path

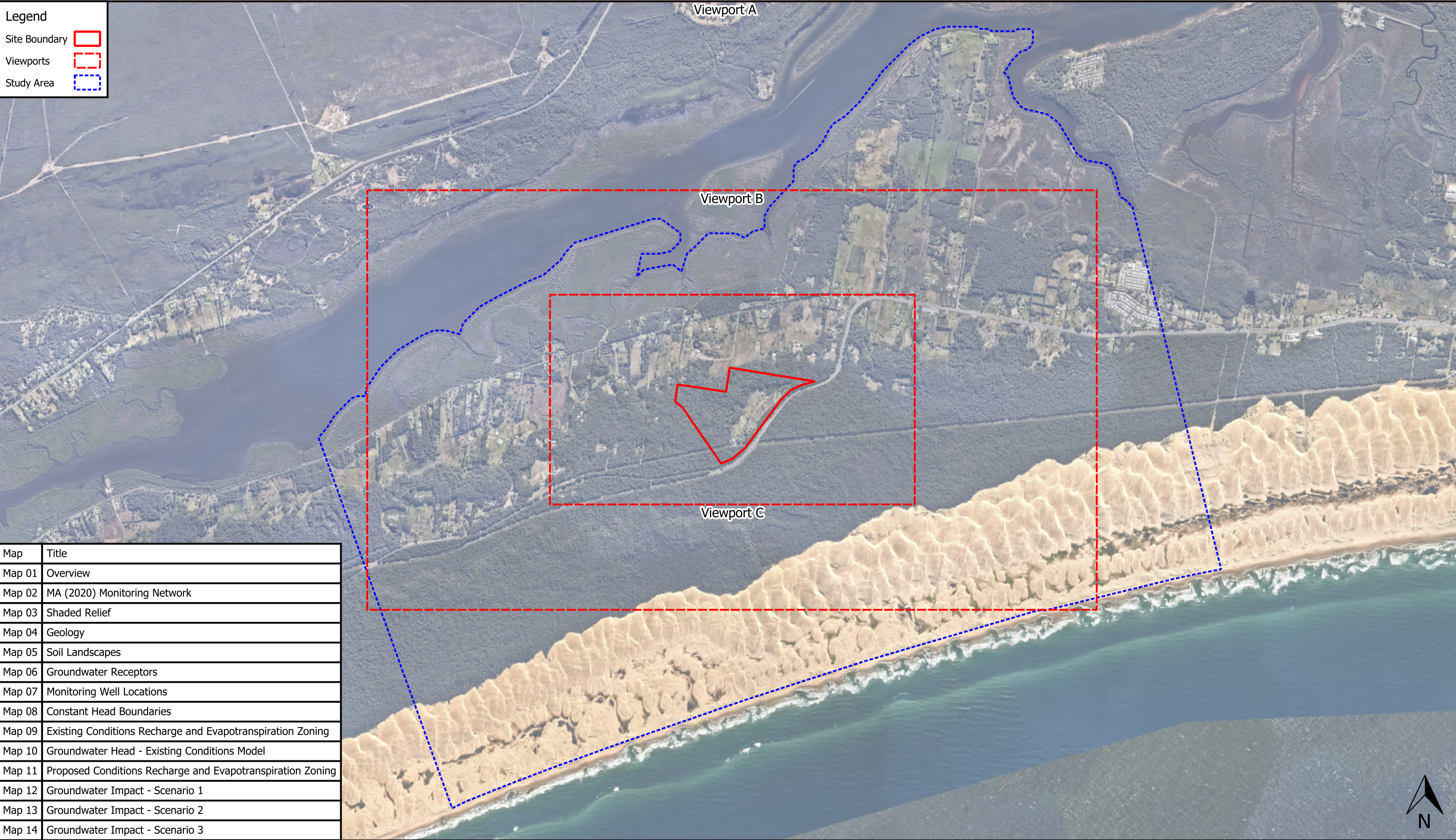
Contours Final Extraction

- 5m
- 1m

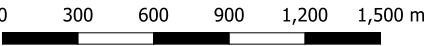
Stage Boundaries 1-15

- Stage 1 Works Area
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15

Appendix B – Site Maps



Map	Title
Map 01	Overview
Map 02	MA (2020) Monitoring Network
Map 03	Shaded Relief
Map 04	Geology
Map 05	Soil Landscapes
Map 06	Groundwater Receptors
Map 07	Monitoring Well Locations
Map 08	Constant Head Boundaries
Map 09	Existing Conditions Recharge and Evapotranspiration Zoning
Map 10	Groundwater Head - Existing Conditions Model
Map 11	Proposed Conditions Recharge and Evapotranspiration Zoning
Map 12	Groundwater Impact - Scenario 1
Map 13	Groundwater Impact - Scenario 2
Map 14	Groundwater Impact - Scenario 3



1:30000 @ A3

Viewport A

Notes:
- Aerial from Nearmap (2025).

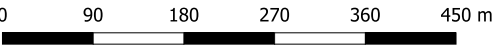
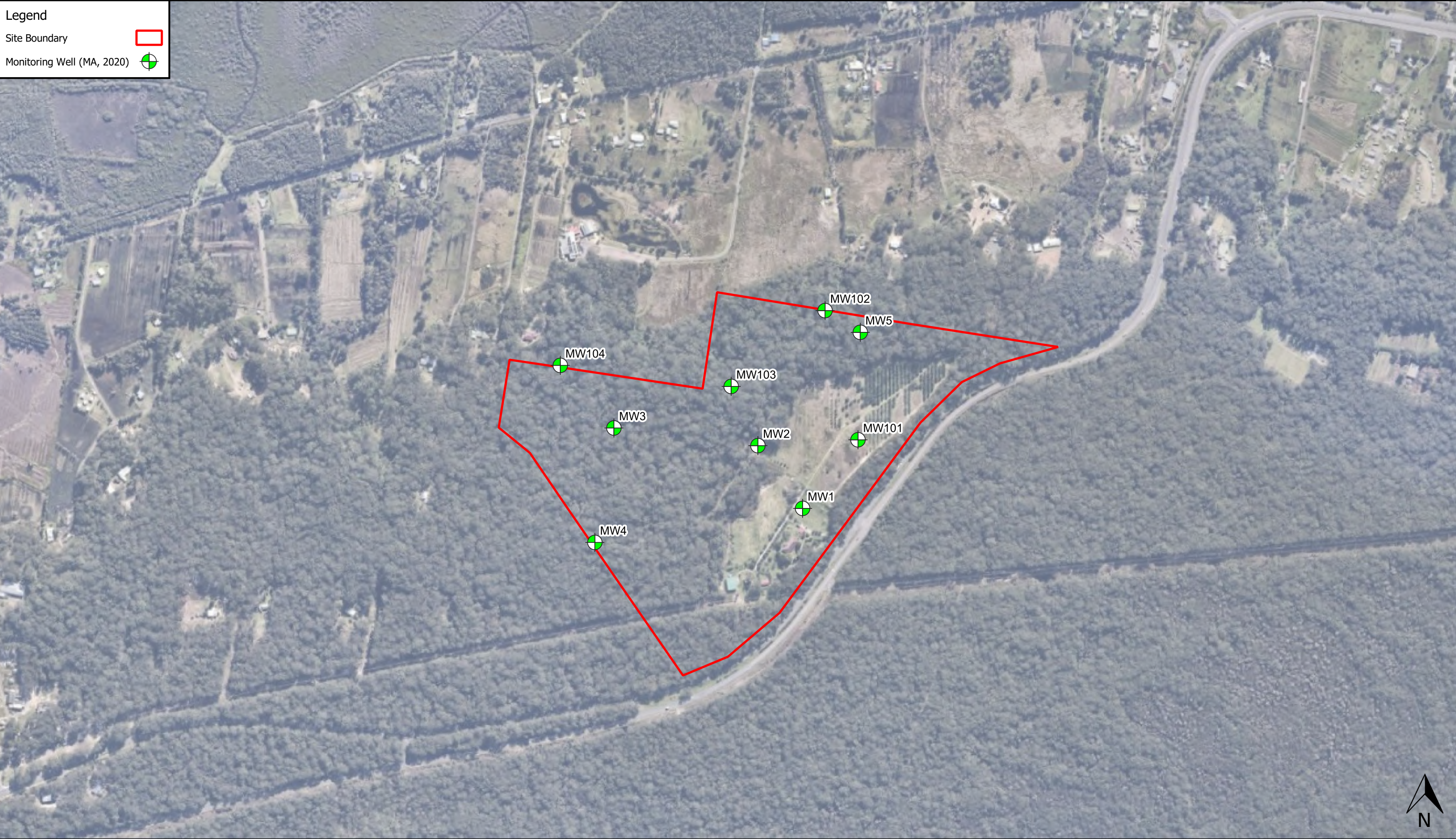
Map Title / Figure:
Overview

Map	3631 Nelson Bay Road, Bobs Farm, NSW
Site	Proposed Sand Quarry
Project	Hydrogeological Impact Assessment
Sub-Project	Newcastle Sand C/- ADW Johnson
Client	
Date	15/04/2026

Legend

Site Boundary

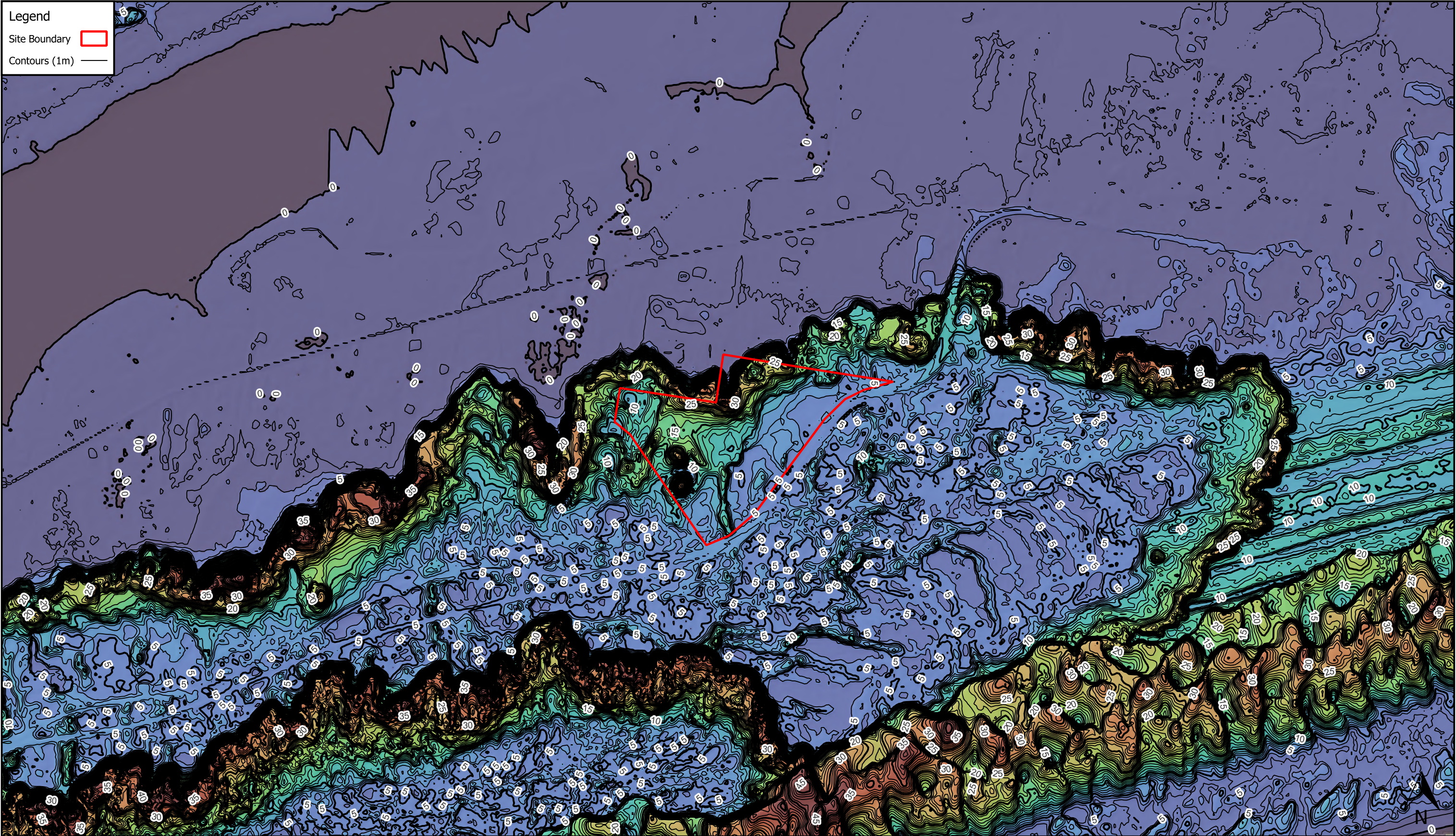
Monitoring Well (MA, 2020)



1:7500 @ A3
Viewport C
Notes:
- Aerial from Nearmap (2025).

Map Title / Figure:
MA (2020) Monitoring Network

Map	Map 02
Site	3631 Nelson Bay Road, Bobs Farm, NSW
Project	Proposed Sand Quarry
Sub-Project	Hydrogeological Impact Assessment
Client	Newcastle Sand C/- ADW Johnson
Date	15/04/2026



0 100 200 300 400 500 m

1:15000 @ A3

Viewport B

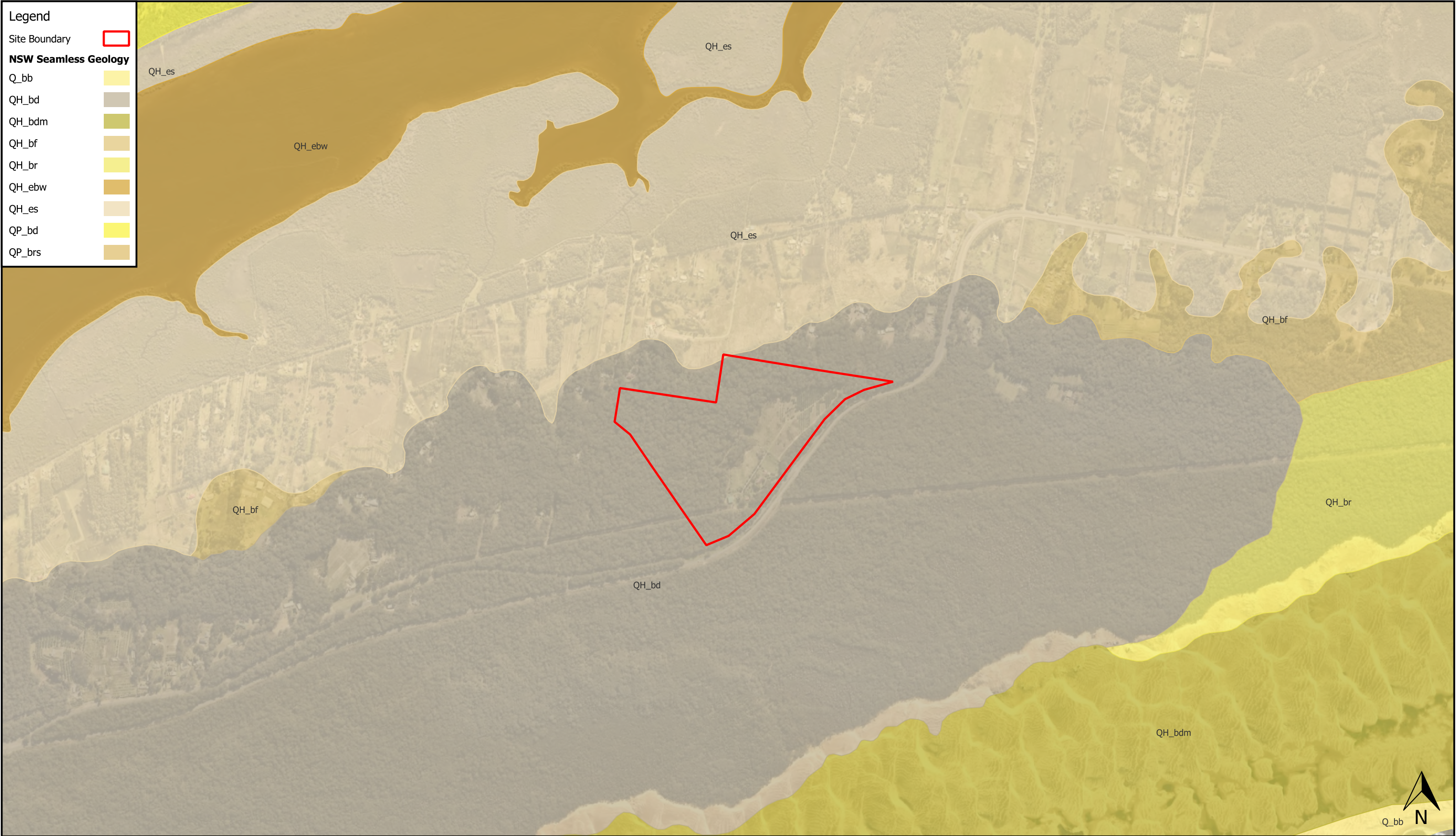
Notes:
- Aerial from Nearmap (2025).
- Topography from NSW DFSI (2014).

Map Title / Figure:

Shaded Relief

Map 03
3631 Nelson Bay Road, Bobs Farm, NSW
Proposed Sand Quarry
Hydrogeological Impact Assessment
Newcastle Sand C/- ADW Johnson
15/04/2026

Map
Site
Project
Sub-Project
Client
Date

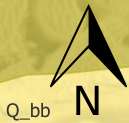


0 100 200 300 400 500 m

1:15000 @ A3

Viewport B

Notes:
- Aerial from Nearmap (2025).
- Surface Geology from NSW Seamless Geology, NSW Department of Regional NSW (2024).



Map Title / Figure:
Geology

Map 04
3631 Nelson Bay Road, Bobs Farm, NSW
Proposed Sand Quarry
Hydrogeological Impact Assessment
Newcastle Sand C/- ADW Johnson
15/04/2026

Map
Site
Project
Sub-Project
Client
Date

Legend

Site Boundary

BOBS FARM

BOYCES TRACK

FULLERTON COVE

HAWKS NEST

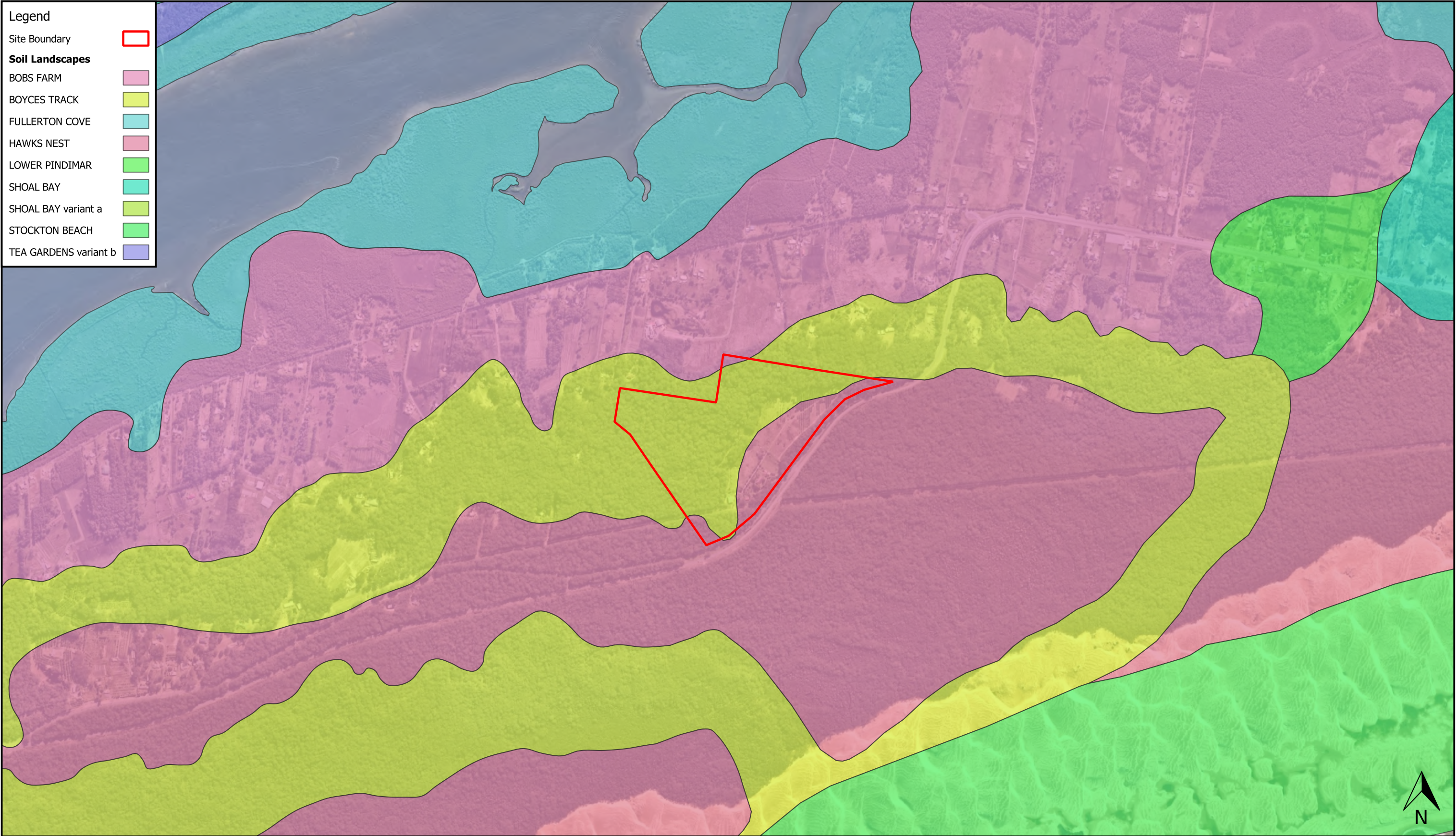
LOWER PINDIMAR

SHOAL BAY

SHOAL BAY variant a

STOCKTON BEACH

TEA GARDENS variant b



0 100 200 300 400 500 m

1:15000 @ A3

Viewport B

Notes:
- Aerial from Nearmap (2025).
- Soil Landscapes from DCCEEW (2024).

Map Title / Figure:
Soil Landscapes

Map 05	Map
3631 Nelson Bay Road, Bobs Farm, NSW	Site
Proposed Sand Quarry	Project
Hydrogeological Impact Assessment	Sub-Project
Newcastle Sand C/- ADW Johnson	Client
15/04/2026	Date



Legend

Site Boundary

NGIS Bores

Irrigation

Stock and Domestic

Unknown

Water Supply

WPC Mapped GDE

Paperbark Swamp Forest

WEC Mapped GDE

Swamp Oak Forest

Freshwater Wetland

SEPP Coastal Wetlands

Coastal Wetlands

0 100 200 300 400 500 m

1:15000 @ A3

Viewport B

Notes:
- Aerial from Nearmap (2024).
- Registered bore locations from BOM Groundwater Explorer (2024).
- GDE locations from WEC (2020) and WPC.
- Coastal wetland locations from NSW SEPP (R&H) 2021

Map Title / Figure:
Groundwater Receptors

Legend

Site Boundary

Monitoring Well



0 90 180 270 360 450 m

1:7500 @ A3
Viewport C
Notes:
- Aerial from Nearmap (2025).

Map Title / Figure:
Monitoring Well Locations

Map	Map 07
Site	3631 Nelson Bay Road, Bobs Farm, NSW
Project	Proposed Sand Quarry
Sub-Project	Hydrogeological Impact Assessment
Client	Newcastle Sand C/- ADW Johnson
Date	15/04/2026



Legend

Site Boundary

Study Area

Constant Head Boundary (0.017 mAHD)

0 300 600 900 1,200 1,500 m

1:30000 @ A3

Viewport A

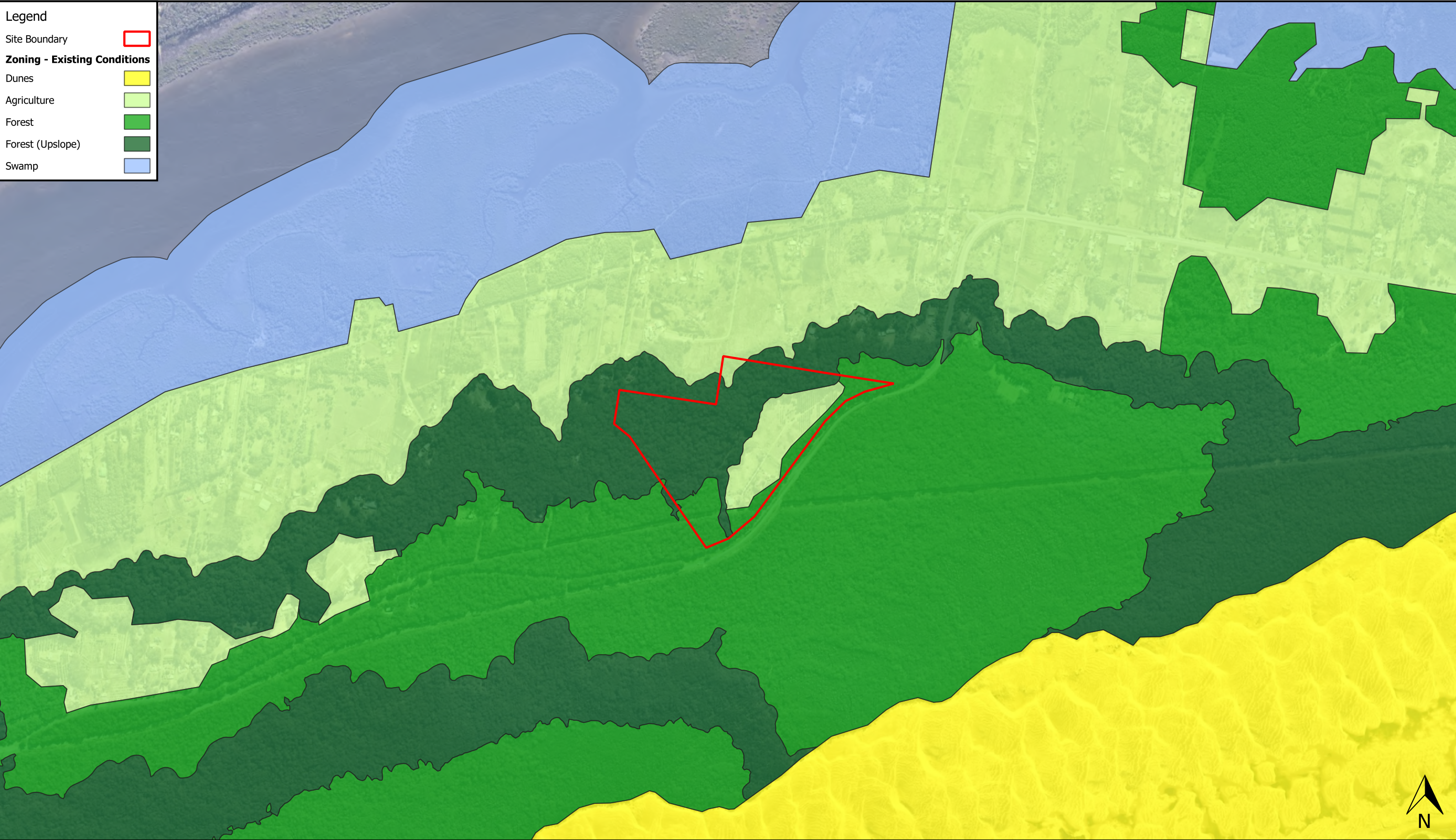
Notes:

- Aerial from Nearmap (2025).
- Constant head level based on data recorded at Mallabula Point water level gauge (MHL, NSW Government).

Map Title / Figure:
Constant Head Boundaries

Map 08
3631 Nelson Bay Road, Bobs Farm, NSW
Proposed Sand Quarry
Hydrogeological Impact Assessment
Newcastle Sand C/- ADW Johnson
15/04/2026

Map
Site
Project
Sub-Project
Client
Date



Legend

Site Boundary

Zoning - Existing Conditions

Dunes

Agriculture

Forest

Forest (Upslope)

Swamp

0 100 200 300 400 500 m

1:15000 @ A3

Viewport B

Notes:
- Aerial from Nearmap (2025).

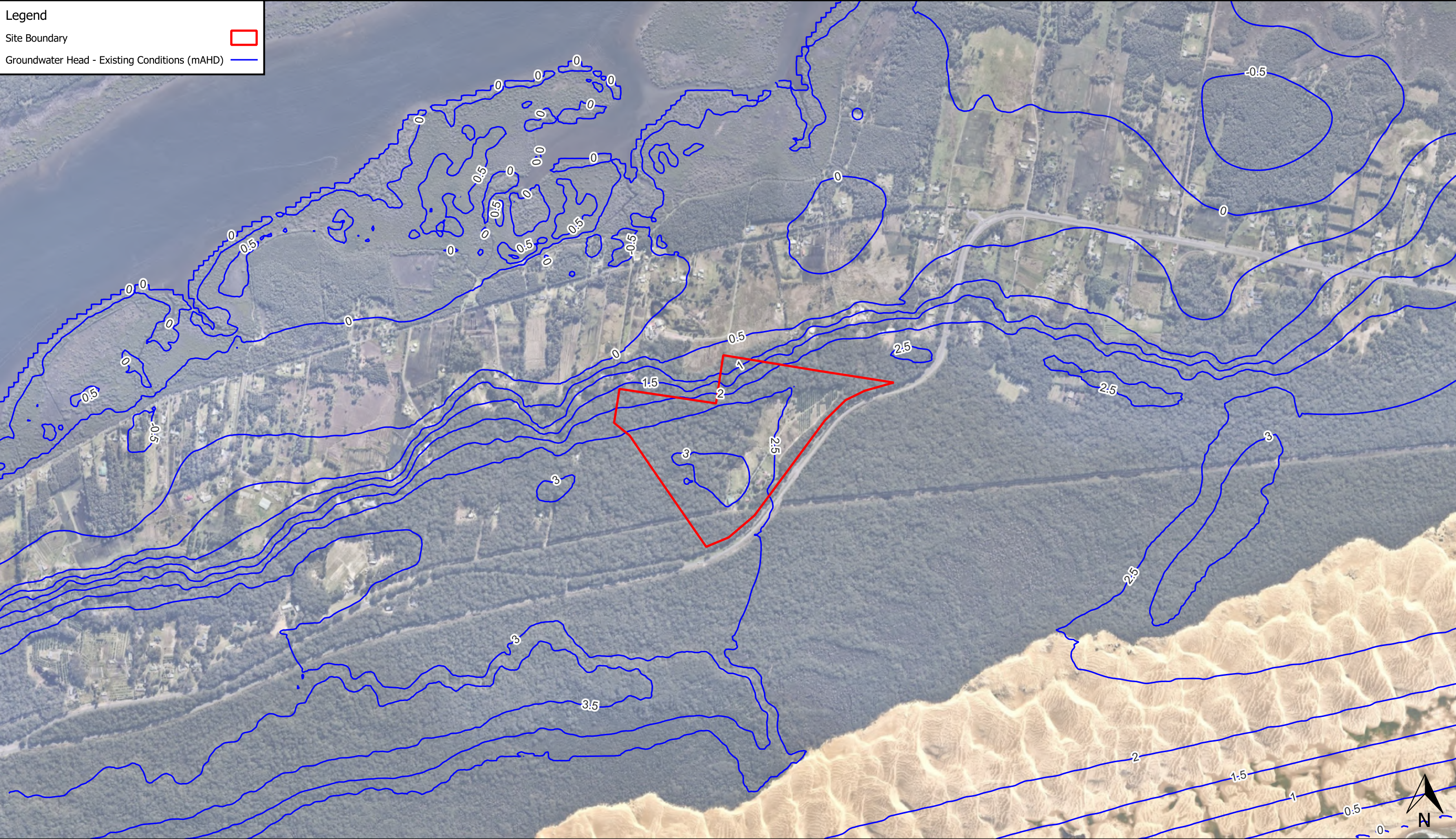
Existing Conditions Recharge and Evapotranspiration Zoning

Map 09		Map
3631 Nelson Bay Road, Bobs Farm, NSW		Site
Proposed Sand Quarry		Project
Hydrogeological Impact Assessment		Sub-Project
Newcastle Sand C/- ADW Johnson		Client
15/04/2026		Date

Legend

Site Boundary

Groundwater Head - Existing Conditions (mAHD)



0 100 200 300 400 500 m

1:15000 @ A3
Viewport B
Notes:
- Aerial from Nearmap (2025).

Groundwater Head - Existing Conditions Model

Map 10

3631 Nelson Bay Road, Bobs Farm, NSW

Proposed Sand Quarry

Hydrogeological Impact Assessment

Newcastle Sand C/- ADW Johnson

15/04/2026

Map

Site

Project

Sub-Project

Client

Date

Project No: P2511038 Map Set: MS03-R01 EPSG: 7856 © Martens & Associates Pty Ltd | E mail:martens.com.au | WEB www.martens.com.au



Legend

Site Boundary

Zoning - Proposed Conditions

Excavation

Agriculture

Forest

Forest (Upslope)

Swamp

0 90 180 270 360 450 m

1:7500 @ A3
Viewport C

Notes:
- Aerial from Nearmap (2025).
- Excavation footprint from VGT (2026).

Map Title / Figure: Proposed Conditions Recharge and Evapotranspiration Zoning

Map	Map 11
Site	3631 Nelson Bay Road, Bobs Farm, NSW
Project	Proposed Sand Quarry
Sub-Project	Hydrogeological Impact Assessment
Client	Newcastle Sand C/- ADW Johnson
Date	15/04/2026



Legend

Site Boundary

NGIS Bores

Irrigation

Unknown

Water Supply

WPC Mapped GDE

Paperbark Swamp Forest

WEC Mapped GDE

Swamp Oak Forest

Freshwater Wetland

SEPP Coastal Wetlands

Coastal Wetlands

Groundwater Impact - Scenario 1

Drawdown (m)

Uplift (m)

0 90 180 270 360 450 m

1:7500 @ A3
Viewport C

Notes:

- Aerial from Nearmap (2024).
- Registered bore locations from BOM Groundwater Explorer (2024).
- GDE locations from WEC (2020) and WPC.
- Coastal wetland locations from NSW SEPP (R&H) 2021

Map Title / Figure:
Groundwater Impact - Scenario 1



Legend

Site Boundary

NGIS Bores

Irrigation

Unknown

Water Supply

WPC Mapped GDE

Paperbark Swamp Forest

WEC Mapped GDE

Swamp Oak Forest

Freshwater Wetland

SEPP Coastal Wetlands

Coastal Wetlands

Groundwater Impact - Scenario 2

Drawdown (m)

0 90 180 270 360 450 m

1:7500 @ A3
Viewport C

Notes:

- Aerial from Nearmap (2024).
- Registered bore locations from BOM Groundwater Explorer (2024).
- GDE locations from WEC (2020) and WPC.
- Coastal wetland locations from NSW SEPP (R&H) 2021

Map Title / Figure:
Groundwater Impact - Scenario 2

Map 13

3631 Nelson Bay Road, Bobs Farm, NSW

Proposed Sand Quarry

Hydrogeological Impact Assessment

Newcastle Sand C/- ADW Johnson

15/04/2026

Map

Site

Project

Sub-Project

Client

Date

Appendix C – Borehole and Monitoring Well Logs

Plan of:	Bobs Farm Quarry BH-1	Location:	Bobs Farm	Projection:	N/A	Date:	26/11/2013	Version:	A	
				Contour Interval:	N/A	Sheet:	2 of 2	Survey:	N/A	
					Plan By:		TC	Source:	VGT Pty Ltd	
Figure:	ONE	Council:	Port Stephens Council	Project Manager:		GVT				
Client:	EMS	Scale:			Office:	Thornton	Our Ref:	V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log		

Drill Hole Number: BH 1

Project: Bobs Farm

Drilling Co: Total Drill

Date: August 2013

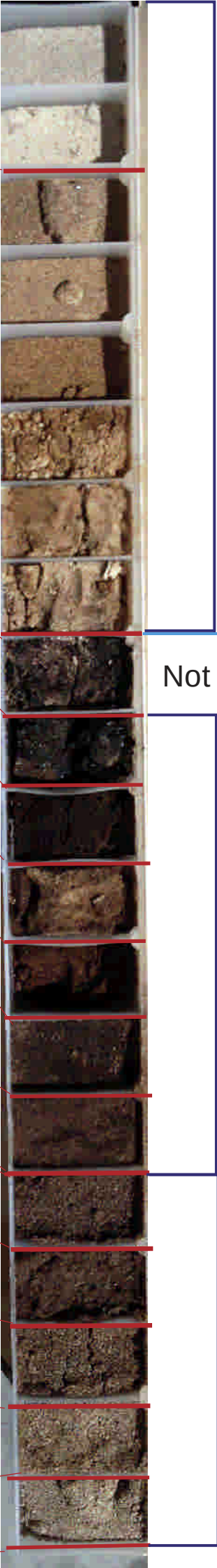
Job Number: QMS

Logged By: G THOMSON

Hole Depth: 19m

Hole Dia: 4.5 inch

Description	Depth	Graphic Log	Heavy Mineral	Remarks
Ground Surface	0			
SAND - Cloud grey with roots, mg				Solid flight augers GR 406691; 6373153, r1 5.8m Coburs from AS 2700- 1985
SAND - Pearl grey, mg				
SAND - Tan, mg				
	1			medium-grained (mg)
	2			
	3			Water Table 3.0m Moist samples Minor heavy mineral?
Water Table 3.5m				
SAND -Black, mg, Sulphur smell	4			Sulphur smell
PALEOSOL - Black, cricket pitch?				
SAND - Dark earth, mg	5			Sulphur smell
	6			Hollow flight augers
SAND - Mixed sample. dark earth, mcg				Could not retrieve samples
	7			Sampled from top of hole
				As part of hole cleaning up augers
	8			
	9			
	10			
SAND - Mixed sample. dark earth, mcg				
	11			
	12			
	13			
	14			
	15			
	16			
	17			
	18			
	19			
	20			



BH1-BL-AWT
0.6 to 3.5m

Water Table 3.5m

Not Tested

BH1-BL-G2
4.2 to 12m

BH1-BL-G1
12 to 19m

Above Water Table

Below Water Table

Plan of:	Bobs Farm Quarry BH-5	Location:	Bobs Farm	Projection:	N/A	Date:	26/11/2013	Version:	A
				Contour Interval:	N/A	Sheet:	2 of 2	Survey:	N/A
						Plan By:	TC	Source:	VGT Pty Ltd
Figure:	FIVE	Council:	Port Stephens Council			Project Manager:	GVT		
Client:	EMS	Scale:				Office:	Thornton	Our Ref:	V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log



Drill Hole Number: BH 5

Project: Bobs Farm Job Number: QMS Hole Depth: 26.5 m
Drilling Co: Total Drill Logged By: G THOMSON Hole Dia: 4.5 inch
Date: August 2013

Description	Depth	Graphic Log	Heavy Mineral	Remarks
Ground Surface	0			GR 406803; 6373515; rl 18.2
SAND - Koala grey, darker at top, mg organic at top and silty at base.	0.5			
SAND - Tan / buff, mg, silty in part	1			
SAND - Buff, mg	2			
	3			
	4			
	5			
SAND - Raffia, mg, no silt	6			
	7			
	8			
	9			
SAND - Raffia, mg, no silt	10			
	11			
	12			
	13			
	14			
SAND -Pale Ochre, mc	15			
Water Table 15.4m	15.4			
	16			
	17			
SAND-Cloud grey, minor pale ochre, mcg	18			
	19			
SAND-Cloud grey, with 5-10% black fleck	20			
CLAY - Black, shell common	21			
	22			
SAND - Lead grey, shells	23			
SAND-Light grey, 1-2% black speck minor shell grit, mcg	24			
	25			
	26			
	27			



Not Tested

BH5-BL-B
5.5 to 14.5m

Water Table 15.4m

Not Tested

BH5-BL-M
20.0 to 22.0m

BH5-BL-G
23.0 to 25.65m

Above Water Table

Below Water Table

CLIENT	Ammos Resource Management Pty Ltd	COMMENCED	18/09/2019	COMPLETED	18/09/2019	REF MW101 Sheet 1 OF 2 PROJECT NO. P1303897	
PROJECT	Supplementary Acid Sulfate Soils Assessment	LOGGED	WX	CHECKED	JF		
SITE	3631 Nelson Bay Road, Bobs Farm, NSW	GEOLOGY	Quaternary	VEGETATION	Grass		
EQUIPMENT	4WD truck-mounted hydraulic drill rig	EASTING	152.0046	RL SURFACE	6.5 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 17.95 m depth	NORTHING	-32.774565	ASPECT	Northeast	SLOPE	<2%

Drilling				Sampling			Field Material Description										
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS					
AD/T	L			19/09/19													
			</														

EXCAVATION LOG TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS 2.00 LIB.GLB Log MARTENS BOREHOLE P1303897\MW101\MW104\01.GPJ <<DrawingFile>> 11/09/2020 16:16 8.30.004 D:\Lib\Martens 2.00 2016-11-13 Proj\Martens 2.00 2016-11-13

CLIENT	Ammos Resource Management Pty Ltd	COMMENCED	18/09/2019	COMPLETED	18/09/2019	REF MW101 Sheet 2 OF 2 PROJECT NO. P1303897	
PROJECT	Supplementary Acid Sulfate Soils Assessment	LOGGED	WX	CHECKED	JF		
SITE	3631 Nelson Bay Road, Bobs Farm, NSW	GEOLOGY	Quaternary	VEGETATION	Grass		
EQUIPMENT	4WD truck-mounted hydraulic drill rig	EASTING	152.0046	RL SURFACE	6.5 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 17.95 m depth	NORTHING	-32.774565	ASPECT	Northeast	SLOPE	<2%

Drilling				Sampling			Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS		
AD/T	L			-3.50			SP	SAND; medium grained; pale grey. Pale grey white.	W		</		

EXCAVATION LOG TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

CLIENT	Ammos Resource Management Pty Ltd	COMMENCED	30/09/2019	COMPLETED	01/10/2019	REF MW104 Sheet 1 OF 3 PROJECT NO. P1303897	
PROJECT	Supplementary Acid Sulfate Soils Assessment	LOGGED	WX	CHECKED	JF		
SITE	3631 Nelson Bay Road, Bobs Farm, NSW	GEOLOGY	Quaternary	VEGETATION	None		
EQUIPMENT	4WD truck-mounted hydraulic drill rig	EASTING	151.998887	RL SURFACE	12 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 26.00 m depth	NORTHING	-32.773046	ASPECT	South	SLOPE	5-10%

Drilling				Sampling			Field Material Description								
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS			
AD/T												ID	Static Water Level		
												MW104			
					12.00	3897/MW104/0.1-0.2/S/1 D 0.00 m			SP	TOPSOIL: SAND; fine to medium subrounded to rounded grained; dark grey and grey; with silt; trace organic material.					
						3897/MW104/0.4-0.5/S/1 D 0.40 m					D - M				
			1		1.20	3897/MW104/0.1-0.2/S/1 D 1.00 m			SP						
					10.80										
						3897/MW104/1.5/S/1 D 1.50 m									
			2		2.20	3897/MW104/2.0/S/1 D 2.00 m				SAND; fine to medium grained; brown, grey and dark grey; no organics; trace silt.					
					9.80					Dark grey and dark brown; with silt.					
						3897/MW104/2.5/S/1 D 2.50 m				Dark brown.					
			3		2.80	3897/MW104/3.0/S/1 D 3.00 m									
					9.20										
						3897/MW104/3.5/S/1 D 3.50 m				Orange-dark brown; trace silt.					
			4		3.70	3897/MW104/4.0/S/1 D 4.00 m									
					8.30					Orange and pale brown, no silt.					
						3897/MW104/4.5/S/1 D 4.50 m									
			5			3897/MW104/5.0/S/1 D 5.00 m					M				
						3897/MW104/5.5/S/1 D 5.50 m									
			6		6.20	3897/MW104/6.5/S/1 D 6.50 m				Pale brown and yellow.					
					5.80										
					3897/MW104/7.5/S/1 D 7.50 m										
		7													
					3897/MW104/8.5/S/1 D 8.50 m										
		8													
					3897/MW104/9.5/S/1 D 9.50 m			CI	Sandy Silty CLAY; medium plasticity; dark brown; fine to medium grained sand; trace organic material.						
		9		9.10					Pale grey.						
				2.90						W					
				9.40											
				2.60						M (>PL)					

EXCAVATION LOG TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

CLIENT	Ammos Resource Management Pty Ltd	COMMENCED	30/09/2019	COMPLETED	01/10/2019	REF MW104 Sheet 2 OF 3 PROJECT NO. P1303897	
PROJECT	Supplementary Acid Sulfate Soils Assessment	LOGGED	WX	CHECKED	JF		
SITE	3631 Nelson Bay Road, Bobs Farm, NSW	GEOLOGY	Quaternary	VEGETATION	None		
EQUIPMENT	4WD truck-mounted hydraulic drill rig	EASTING	151.998887	RL SURFACE	12 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø100 mm x 26.00 m depth	NORTHING	-32.773046	ASPECT	South	SLOPE	5-10%

Drilling				Sampling			Field Material Description								
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	PIEZOMETER DETAILS		
AD/T				10.20				CI					MW104	Static Water Level	
				1.80				SP	SAND; fine to medium grained; grey.						
			11		3897/MW104/10.5/S/1 D 10.50 m										
			12		3897/MW104/11.5/S/1 D 11.50 m										
			13		3897/MW104/12.5/S/1 D 12.50 m										
			14		3897/MW104/14.0-14.5/S/T D 14.00 m										
			15												
			16		3897/MW104/15.75-16.2/S/T D 15.75 m										
			17		3897/MW104/17.25/S/1 D 17.25 m										
			18		3897/MW104/18.75/S/1 D 18.75 m										
		19													

EXCAVATION LOG TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS



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mail@martens.com.au WEB: http://www.martens.com.au

**Engineering Log -
TEST**

CLIENT		Ammos Resource Management Pty Ltd		COMMENCED		30/09/2019		COMPLETED		01/10/2019		REF MW104	
PROJECT		Supplementary Acid Sulfate Soils Assessment		LOGGED		WX		CHECKED		JF		Sheet 3 OF 3	
SITE		3631 Nelson Bay Road, Bobs Farm, NSW		GEOLOGY		Quaternary		VEGETATION		None		PROJECT NO. P1303897	
EQUIPMENT		4WD truck-mounted hydraulic drill rig		EASTING		151.998887		RL SURFACE		12 m		DATUM AHD	
EXCAVATION DIMENSIONS		Ø100 mm x 26.00 m depth		NORTHING		-32.773046		ASPECT		South		SLOPE 5-10%	
Drilling		Sampling		Field Material Description									
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	PIEZOMETER DETAILS	
AD/T												Static Water Level MW104	
			21	21.75	3897/MW104/20.25/S/1 D 20.25 m			SP	SAND; fine to medium grained; grey.				
			22	21.75	3897/MW104/21.75/S/1 D 21.75 m			SP	SAND; fine grained; grey.				
			23		3897/MW104/23.25/S/1 D 23.25 m					W		Screen	
			24										
			25		3897/MW104/24.75/S/1 D 24.75 m								
			26	26.00					Hole Terminated at 26.00 m				
			27										
			28										
			29										
EXCAVATION LOG TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS													
					MARTENS & ASSOCIATES PTY LTD Suite 201, 20 George St. Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 mail@martens.com.au WEB: http://www.martens.com.au					Engineering Log - TEST			



ENGINEERING LOG - BOREHOLE

CLIENT: NEWCASTLE SAND

PROJECT: ADDITIONAL MONITORING WELL INSTALLATION

LOCATION: 3631 NELSON BAY ROAD, BOBS FARM

BOREHOLE NO: BH201

PAGE: 1 OF 3

JOB NO: NEW26P-0038

LOGGED BY: BE / BB

DATE: 23/2/26

DRILL TYPE: TRACK MOUNTED DRILL RIG

SURFACE RL:

COORDINATE SYSTEM: GDA

BOREHOLE DIAMETER: 100 mm

DATUM: AHD

EASTING: 406592 m E

NORTHING: 6373286 m S

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
AD/T		1.00m SPT 0, 1, 1 N* = 2		1.0		SP	0.10m TOPSOIL: SAND - fine to medium grained, pale grey, root affected. SAND - fine to medium grained, pale grey.	M				TOPSOIL
		1.45m		1.5								AEOLIAN DEPOSITS
		2.50m SPT 2, 3, 4 N* = 7		2.5			Grey to dark grey.					
		2.95m		3.0			Pale brown to pale grey.					
		4.00m SPT 3, 4, 5 N* = 9		4.0			Pale brown with brown.					
		4.45m		4.5			Brown.					
							Pale brown to brown.					

LEGEND:		Notes, Samples and Tests		Consistency		UCS (kPa)	Moisture Condition	
Water		U ₅₀ 50mm Diameter tube sample		VS	Very Soft	<25	D	Dry
Water Level (Date and time shown)		CBR Bulk sample for CBR testing		S	Soft	25 - 50	M	Moist
Water Inflow		E Environmental sample (Glass jar, sealed and chilled on site)		F	Firm	50 - 100	W	Wet
Water Outflow		ASS Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)		St	Stiff	100 - 200	W _p	Plastic Limit
Strata Changes		B Bulk Sample		VSt	Very Stiff	200 - 400	W _L	Liquid Limit
Gradational or transitional strata		Field Tests		H	Hard	>400		
Definitive or distinct strata change		PID Photoionisation detector reading (ppm)		Fb	Friable			
		DCP(x-y) Dynamic penetrometer test (test depth interval shown)		Density	V	Very Loose	Density Index <15%	
		HP Hand Penetrometer test (UCS kPa)			L	Loose	Density Index 15 - 35%	
					MD	Medium Dense	Density Index 35 - 65%	
					D	Dense	Density Index 65 - 85%	
					VD	Very Dense	Density Index 85 - 100%	



ENGINEERING LOG - BOREHOLE

CLIENT: NEWCASTLE SAND

PROJECT: ADDITIONAL MONITORING WELL INSTALLATION

LOCATION: 3631 NELSON BAY ROAD, BOBS FARM

BOREHOLE NO: BH201

PAGE: 2 OF 3

JOB NO: NEW26P-0038

LOGGED BY: BE / BB

DATE: 23/2/26

DRILL TYPE: TRACK MOUNTED DRILL RIG

SURFACE RL:

COORDINATE SYSTEM: GDA

BOREHOLE DIAMETER: 100 mm

DATUM: AHD

EASTING: 406592 m E

NORTHING: 6373286 m S

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
AD/T	23/02/26 16:00	5.50m SPT 3, 5, 6 N* = 11		5.5		SP	SAND - fine to medium grained, pale grey. (continued) Pale brown.	M				AEOLIAN DEPOSITS
		5.95m		6.0								
		7.00m SPT 4, 6, 8 N* = 14		7.0								
		7.45m		7.5								
		8.50m SPT 2, 7, 7 N* = 14		8.5								
WB	23/02/26 16:00	8.95m		9.0		SP	Pale grey-brown to pale grey.	W				
		10.00m		9.5								

LEGEND:		Notes, Samples and Tests		Consistency		UCS (kPa)		Moisture Condition	
Water		U ₅₀ 50mm Diameter tube sample		VS	Very Soft	<25		D	Dry
Water Level (Date and time shown)		CBR Bulk sample for CBR testing		S	Soft	25 - 50		M	Moist
Water Inflow		E Environmental sample (Glass jar, sealed and chilled on site)		F	Firm	50 - 100		W	Wet
Water Outflow		ASS Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)		St	Stiff	100 - 200		W _p	Plastic Limit
Strata Changes		B Bulk Sample		VSt	Very Stiff	200 - 400		W _L	Liquid Limit
Gradational or transitional strata		Field Tests		H	Hard	>400			
Definitive or distinct strata change		PID Photoionisation detector reading (ppm)		Fb	Friable				
		DCP(x-y) Dynamic penetrometer test (test depth interval shown)		Density	V	Very Loose		Density Index <15%	
		HP Hand Penetrometer test (UCS kPa)			L	Loose		Density Index 15 - 35%	
					MD	Medium Dense		Density Index 35 - 65%	
					D	Dense		Density Index 65 - 85%	
					VD	Very Dense		Density Index 85 - 100%	



ENGINEERING LOG - BOREHOLE

CLIENT: NEWCASTLE SAND

PROJECT: ADDITIONAL MONITORING WELL INSTALLATION

LOCATION: 3631 NELSON BAY ROAD, BOBS FARM

BOREHOLE NO: BH201

PAGE: 3 OF 3

JOB NO: NEW26P-0038

LOGGED BY: BE / BB

DATE: 23/2/26

DRILL TYPE: TRACK MOUNTED DRILL RIG

SURFACE RL:

COORDINATE SYSTEM: GDA

BOREHOLE DIAMETER: 100 mm

DATUM: AHD

EASTING: 406592 m E

NORTHING: 6373286 m S

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
WB		SPT 1, 2, 2 N* = 4					SAND - fine to medium grained, pale grey. (continued)					AEOLIAN DEPOSITS
		10.45m		10.5		SP		W				
				11.0			CLAY - medium to high plasticity, dark grey.					MARINE DEPOSITS
		11.50m		11.5		CH		M > W _p				
		SPT 1, 2, 10 N* = 12				CH	Sandy CLAY - medium to high plasticity, dark grey, fine to medium grained sand.					
		11.95m		12.0			SAND - fine to medium grained, pale grey to grey.					
				12.5			Grey to dark grey.					
		13.00m		13.0		SP		W				
		SPT 13, 20, 30 N* = 50										
		13.45m		13.5								
				14.0			Hole Terminated at 14.00 m Target depth					
				14.5								

LEGEND:		Notes, Samples and Tests		Consistency		UCS (kPa)	Moisture Condition	
Water		U ₅₀ 50mm Diameter tube sample		VS	Very Soft	<25	D	Dry
Water Level (Date and time shown)		CBR Bulk sample for CBR testing		S	Soft	25 - 50	M	Moist
Water Inflow		E Environmental sample (Glass jar, sealed and chilled on site)		F	Firm	50 - 100	W	Wet
Water Outflow		ASS Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)		St	Stiff	100 - 200	W _p	Plastic Limit
Strata Changes		B Bulk Sample		VSt	Very Stiff	200 - 400	W _L	Liquid Limit
Gradational or transitional strata		Field Tests		H	Hard	>400		
Definitive or distinct strata change		PID Photoionisation detector reading (ppm)		Fb	Friable			
		DCP(x-y) Dynamic penetrometer test (test depth interval shown)		Density	V	Very Loose	Density Index <15%	
		HP Hand Penetrometer test (UCS kPa)			L	Loose	Density Index 15 - 35%	
					MD	Medium Dense	Density Index 35 - 65%	
					D	Dense	Density Index 65 - 85%	
					VD	Very Dense	Density Index 85 - 100%	



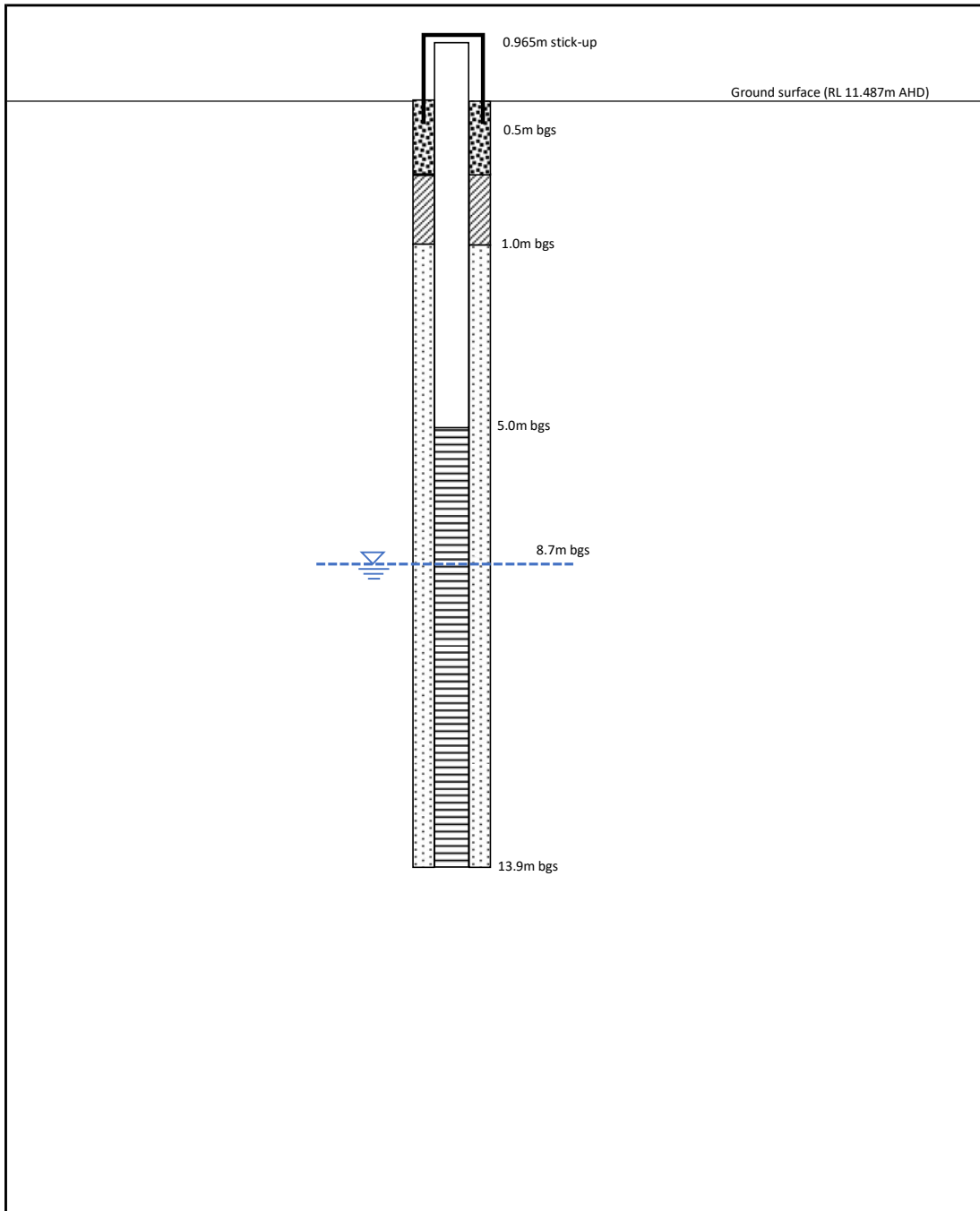
MONITORING WELL CONSTRUCTION

Client: Newcastle Sand
Project: Additional Monitoring Well Construction
Location: Bobs Farm Sand Quarry

Borehole No.: BH201
Job No.: NEW26P-0038
Logged By: BB
Date: 24/02/2026

Borehole diameter: 100mm

PVC Screen & Casing Diameter: 50mm (inside)



LEGEND:



PVC Casing



Sand/Gravel (2mm to 5mm)



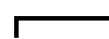
Concrete



PVC Screen (machine slotted)



Bentonite



Gatic cover



ENGINEERING LOG - BOREHOLE

CLIENT: NEWCASTLE SAND

PROJECT: ADDITIONAL MONITORING WELL INSTALLATION

LOCATION: 3631 NELSON BAY ROAD, BOBS FARM

BOREHOLE NO: BH202

PAGE: 1 OF 3

JOB NO: NEW26P-0038

LOGGED BY: BB

DATE: 24/2/26

DRILL TYPE: TRACK MOUNTED DRILL RIG

SURFACE RL:

COORDINATE SYSTEM: GDA

BOREHOLE DIAMETER: 100 mm

DATUM: AHD

EASTING: 406260 m E

NORTHING: 6373082 m S

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
AD/T				0.20m		SP	TOPSOIL: SAND - fine to medium grained, grey-brown, trace fines of low plasticity, root affected.	D				TOPSOIL
							SAND - fine to medium grained, grey-brown to pale grey-brown.	D - M				AEOLIAN DEPOSITS
				0.5			Pale brown.					NO SPTS CONDUCTED PRIOR TO WATER TABLE DUE TO TIME CONSTRAINTS
				1.0			Brown to dark brown.					
				1.5								
				2.0								
				2.5								
				3.0								
				3.5								
				4.0								
				4.5								

LEGEND:		Notes, Samples and Tests		Consistency		UCS (kPa)		Moisture Condition	
Water		U ₅₀ 50mm Diameter tube sample		VS	Very Soft	<25		D	Dry
Water Level (Date and time shown)		CBR Bulk sample for CBR testing		S	Soft	25 - 50		M	Moist
Water Inflow		E Environmental sample (Glass jar, sealed and chilled on site)		F	Firm	50 - 100		W	Wet
Water Outflow		ASS Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)		St	Stiff	100 - 200		W _p	Plastic Limit
Strata Changes		B Bulk Sample		VSt	Very Stiff	200 - 400		W _L	Liquid Limit
Gradational or transitional strata		Field Tests		H	Hard	>400			
Definitive or distinct strata change		PID Photoionisation detector reading (ppm)		Fb	Friable				
		DCP(x-y) Dynamic penetrometer test (test depth interval shown)		Density		V	Very Loose	Density Index <15%	
		HP Hand Penetrometer test (UCS kPa)				L	Loose	Density Index 15 - 35%	
						MD	Medium Dense	Density Index 35 - 65%	
						D	Dense	Density Index 65 - 85%	
						VD	Very Dense	Density Index 85 - 100%	



ENGINEERING LOG - BOREHOLE

CLIENT: NEWCASTLE SAND
PROJECT: ADDITIONAL MONITORING WELL INSTALLATION
LOCATION: 3631 NELSON BAY ROAD, BOBS FARM

BOREHOLE NO: BH202
PAGE: 2 OF 3
JOB NO: NEW26P-0038
LOGGED BY: BB
DATE: 24/2/26

DRILL TYPE: TRACK MOUNTED DRILL RIG
BOREHOLE DIAMETER: 100 mm
SURFACE RL:
DATUM: AHD
COORDINATE SYSTEM: GDA
EASTING: 406260 m E
NORTHING: 6373082 m S

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
AD/T							SAND - fine to medium grained, grey-brown to pale grey-brown. (continued) Dark grey. Pale grey to white.	M				AEOLIAN DEPOSITS
							Dark grey-brown.	M - W				
						SP	Grey-brown to grey.					
							Dark grey.	W				
							Pale brown to pale grey-brown.					

LEGEND:		Notes, Samples and Tests		Consistency		UCS (kPa)	Moisture Condition	
Water		U ₅₀ 50mm Diameter tube sample		VS	Very Soft	<25	D	Dry
Water Level (Date and time shown)		CBR Bulk sample for CBR testing		S	Soft	25 - 50	M	Moist
Water Inflow		E Environmental sample (Glass jar, sealed and chilled on site)		F	Firm	50 - 100	W	Wet
Water Outflow		ASS Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)		St	Stiff	100 - 200	W _p	Plastic Limit
Strata Changes		B Bulk Sample		VSt	Very Stiff	200 - 400	W _L	Liquid Limit
Gradational or transitional strata		Field Tests		H	Hard	>400		
Definitive or distinct strata change		PID Photoionisation detector reading (ppm)		Fb	Friable			
		DCP(x-y) Dynamic penetrometer test (test depth interval shown)		Density	V	Very Loose	Density Index <15%	
		HP Hand Penetrometer test (UCS kPa)			L	Loose	Density Index 15 - 35%	
					MD	Medium Dense	Density Index 35 - 65%	
					D	Dense	Density Index 65 - 85%	
					VD	Very Dense	Density Index 85 - 100%	

ENGINEERING LOG - BOREHOLE

CLIENT: NEWCASTLE SAND

PROJECT: ADDITIONAL MONITORING WELL INSTALLATION

LOCATION: 3631 NELSON BAY ROAD, BOBS FARM

BOREHOLE NO: **BH202**

PAGE: 3 OF 3

JOB NO: NEW26P-0038

LOGGED BY: BB

DATE: 24/2/26

DRILL TYPE: TRACK MOUNTED DRILL RIG

SURFACE RL:

COORDINATE SYSTEM: GDA

BOREHOLE DIAMETER: 100 mm

DATUM: AHD

EASTING: 406260 m E

NORTHING: 6373082 m S

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
WB		SPT 14, 15, 15 N* = 30					SAND - fine to medium grained, grey-brown to pale grey-brown. (continued)					AEOLIAN DEPOSITS
		10.45m		10.5								
		11.50m		11.0								
		SPT 15, 20, 19 N* = 39		11.5		SP		W				
		11.95m		12.0								MARINE DEPOSITS
		13.00m		12.5								
		SPT 5, 10, 19 N* = 29		13.0		CH	Sandy CLAY - medium to high plasticity, dark grey, fine to medium grained sand.	M > w _L				
		13.45m		13.5			SAND - fine to medium grained, pale grey to grey.					
				14.0		SP		W				Hole Terminated at 14.50 m Target depth
				14.5								

LEGEND:		Notes, Samples and Tests		Consistency		UCS (kPa)		Moisture Condition	
Water		U ₅₀ 50mm Diameter tube sample		VS	Very Soft	<25		D	Dry
Water Level (Date and time shown)		CBR Bulk sample for CBR testing		S	Soft	25 - 50		M	Moist
Water Inflow		E Environmental sample (Glass jar, sealed and chilled on site)		F	Firm	50 - 100		W	Wet
Water Outflow		ASS Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)		St	Stiff	100 - 200		W _p	Plastic Limit
Strata Changes		B Bulk Sample		VSt	Very Stiff	200 - 400		W _L	Liquid Limit
Gradational or transitional strata		Field Tests		H	Hard	>400			
Definitive or distinct strata change		PID Photoionisation detector reading (ppm)		Fb	Friable				
		DCP(x-y) Dynamic penetrometer test (test depth interval shown)		Density	V	Very Loose	Density Index <15%		
		HP Hand Penetrometer test (UCS kPa)			L	Loose	Density Index 15 - 35%		
					MD	Medium Dense	Density Index 35 - 65%		
					D	Dense	Density Index 65 - 85%		
					VD	Very Dense	Density Index 85 - 100%		



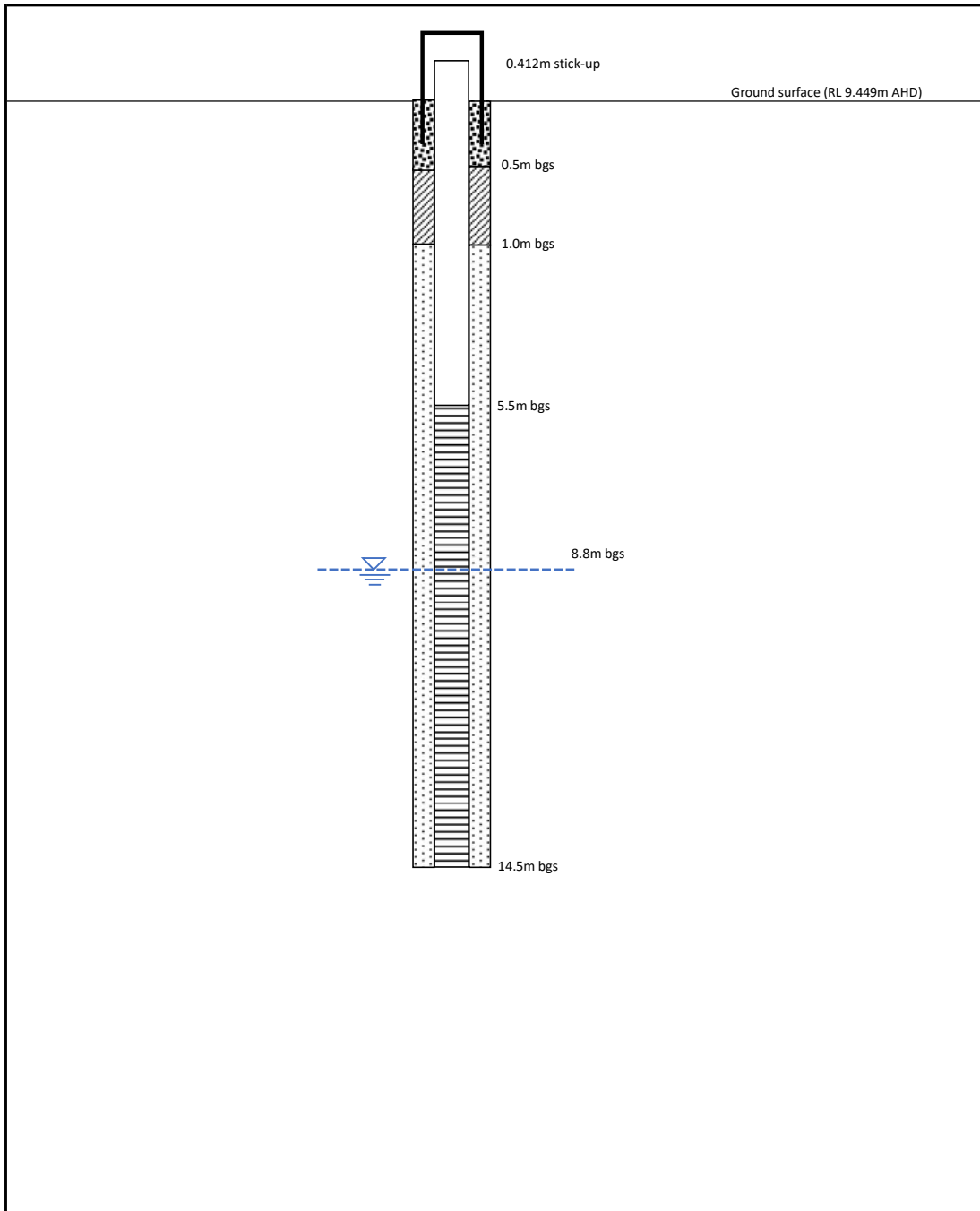
MONITORING WELL CONSTRUCTION

Client: Newcastle Sand
Project: Additional Monitoring Well Construction
Location: Bobs Farm Sand Quarry

Borehole No.: BH202
Job No.: NEW26P-0038
Logged By: BB
Date: 24/02/2026

Borehole diameter: 100mm

PVC Screen & Casing Diameter: 50mm (inside)



LEGEND:



PVC Casing



Sand/Gravel (2mm to 5mm)



Concrete



PVC Screen (machine slotted)



Bentonite



Gatic cover

ENGINEERING LOG - BOREHOLE

CLIENT: NEWCASTLE SAND

PROJECT: ADDITIONAL MONITORING WELL INSTALLATION

LOCATION: 3631 NELSON BAY ROAD, BOBS FARM

BOREHOLE NO: **BH203**

PAGE: 1 OF 2

JOB NO: NEW26P-0038

LOGGED BY: BE

DATE: 23/2/26

DRILL TYPE: TRACK MOUNTED DRILL RIG

SURFACE RL: 6.5 m

COORDINATE SYSTEM: GDA

BOREHOLE DIAMETER: 100 mm

DATUM: AHD

EASTING: 406529 m E

NORTHING: 6373026 m S

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
AD/T						SM	0.10m FILL-TOPSOIL: Silty SAND - fine to coarse grained (mostly fine to medium grained), grey-brown, fines of low plasticity, trace fine to medium grained angular to sub-angular gravel, root affected.					FILL - TOPSOIL
						GP	0.30m FILL: Sandy GRAVEL / Gravelly SAND - fine to medium grained, angular to sub-angular, pale brown, fine to coarse grained (mostly fine to medium grained) sand.					FILL
		1.00m SPT 2, 4, 5 N* = 9		5.5	1.0	SP	SAND - fine to coarse grained (mostly fine to medium grained), grey-brown to brown, trace fine grained sub-angular gravel.	M				AEOLIAN DEPOSITS
		1.45m		5.0	1.5							
WB	23/02/26 12:30	2.50m SPT 3, 5, 5 N* = 10		4.0	2.5	SP						
		2.95m		3.5	3.0		SAND - fine to medium grained, pale brown with pale grey-brown.					
		4.00m SPT 1, 3, 6 N* = 9		2.5	4.0	SP	Brown with some pale brown.	W				
		4.45m		2.0	4.5							

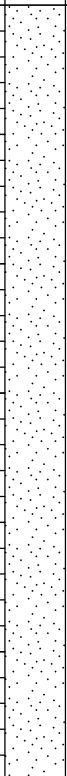
LEGEND:		Notes, Samples and Tests		Consistency		UCS (kPa)	Moisture Condition	
<u>Water</u>		U ₅₀	50mm Diameter tube sample	VS	Very Soft	<25	D	Dry
 Water Level (Date and time shown)		CBR	Bulk sample for CBR testing	S	Soft	25 - 50	M	Moist
 Water Inflow		E	Environmental sample (Glass jar, sealed and chilled on site)	F	Firm	50 - 100	W	Wet
 Water Outflow		ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)	St	Stiff	100 - 200	W _p	Plastic Limit
<u>Strata Changes</u>		B	Bulk Sample	VSt	Very Stiff	200 - 400	W _L	Liquid Limit
 Gradational or transitional strata		<u>Field Tests</u>		H	Hard	>400		
 Definitive or distinct strata change		PID	Photoionisation detector reading (ppm)	Fb	Friable			
		DCP(x-y)	Dynamic penetrometer test (test depth interval shown)	Density	V	Very Loose	Density Index <15%	
		HP	Hand Penetrometer test (UCS kPa)		L	Loose	Density Index 15 - 35%	
					MD	Medium Dense	Density Index 35 - 65%	
					D	Dense	Density Index 65 - 85%	
					VD	Very Dense	Density Index 85 - 100%	

ENGINEERING LOG - BOREHOLE

CLIENT: NEWCASTLE SAND
PROJECT: ADDITIONAL MONITORING WELL INSTALLATION
LOCATION: 3631 NELSON BAY ROAD, BOBS FARM

BOREHOLE NO: BH203
PAGE: 2 OF 2
JOB NO: NEW26P-0038
LOGGED BY: BE
DATE: 23/2/26

DRILL TYPE: TRACK MOUNTED DRILL RIG **SURFACE RL:** 6.5 m **COORDINATE SYSTEM:** GDA
BOREHOLE DIAMETER: 100 mm **DATUM:** AHD **EASTING:** 406529 m E **NORTHING:** 6373026 m S

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics, colour, minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
WB		5.50m SPT 2, 4, 4 N* = 8	1.0	5.5		SP	SAND - fine to medium grained, pale brown with pale grey-brown. <i>(continued)</i>	W				
		5.95m	0.5	6.0								
			0.0	6.5								
		7.00m SPT 6, 10, 12 N* = 22	-0.5	7.0								
		7.45m	-1.0	7.5								
			-1.5	8.0								
							Hole Terminated at 8.00 m Target depth					
			-2.0	8.5								
			-2.5	9.0								
			-3.0	9.5								

LEGEND:		Notes, Samples and Tests		Consistency		UCS (kPa)		Moisture Condition	
Water		U ₅₀ 50mm Diameter tube sample		VS	Very Soft	<25		D	Dry
 Water Level (Date and time shown)		CBR Bulk sample for CBR testing		S	Soft	25 - 50		M	Moist
 Water Inflow		E Environmental sample (Glass jar, sealed and chilled on site)		F	Firm	50 - 100		W	Wet
 Water Outflow		ASS Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)		St	Stiff	100 - 200		W _p	Plastic Limit
Strata Changes		B Bulk Sample		VSt	Very Stiff	200 - 400		W _L	Liquid Limit
--- Gradational or transitional strata		Field Tests		H	Hard	>400			
— Definitive or distinct strata change		PID Photoionisation detector reading (ppm)		Fb	Friable				
		DCP(x-y) Dynamic penetrometer test (test depth interval shown)		Density		V	Very Loose	Density Index <15%	
		HP Hand Penetrometer test (UCS kPa)		L		L	Loose	Density Index 15 - 35%	
				MD		MD	Medium Dense	Density Index 35 - 65%	
				D		D	Dense	Density Index 65 - 85%	
				VD		VD	Very Dense	Density Index 85 - 100%	



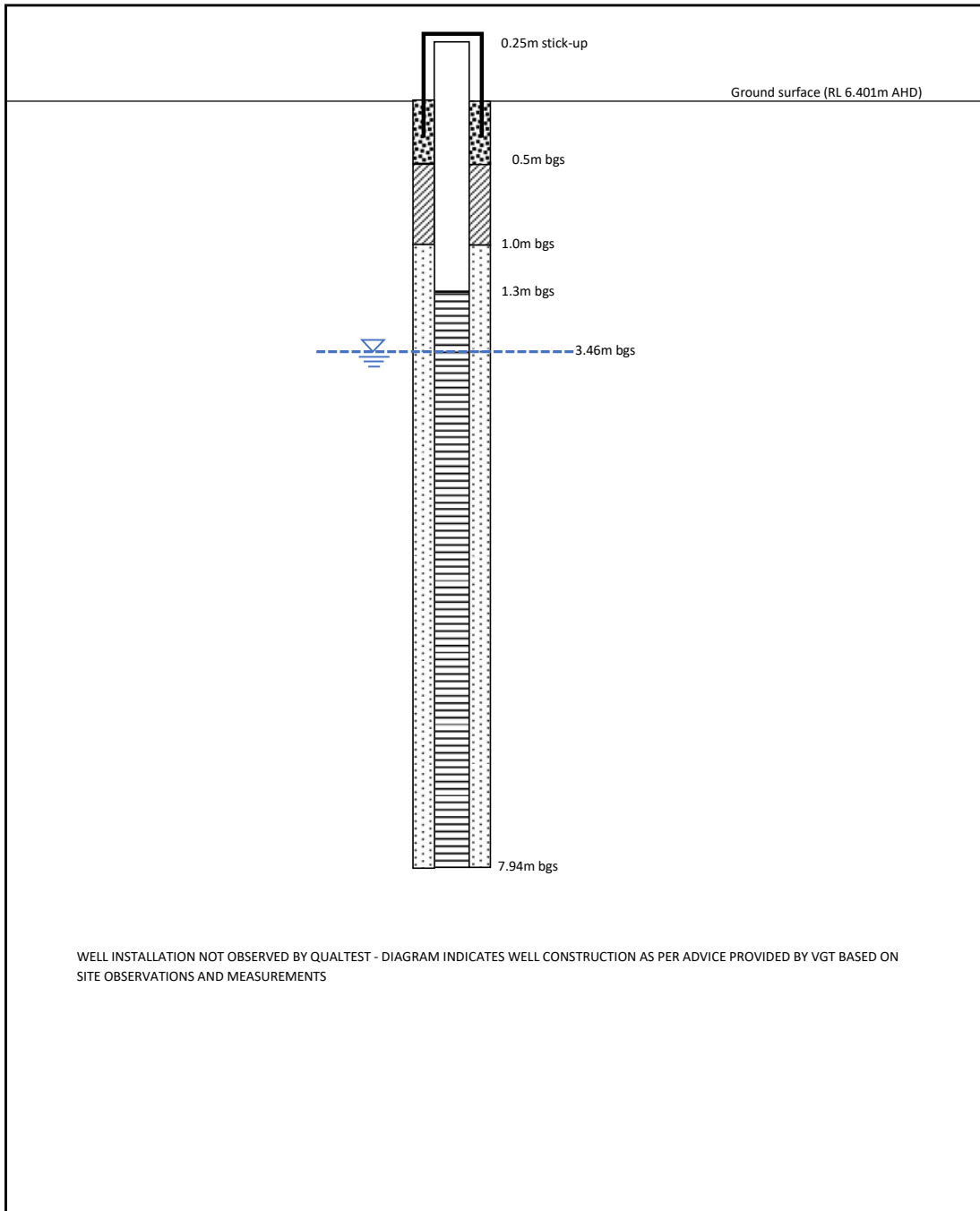
MONITORING WELL CONSTRUCTION

Client: Newcastle Sand
Project: Additional Monitoring Well Construction
Location: Bobs Farm Sand Quarry

Borehole No.: BH203.V2
Job No.: NEW26P-0038
Logged By: Client representative
Date: 26/02/2026

Borehole diameter: 100mm

PVC Screen & Casing Diameter: 50mm (inside)



LEGEND:



PVC Casing



Sand/Gravel (2mm to 5mm)



Concrete



PVC Screen (machine slotted)

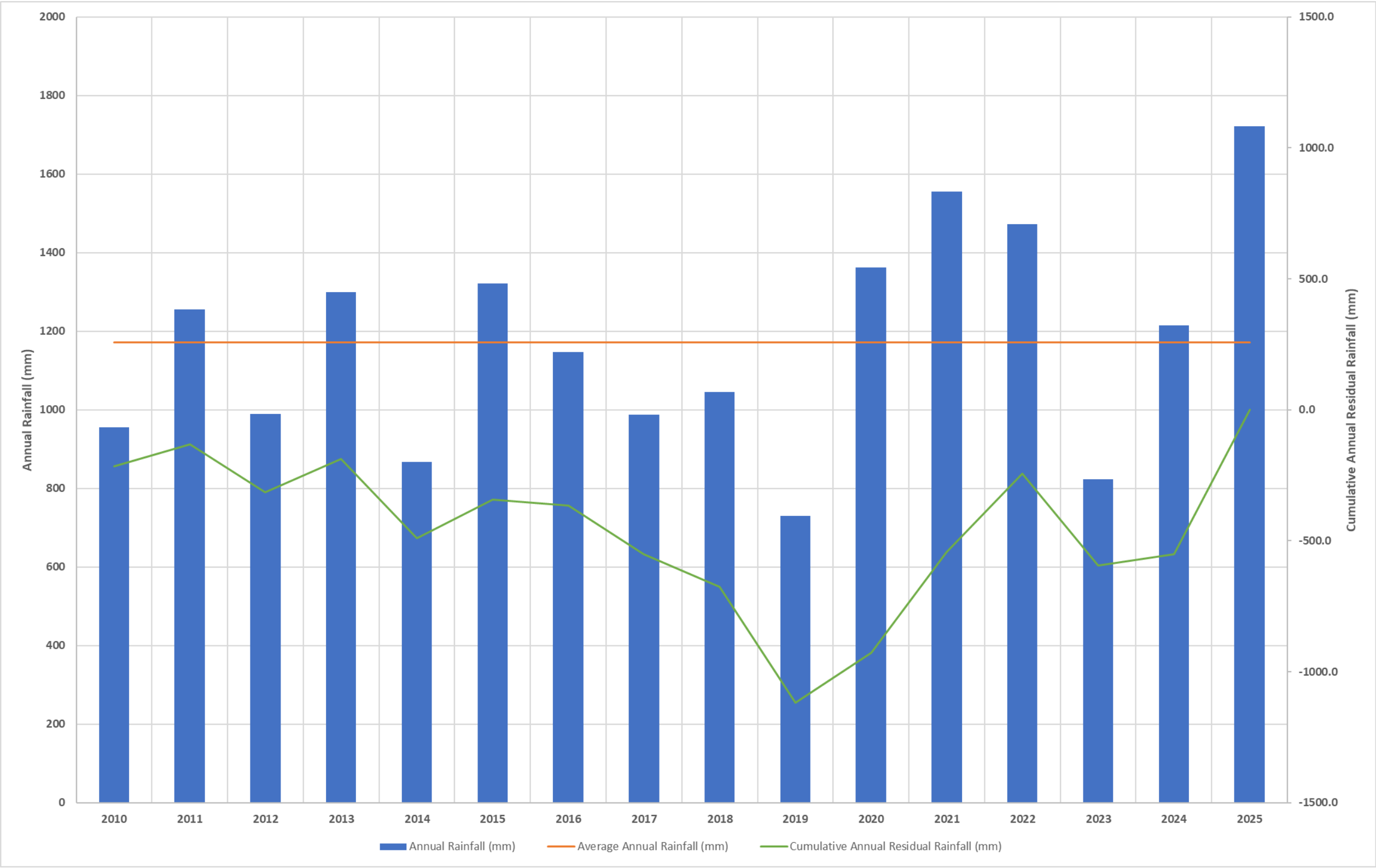


Bentonite

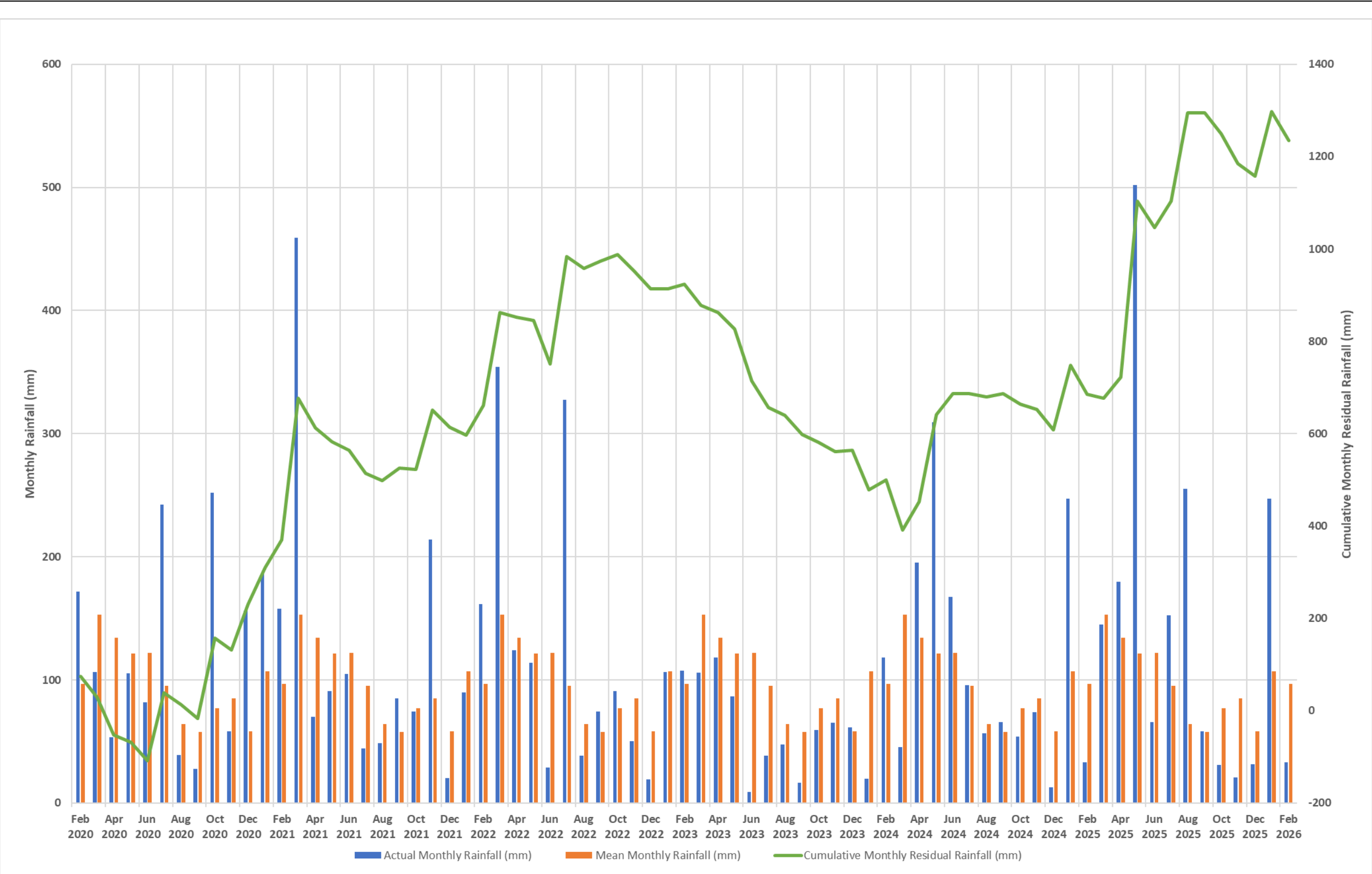


Gatic cover

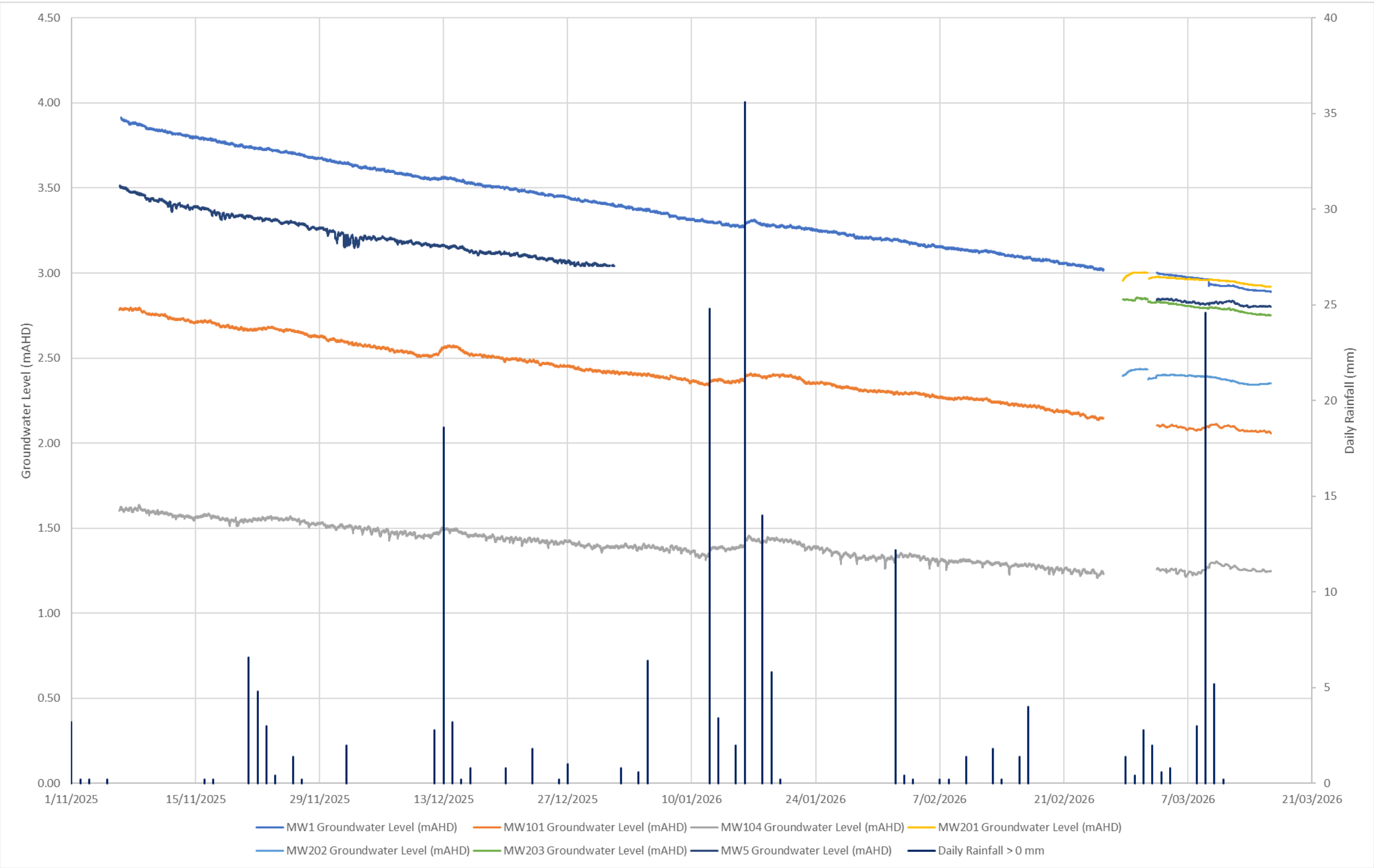
Appendix D – Figures



NOTES: ○ Cumulative annual residual rainfall is the running total of recorded annual rainfall minus average annual rainfall.	Martens & Associates Pty Ltd		Environment Water Wastewater Geotechnical Civil Management	
	Drawn:	DS	Figure 1: Historical annual rainfall and cumulative annual residual rainfall.	Report: P2511038JR07V02
	Approved:	AN		
	Date:	18/05/2026		Page 75

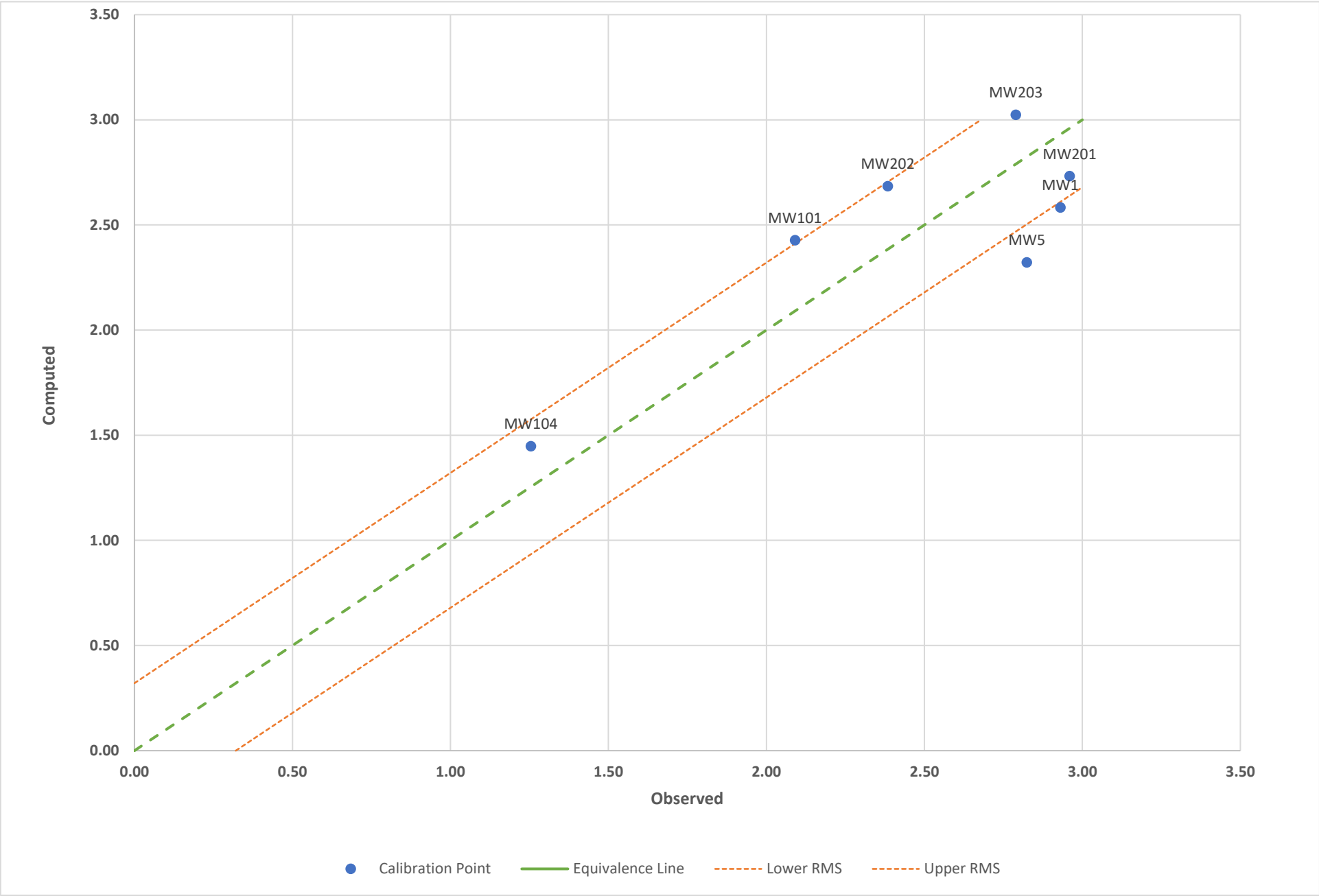


NOTES: ○ Cumulative monthly residual rainfall is the running total of recorded monthly rainfall minus average monthly rainfall.	Martens & Associates Pty Ltd		Environment Water Wastewater Geotechnical Civil Management	
	Drawn:	DS	Figure 2: Recorded and average monthly rainfall, and cumulative monthly residual rainfall.	Report: P2511038JR07V02
	Approved:	AN		
	Date:	18/05/2026		Page 76



	Martens & Associates Pty Ltd		Environment Water Wastewater Geotechnical Civil Management	
	Drawn:	DS	Figure 3: Groundwater levels and daily rainfall.	Report: P2511038JR07V02
	Approved:	JCF		
	Date:	18/05/2026		Page 77

No. of Data Points	7
Mean Residual	-0.002
Mean Absolute Residual	0.306
Root Mean Squared Residual	0.321
Normalised RMS	18.8%



	Martens & Associates Pty Ltd		Environment Water Wastewater Geotechnical Civil Management	
	Drawn:	DS	Figure 4: Existing conditions model calibration results.	Report: P2511038JR07V02
	Approved:	JCF		
	Date:	18/05/2026		Page 78

Appendix E – Slug Test Results

Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007



PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW1 (1)
Method	Hvorslev (1981)

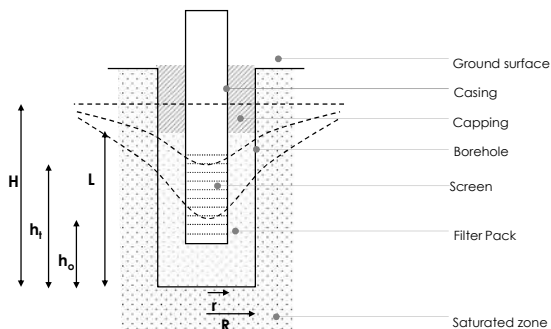
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

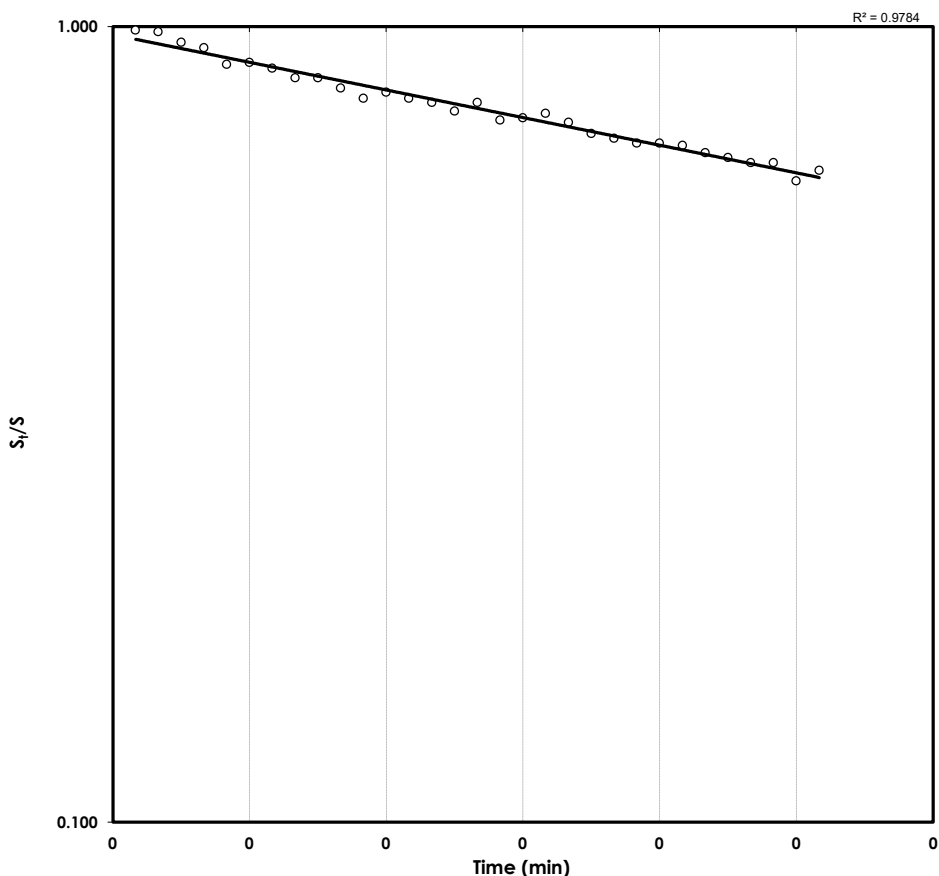
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
15.490	m
15.676	m
0.025	m
0.050	m
2.00	m
0.61	minutes
1.3679	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007



PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW1 (2)
Method	Hvorslev (1981)

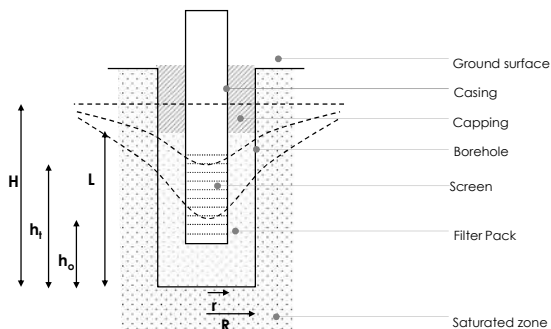
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

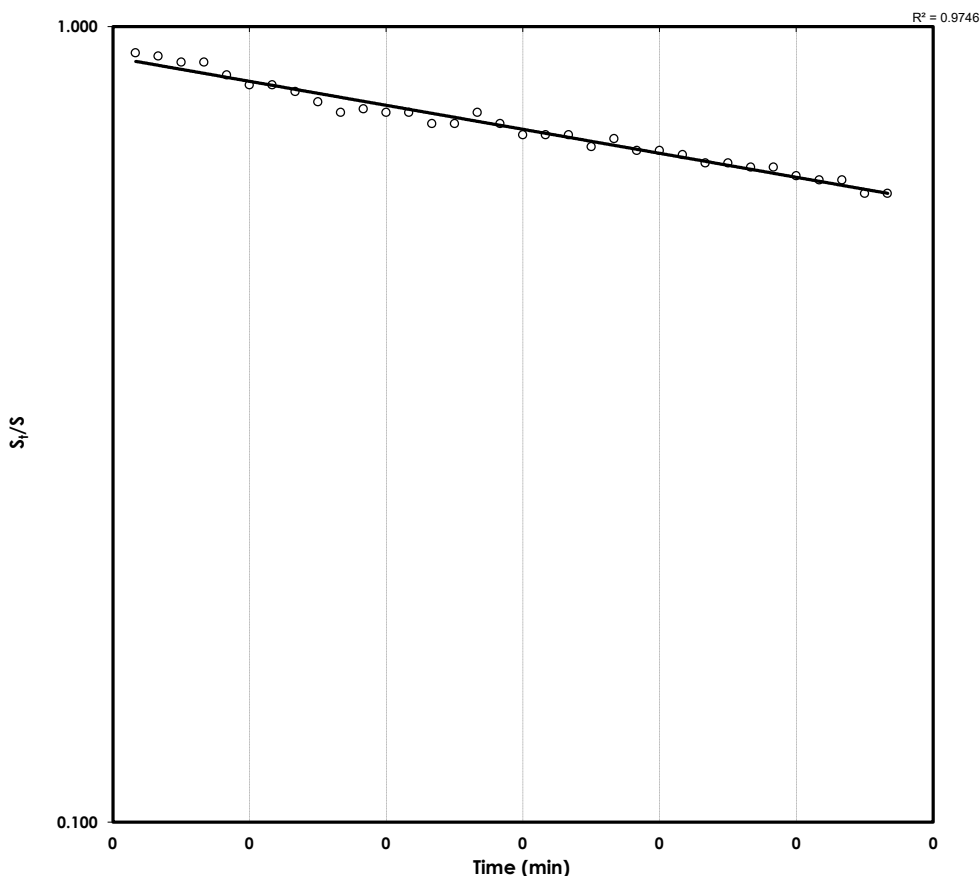
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
15.490	m
15.602	m
0.025	m
0.050	m
2.00	m
0.65	minutes
1.2739	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW1 (3)
Method	Hvorslev (1981)

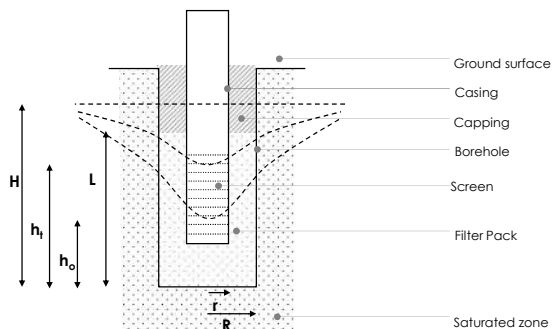
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

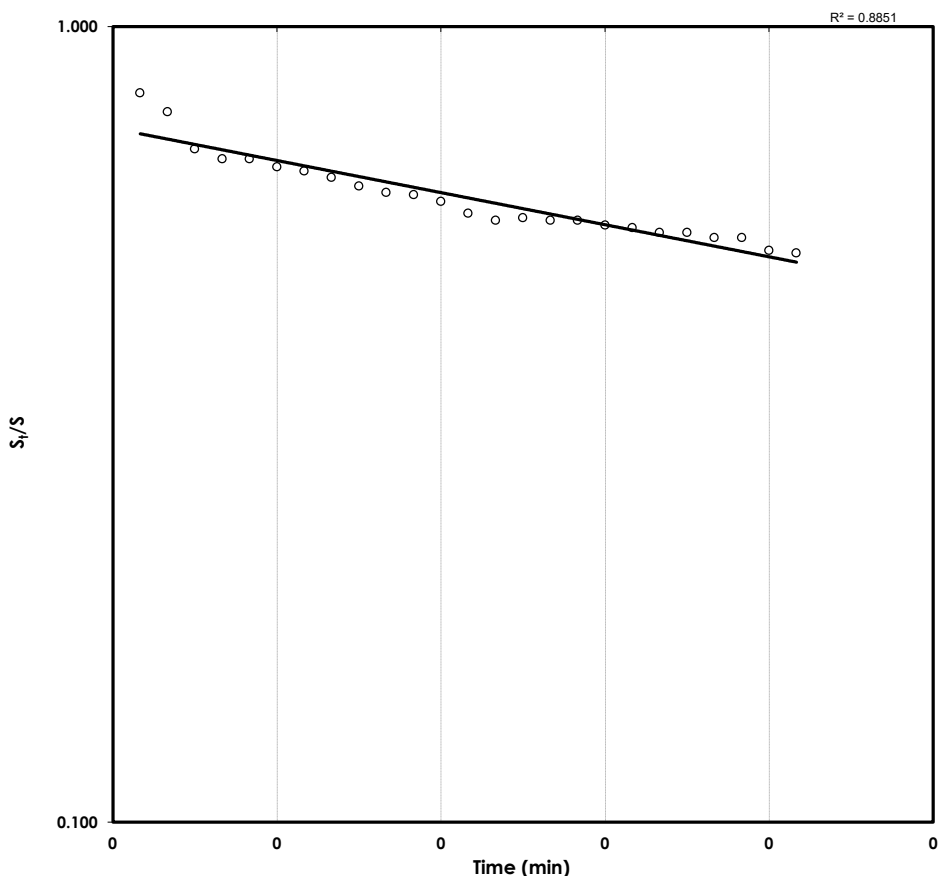
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
15.490	m
15.721	m
0.025	m
0.050	m
2.00	m
0.38	minutes
2.2049	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW1 (4)
Method	Hvorslev (1981)

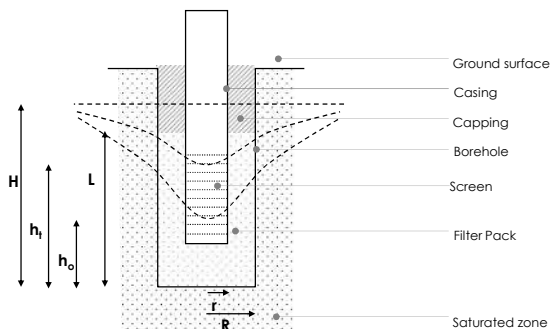
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

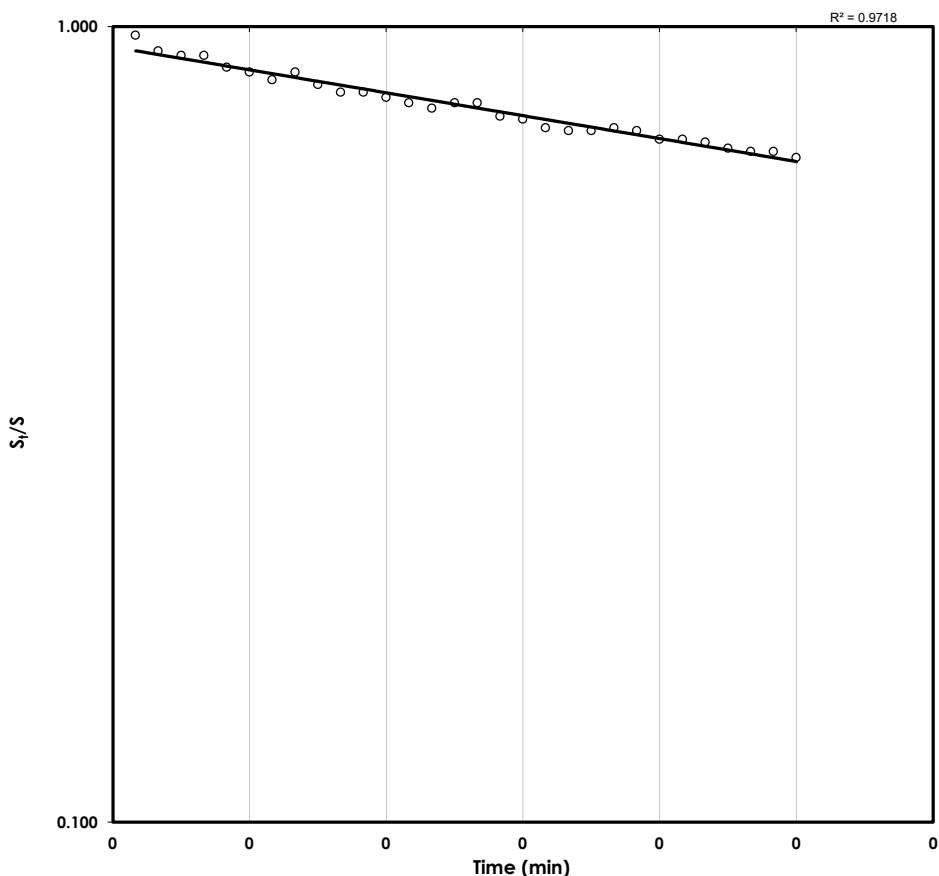
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
15.490	m
15.638	m
0.025	m
0.050	m
2.00	m
0.71	minutes
1.1770	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW101 (1)
Method	Hvorslev (1981)

Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

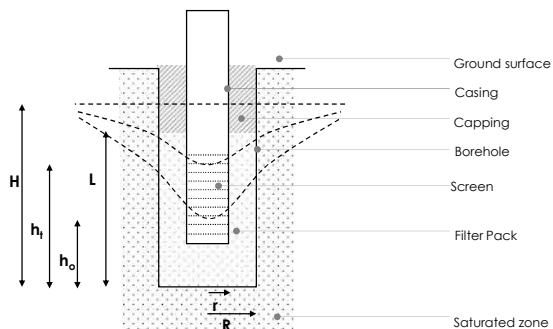
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
r - Casing radius
R - Bore radius
L - Length of open screen

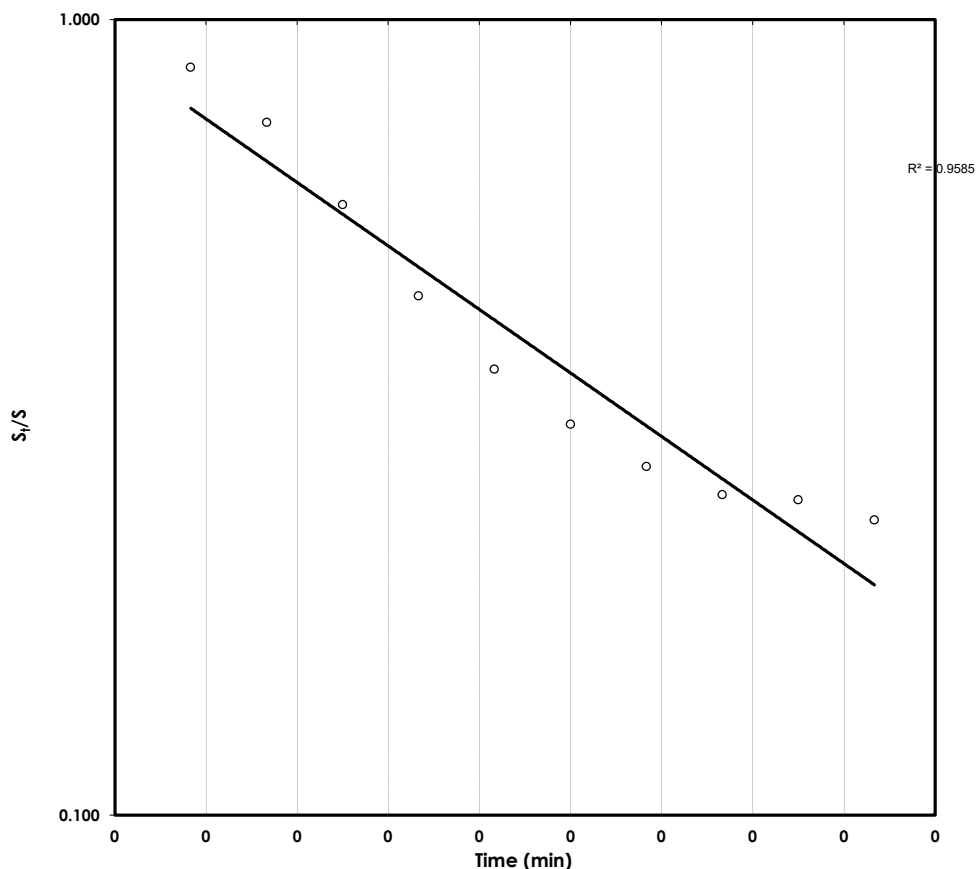
Enter Data	Unit
12.696	m
12.952	m
0.025	m
0.050	m
5.45	m
0.05	minutes
7.9976	m/d

T_o - Length of characteristic time

K_{sat} - Saturated hydraulic conductivity



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW101 (2)
Method	Hvorslev (1981)

Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

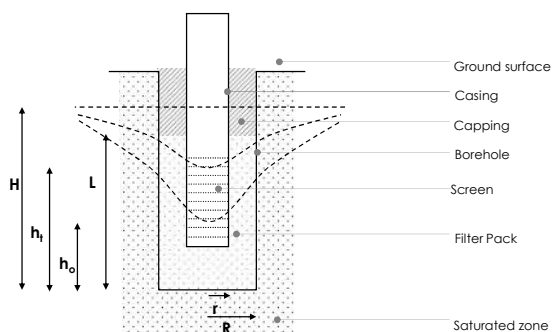
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

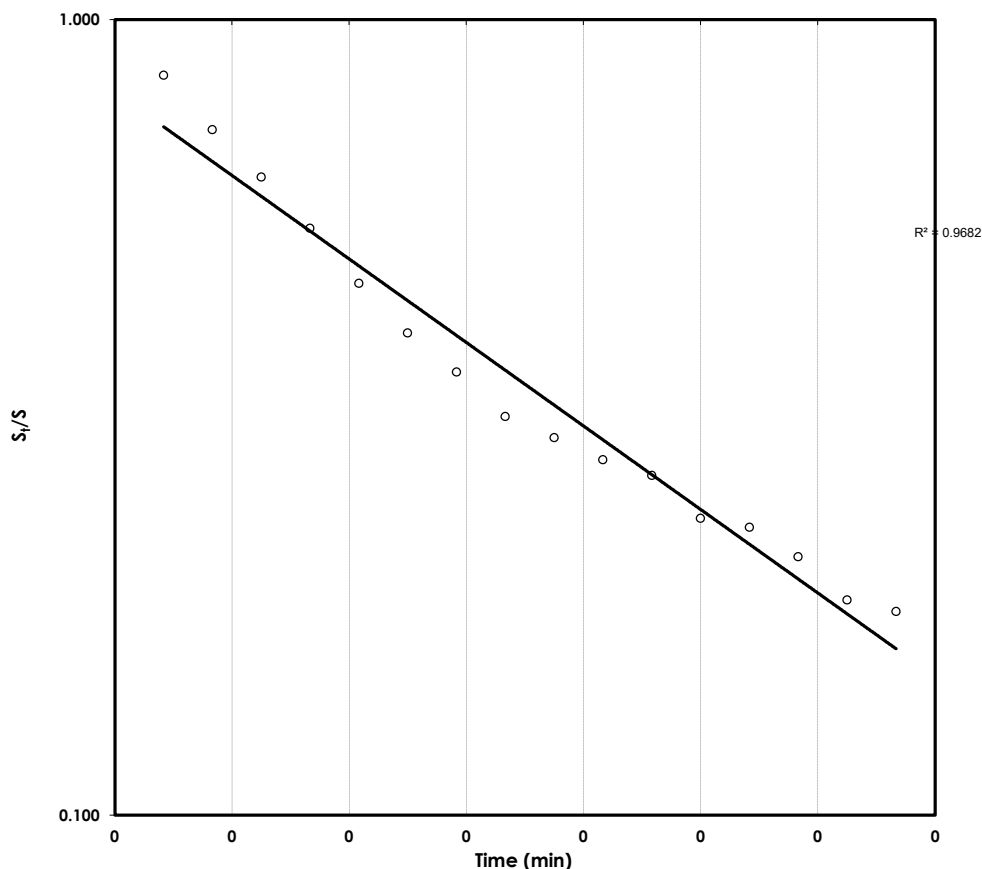
Enter Data	Unit
12.698	m
12.845	m
0.025	m
0.050	m
5.45	m
0.06	minutes
5.9665	m/d

T_o - Length of characteristic time

K_{sat} - Saturated hydraulic conductivity



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW101 (3)
Method	Hvorslev (1981)

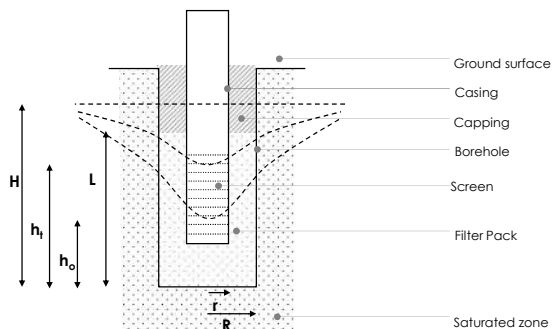
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

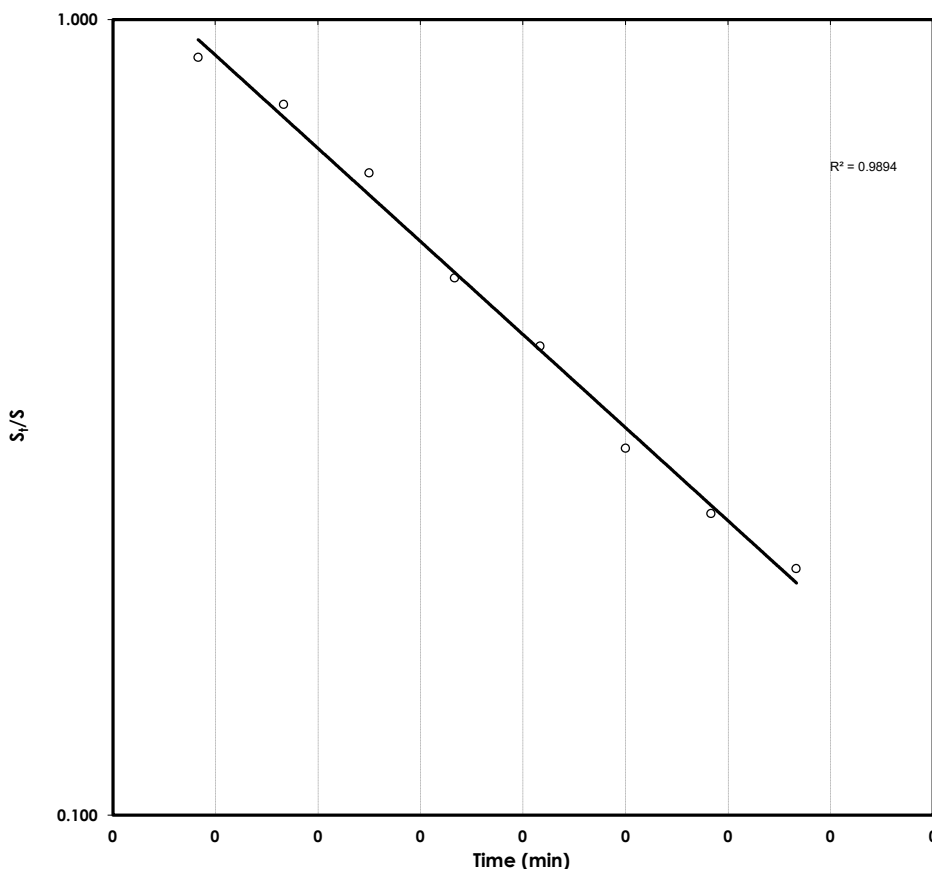
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
12.693	m
13.135	m
0.025	m
0.050	m
5.45	m
0.04	minutes
8.9944	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW104 (1)
Method	Hvorslev (1981)

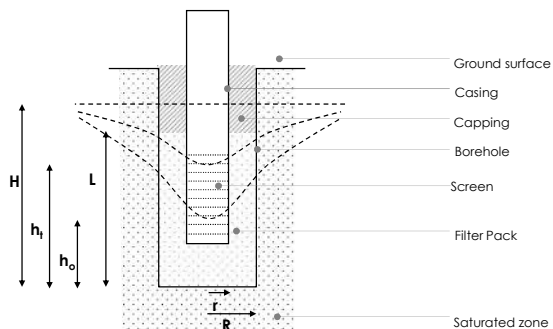
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

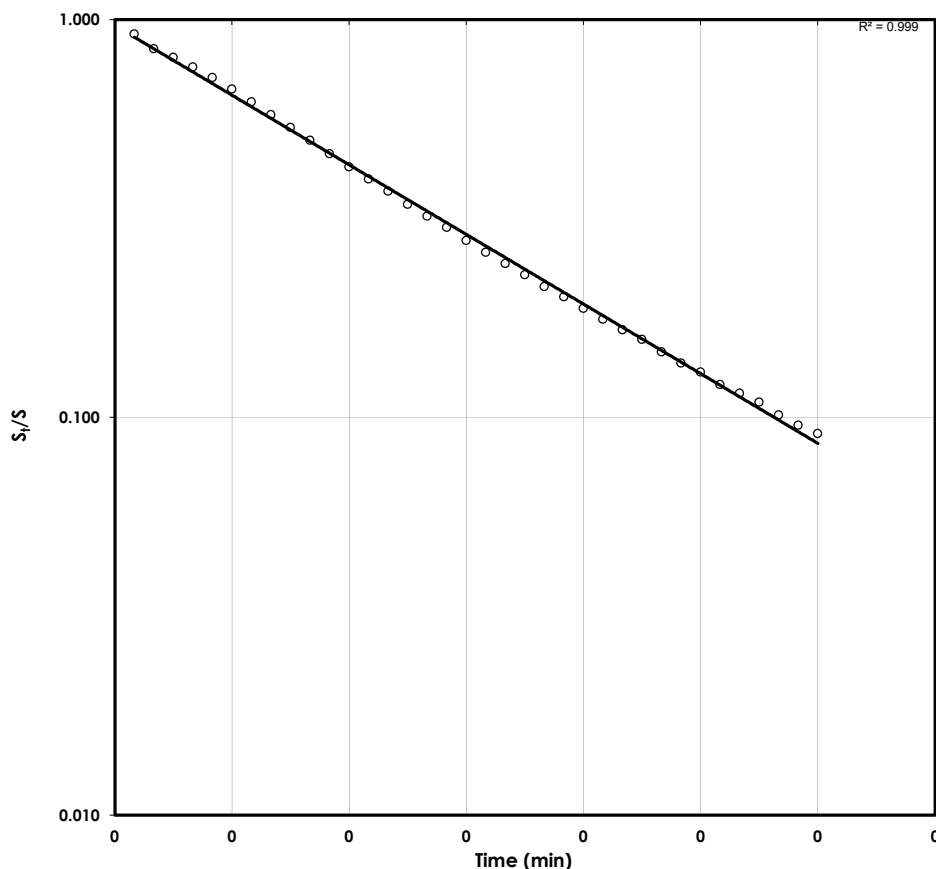
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
15.400	m
16.818	m
0.025	m
0.050	m
9.00	m
0.12	minutes
2.1813	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW104 (2)
Method	Hvorslev (1981)

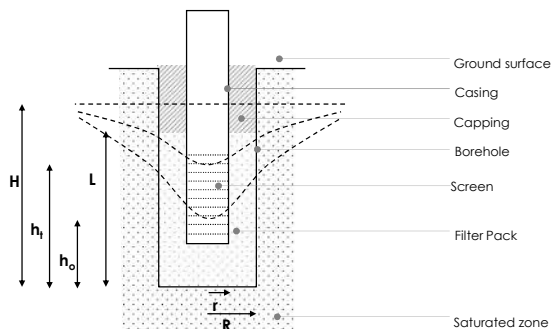
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

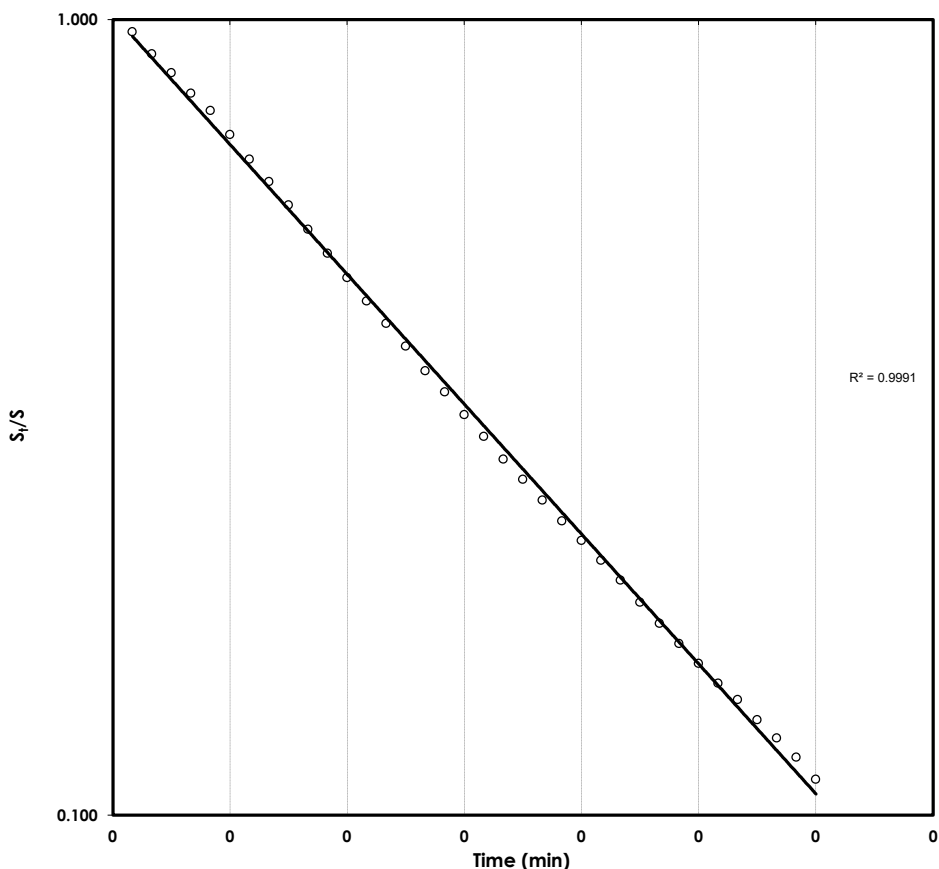
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
15.400	m
16.895	m
0.025	m
0.050	m
9.00	m
0.13	minutes
1.9351	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW104 (3)
Method	Hvorslev (1981)

Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

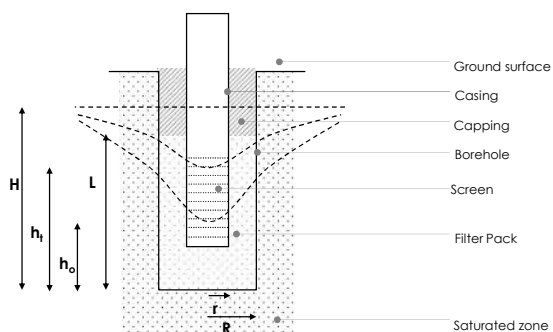
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

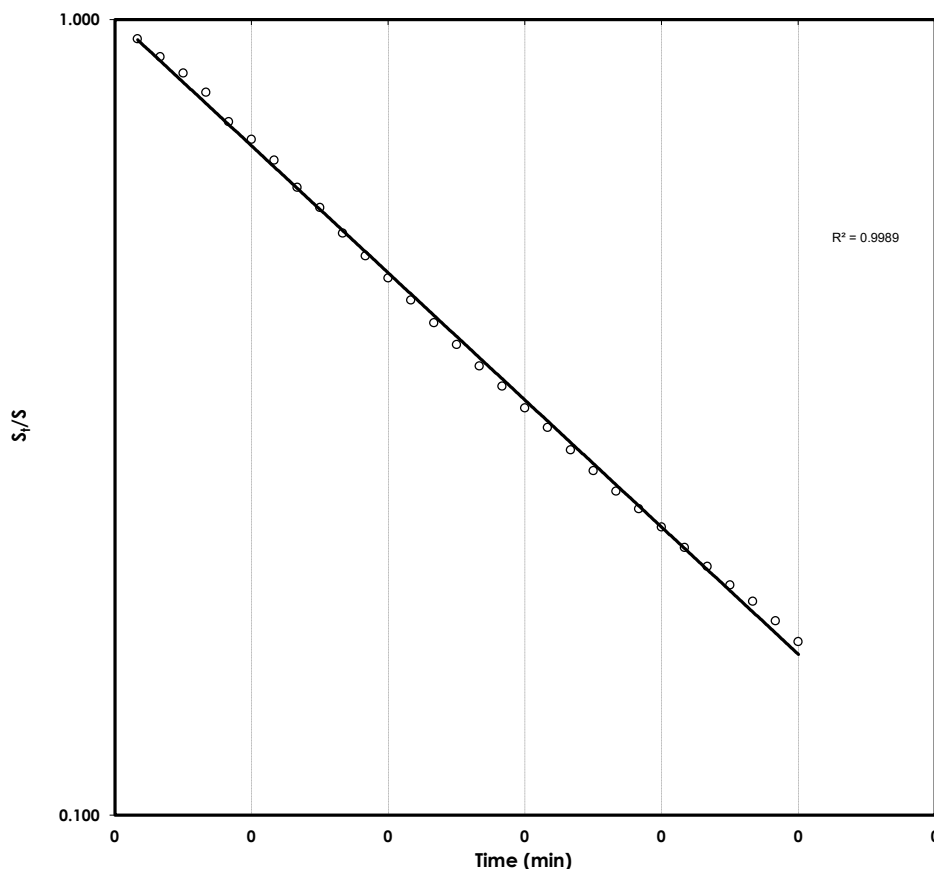
Enter Data	Unit
15.393	m
16.919	m
0.025	m
0.050	m
9.00	m
0.14	minutes
1.9168	m/d

T_o - Length of characteristic time

K_{sat} - Saturated hydraulic conductivity



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW104 (4)
Method	Hvorslev (1981)

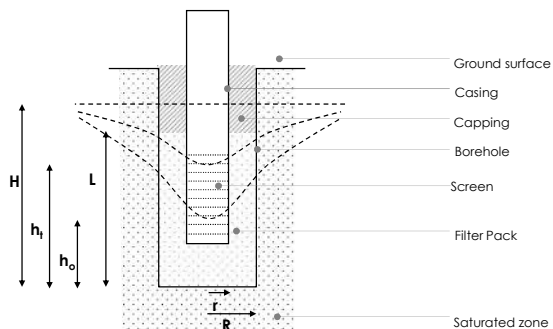
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

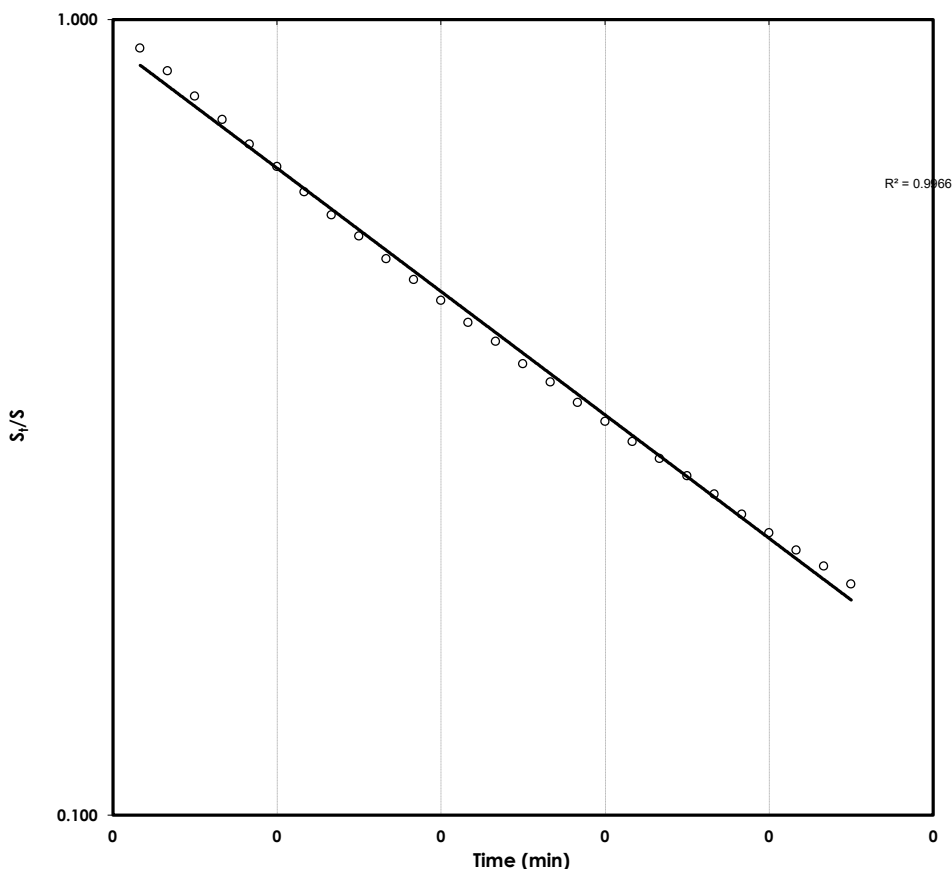
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
15.383	m
16.789	m
0.025	m
0.050	m
9.00	m
0.13	minutes
2.0124	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW201 (1)
Method	Hvorslev (1981)

Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

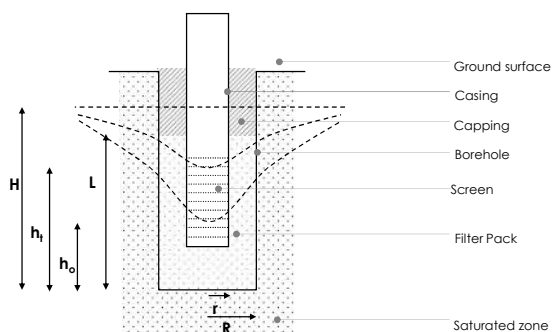
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

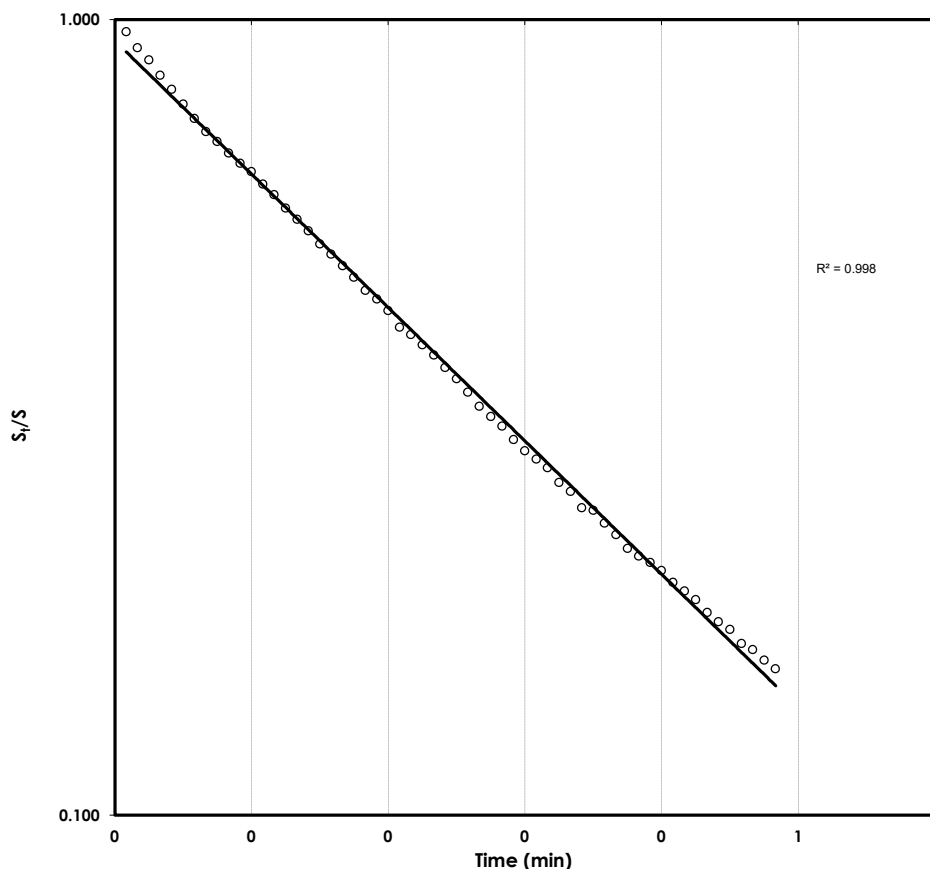
Enter Data	Unit
4.487	m
5.091	m
0.025	m
0.050	m
4.51	m
0.24	minutes
1.8593	m/d

T_o - Length of characteristic time

K_{sat} - Saturated hydraulic conductivity



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007



PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW201 (2)
Method	Hvorslev (1981)

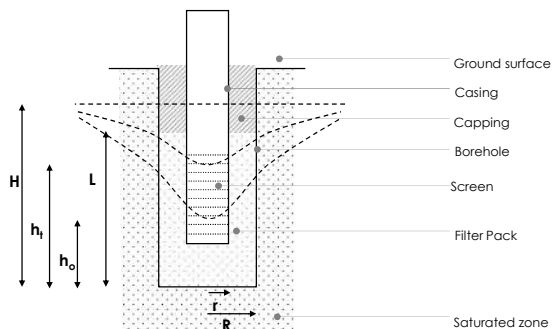
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

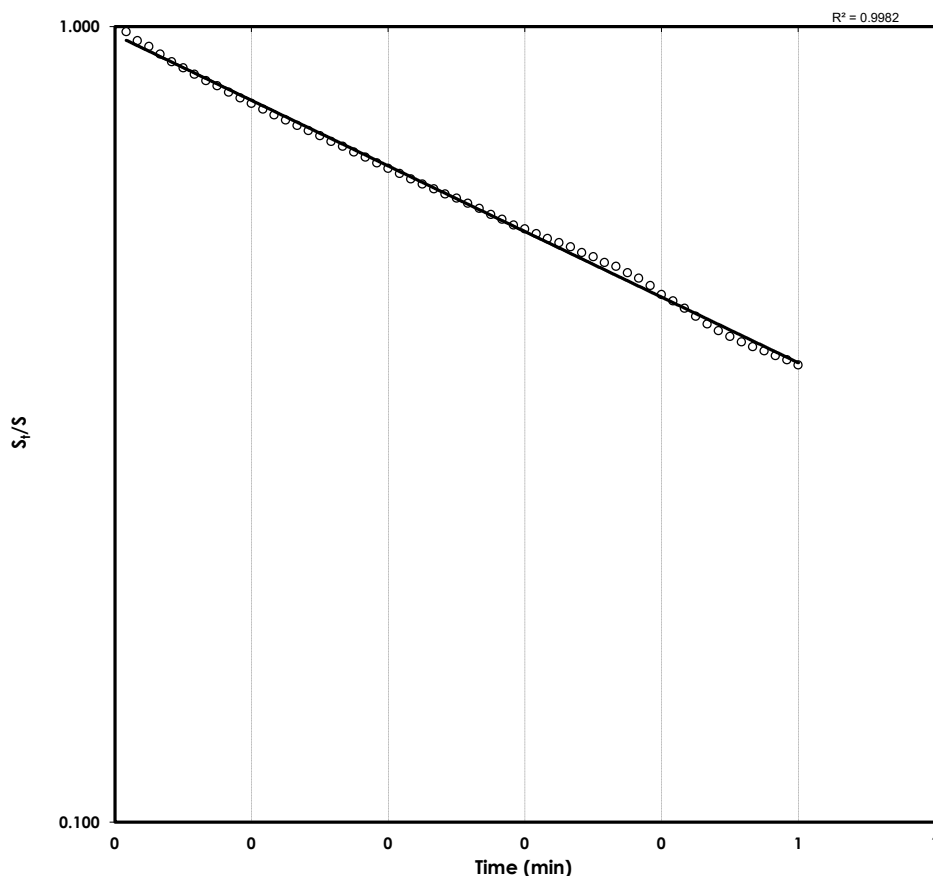
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
4.487	m
5.965	m
0.025	m
0.050	m
4.51	m
0.51	minutes
0.8790	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007



PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW201 (3)
Method	Hvorslev (1981)

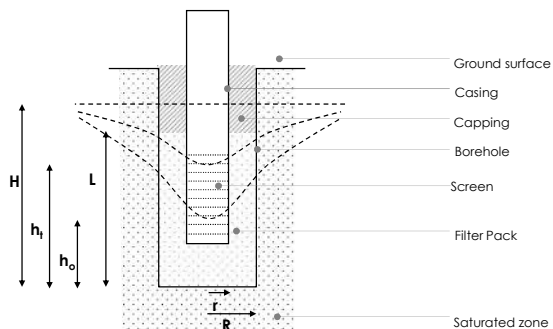
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

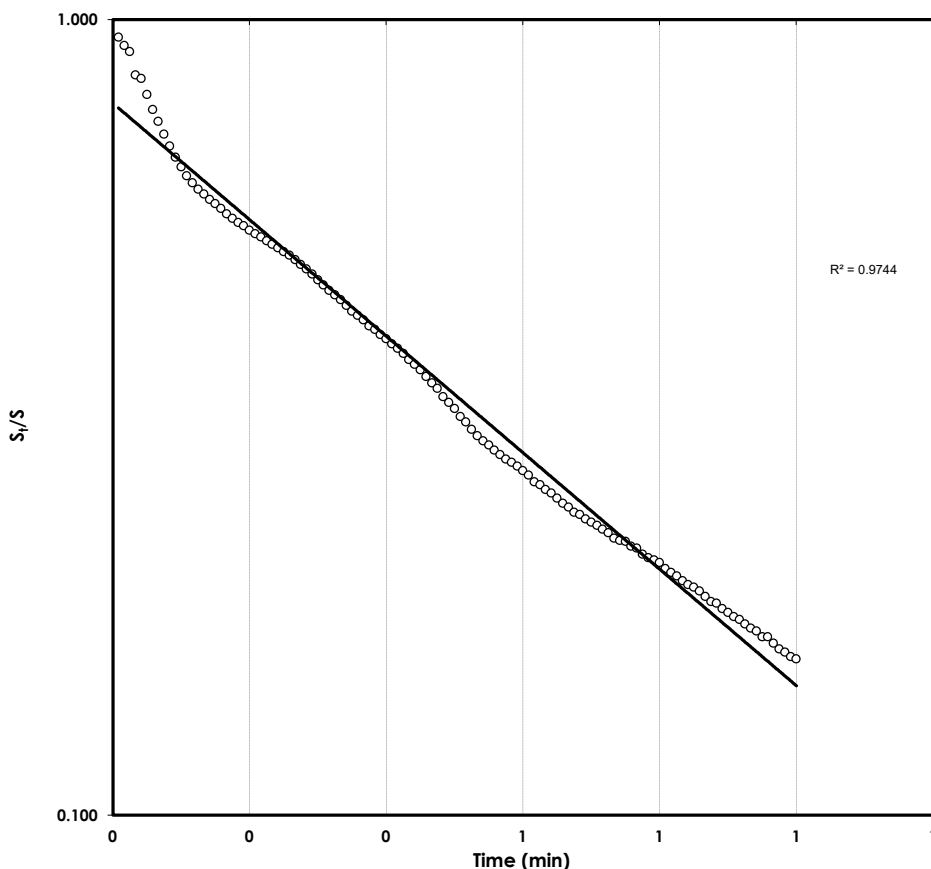
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
4.487	m
6.407	m
0.025	m
0.050	m
4.51	m
0.45	minutes
1.0068	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW202 (1)
Method	Hvorslev (1981)

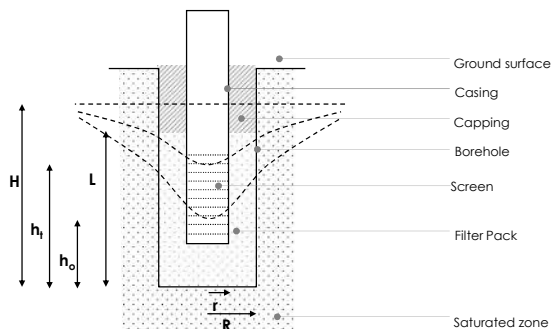
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

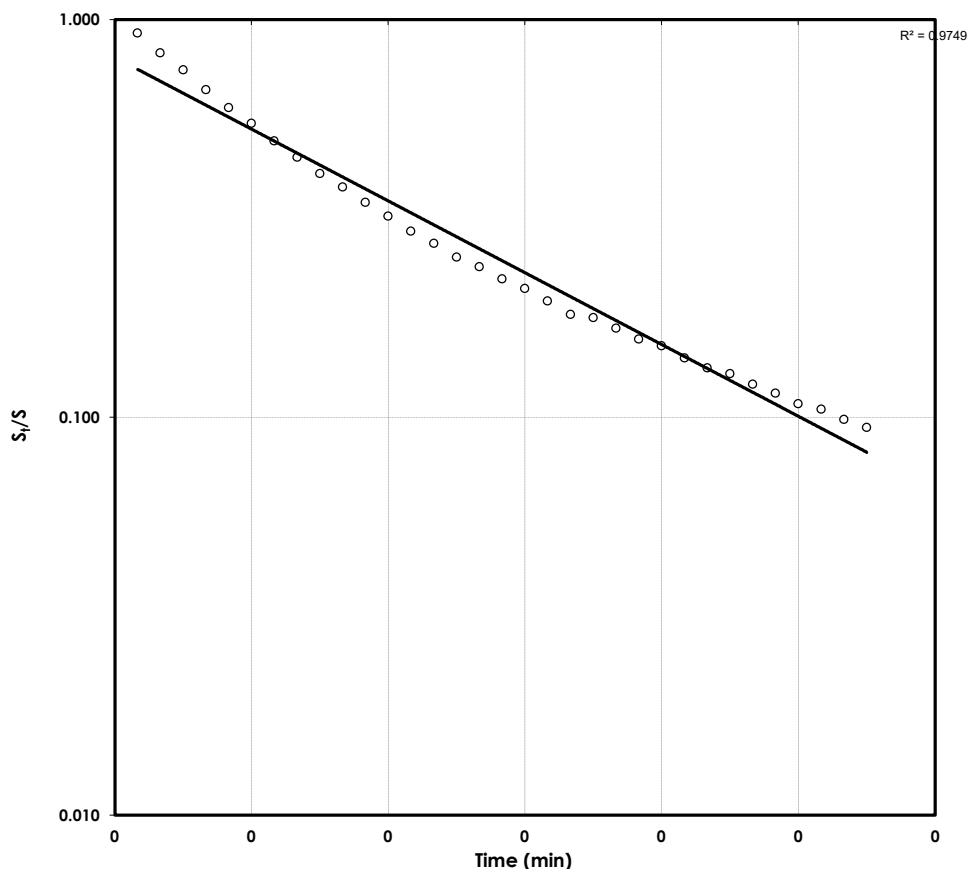
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
6.959	m
7.636	m
0.025	m
0.050	m
7.03	m
0.09	minutes
3.3924	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW202 (2)
Method	Hvorslev (1981)

Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

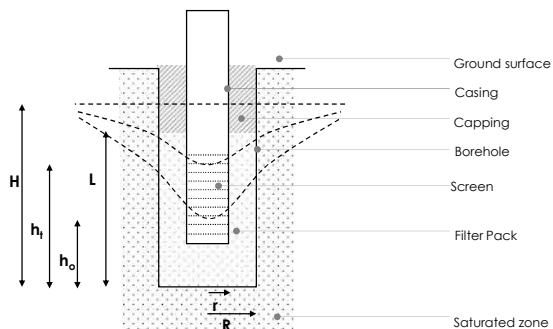
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

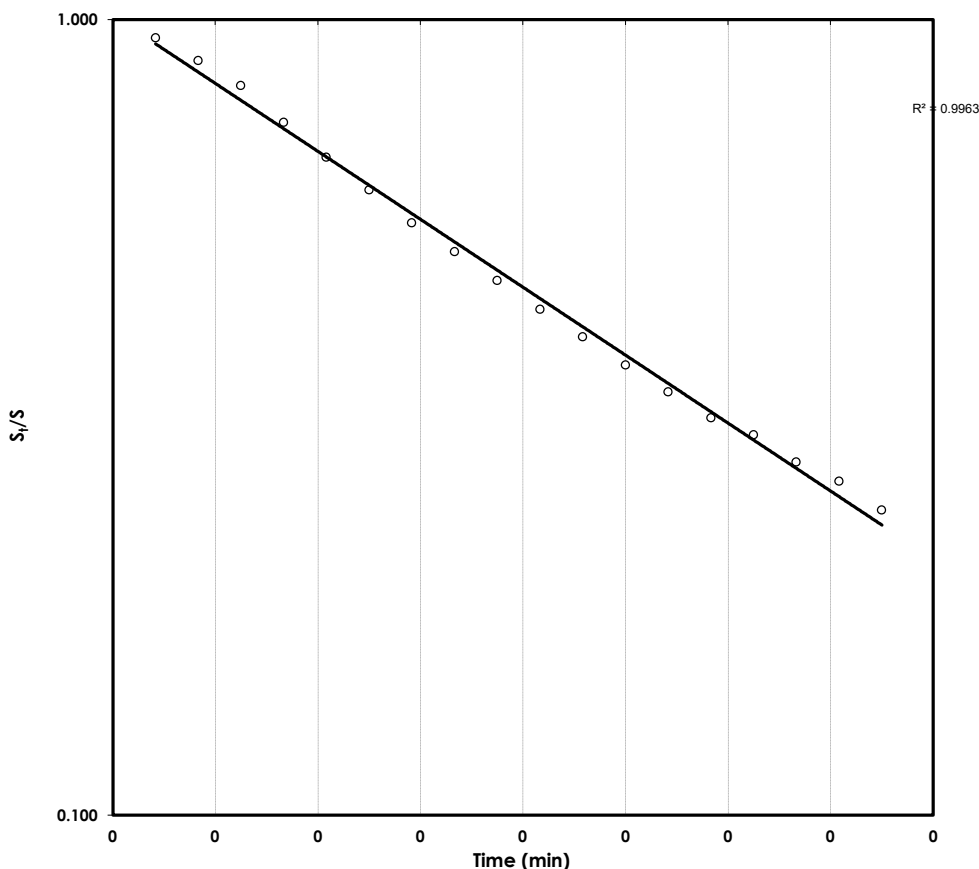
Enter Data	Unit
6.959	m
7.575	m
0.025	m
0.050	m
7.03	m
0.10	minutes
3.0939	m/d

T_o - Length of characteristic time

K_{sat} - Saturated hydraulic conductivity



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW202 (3)
Method	Hvorslev (1981)

Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

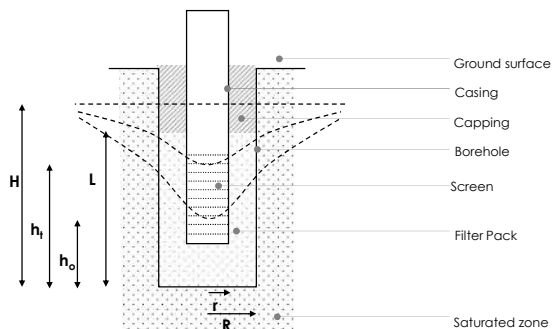
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

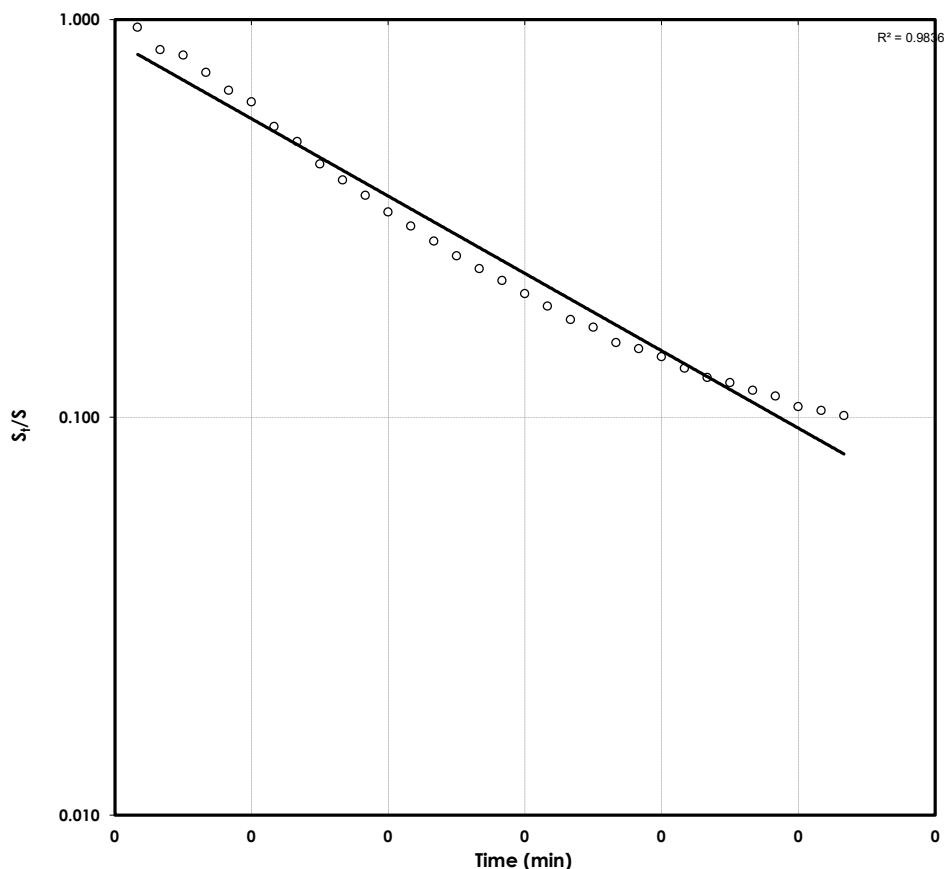
Enter Data	Unit
6.959	m
7.730	m
0.025	m
0.050	m
7.03	m
0.10	minutes
3.2665	m/d

T_o - Length of characteristic time

K_{sat} - Saturated hydraulic conductivity



DATA PLOT



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW203 (1)
Method	Hvorslev (1981)

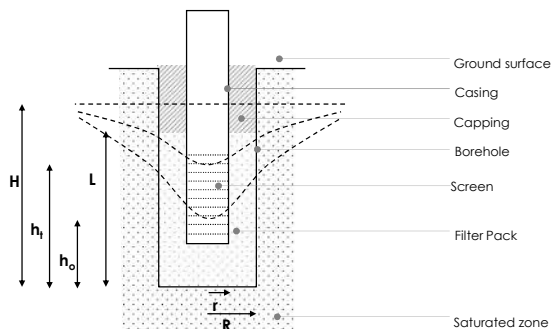
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

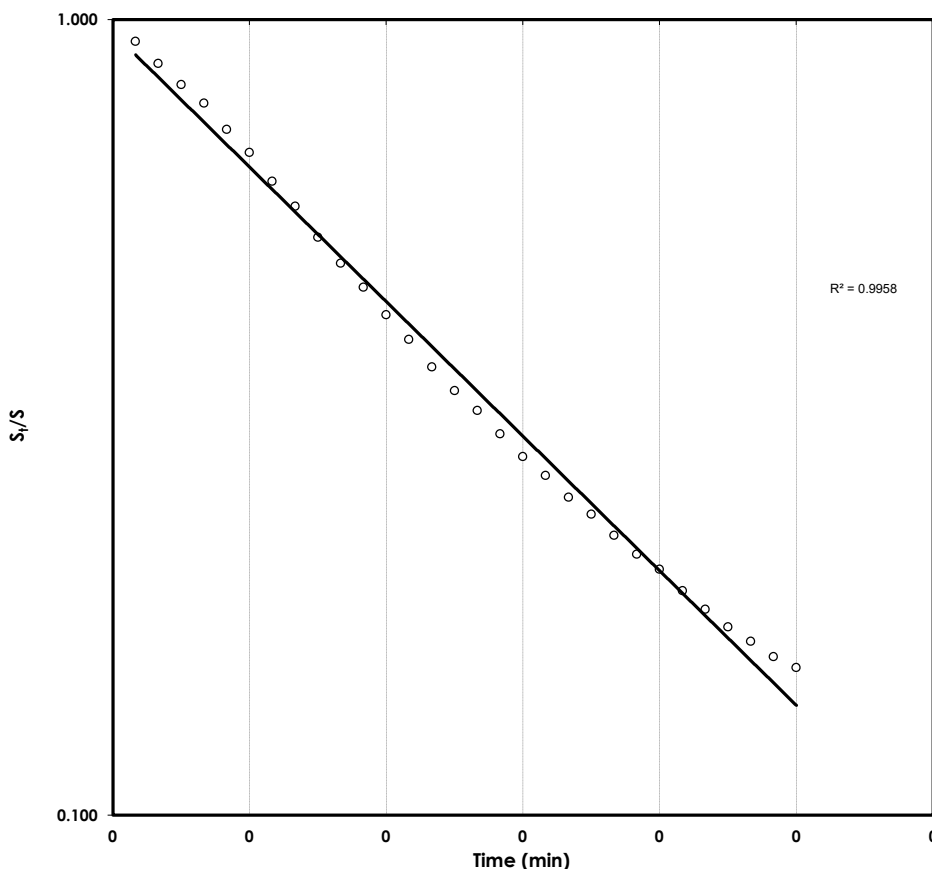
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
4.318	m
4.897	m
0.025	m
0.050	m
4.32	m
0.12	minutes
3.7813	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW203 (2)
Method	Hvorslev (1981)

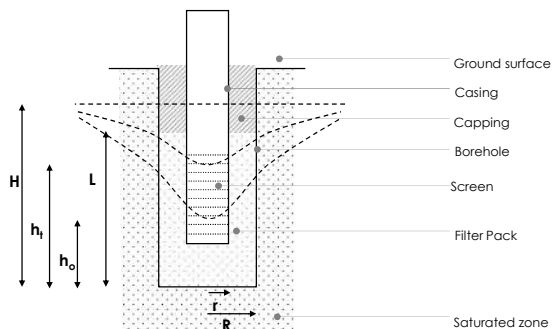
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

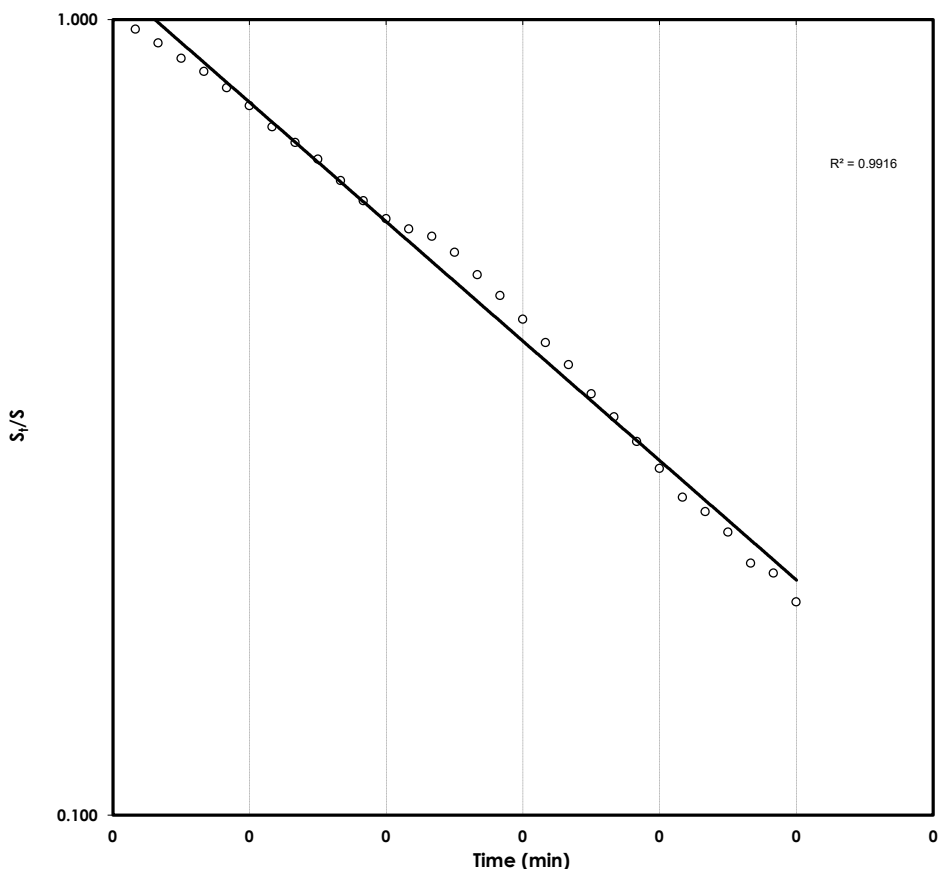
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
r - Casing radius
R - Bore radius
L - Length of open screen

Enter Data	Unit
4.329	m
4.836	m
0.025	m
0.050	m
4.32	m
0.16	minutes
2.9178	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007



PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW203 (3)
Method	Hvorslev (1981)

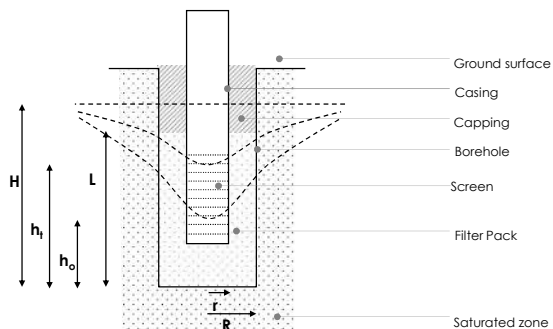
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

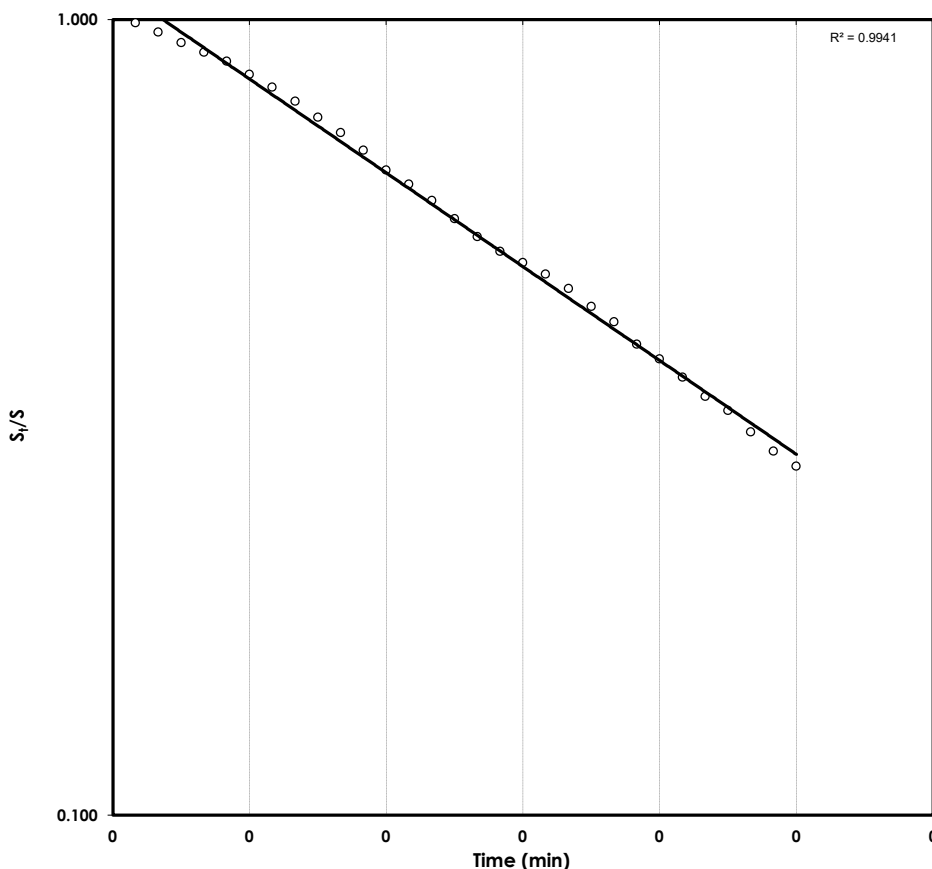
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
4.327	m
4.753	m
0.025	m
0.050	m
4.32	m
0.20	minutes
2.3066	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007



PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW203 (4)
Method	Hvorslev (1981)

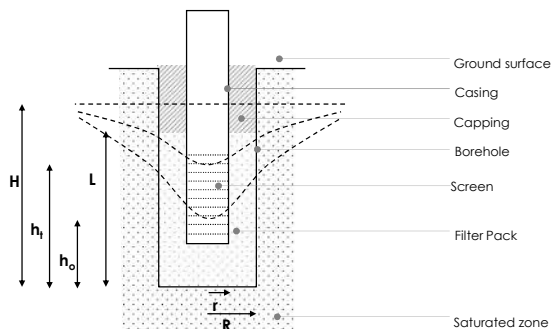
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

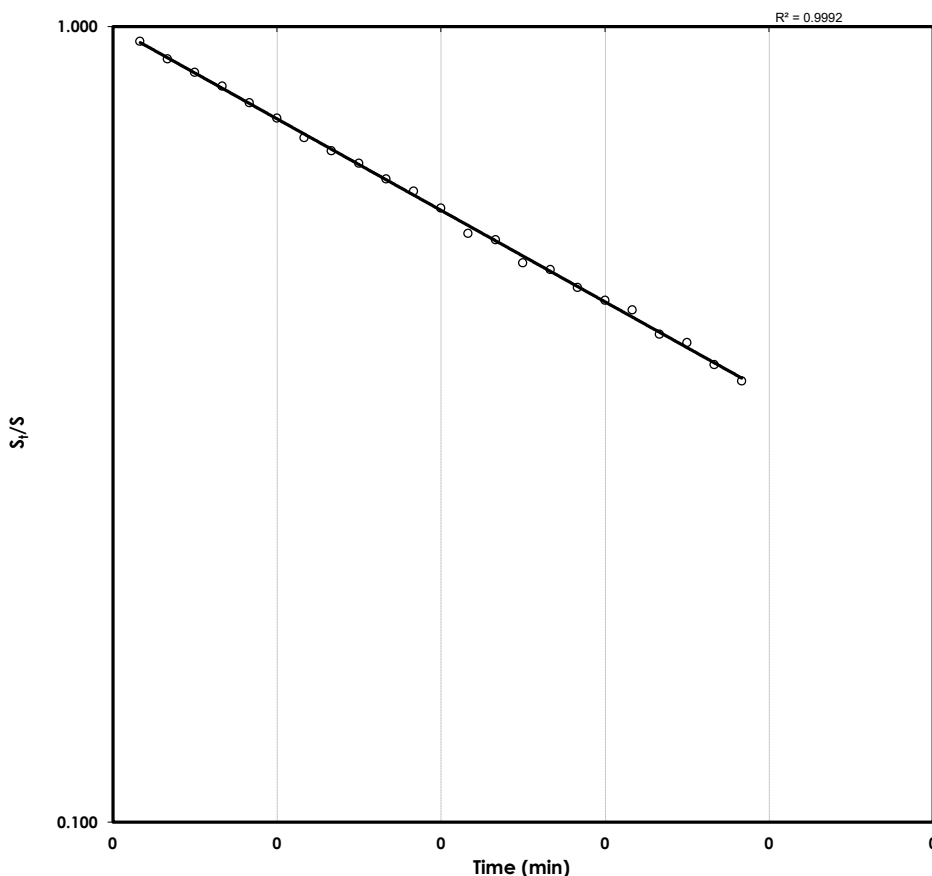
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
4.328	m
4.564	m
0.025	m
0.050	m
4.32	m
0.19	minutes
2.4802	m/d



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Single Bore Slug Test (Rising or Falling)

Method SF-13 Revised 7.3.2007

PROJECT DETAILS

Project	3631 Nelson Bay Road, Bobs Farm, NSW
Project Ref	P2511038JS06 - V01
Borehole Ref	MW203 (5)
Method	Hvorslev (1981)

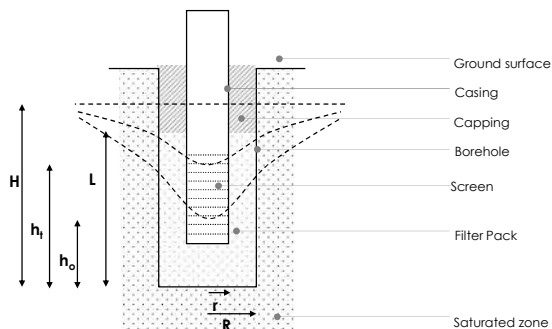
Test Date	2.03.2026
Field Testing	BTM
Data Analysis	BTM
Reviewed	DS

FIELD TEST DATA

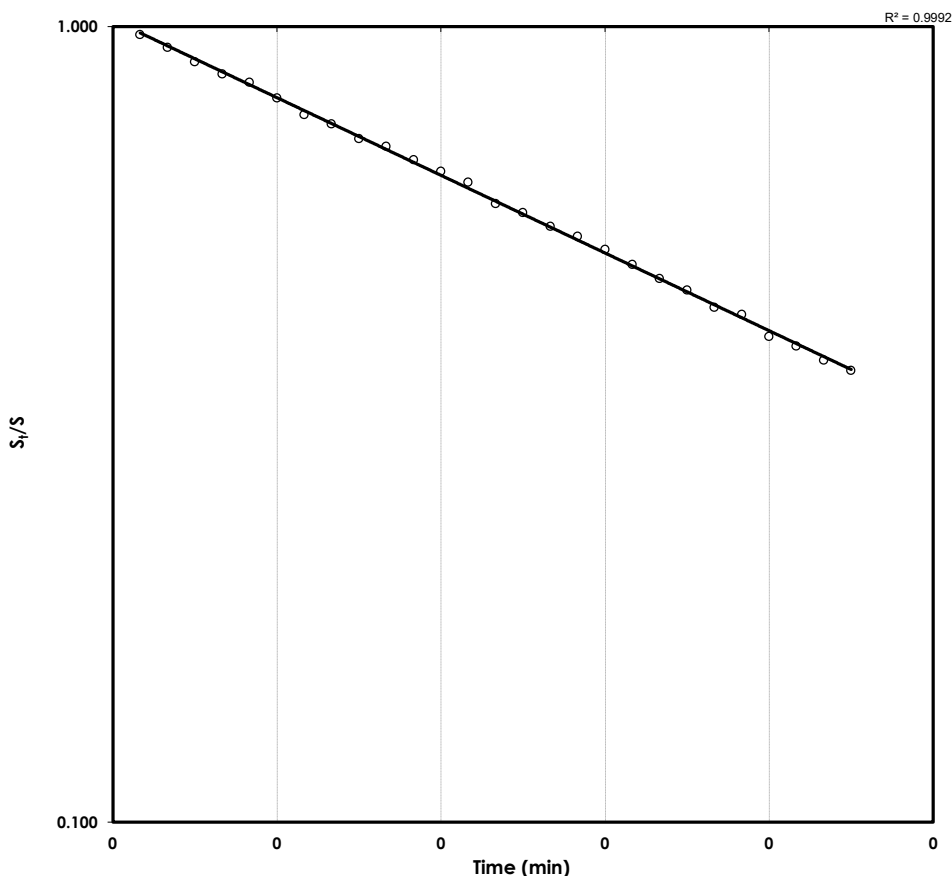
FACTOR

H - Initial water level reading (depth)
 h_o - Water level reading at time = 0 (depth)
 r - Casing radius
 R - Bore radius
 L - Length of open screen

Enter Data	Unit
4.328	m
4.587	m
0.025	m
0.050	m
4.32	m
0.23	minutes
2.0612	m/d



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Appendix F – Laboratory Summary Table

[illegible]



	Metals								PFAS								
	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	Sum of PFHxS and PFOS	Sum of PFAS	Sum of PFAS (PFOS + PFOA)	Perfluorooctanoic acid (PFOA)	Perfluorobutane sulfonic acid (PFBS)	Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)
	mg/L	mg/L	mg/L	µg/L	ug/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	0.001	0.0001	0.001	1	1	0.00005	0.001	0.001	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)		0.0055		1.3	4.4	0.0004	0.07	0.008									
PFAS NEMP 2025 Interim marine 95%												220			0.13		
NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand (>=2m, <4m)																	

Field ID	Date	Lab Report Number																
11038 / MW1	06 Nov 2025	394982	0.021	<0.0001	0.003	58	1	<0.00005	0.008	0.025	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02
11038 / MW5	06 Nov 2025	394982	0.013	0.0002	0.054	48	21	0.00006	0.015	0.063	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02
11038 / MW101	06 Nov 2025	394982	0.009	<0.0001	0.017	4	<1	<0.00005	0.006	0.041	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02

Statistics																		
Number of Results	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Number of Detects	3	1	3	3	2	1	3	3	0	0	0	0	0	0	0	0	0	0
Minimum Concentration	0.009	<0.0001	0.003	4	1	<0.00005	0.006	0.025	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02
Maximum Concentration	0.021	0.0002	0.054	58	21	0.00006	0.015	0.063	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02

* EQL>SAC thus unable to be determined if exceedance has occurred.

Environmental Standards
2024, ANZG, November 2024, ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)
2025, HEPA, March 2025, PFAS NEMP 2025 Interim marine 95%
2013, NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand



	BTEX						TRH						
	Naphthalene (VOC)	Benzene	Toluene	Ethylbenzene	Xylene (m & p)	Xylene (o)	C6-C10 Fraction (F1)	C6-C10 (F1) minus BTEX	>C10-C16 Fraction (F2)	>C10-C16 Fraction (F2 minus Naphthalene)	>C16-C34 Fraction (F3)	>C34-C40 Fraction (F4)	>C10-C40 Fraction (Sum)
	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	0.001	1	1	1	2	1	10	10	50	50	100	100	50
ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)	0.07	700	180	80									
PFAS NEMP 2025 Interim marine 95%													
NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand (>=2m, <4m)		5,000						6,000					

Field ID	Date	Lab Report Number													
11038 / MW1	06 Nov 2025	394982	<0.001	<1	<1	<1	<2	<1	<10	<10	<50	<50	<100	<100	<50
11038 / MW5	06 Nov 2025	394982	<0.001	<1	<1	<1	<2	<1	<10	<10	110	110	<100	<100	110
11038 / MW101	06 Nov 2025	394982	<0.001	<1	<1	<1	<2	<1	<10	<10	65	65	<100	<100	60

Statistics															
Number of Results	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Number of Detects	0	0	0	0	0	0	0	0	0	2	2	0	0	2	2
Minimum Concentration	<0.001	<1	<1	<1	<2	<1	<10	<10	<50	<50	<100	<100	<50	<50	<50
Maximum Concentration	<0.001	<1	<1	<1	<2	<1	<10	<10	110	110	<100	<100	110	110	110

* EQL>SAC thus unable to be determined if exceedance has occurred.

Environmental Standards
2024, ANZG, November 2024, ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)
2025, HEPA, March 2025, PFAS NEMP 2025 Interim marine 95%
2013, NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand



	VOCs																
	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethene	1,2-dichloroethane	1,2-dichloropropane	1,3-dichloropropane	Carbon tetrachloride	Chloroform	Trichloroethene	Tetrachloroethene	Vinyl chloride	1,2,4-trichlorobenzene	Chlorobenzene	Hexachlorobenzene *	Isopropylbenzene	tert-butylbenzene
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	1	1	1	1	1	1	1	1	1	1	1	10	1	1	0.2	1	1
ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)	270	400	1,900	700	1,900	900	1,100	240	770	330	70	100	80	55	0.1	30	
PFAS NEMP 2025 Interim marine 95%																	
NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand (>=2m, <4m)																	

Field ID	Date	Lab Report Number																
11038 / MW1	06 Nov 2025	394982	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<10	<1	<1	<0.2	<1
11038 / MW5	06 Nov 2025	394982	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	<1	<10	<1	<1	<0.2	<1
11038 / MW101	06 Nov 2025	394982	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<10	<1	<1	<0.2	<1

Statistics																		
Number of Results	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Number of Detects	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Minimum Concentration	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<10	<1	<1	<0.2	<1	<1	<1
Maximum Concentration	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	<1	<10	<1	<1	<0.2	<1	<1	<1

* EQL>SAC thus unable to be determined if exceedance has occurred.

Environmental Standards
2024, ANZG, November 2024, ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)
2025, HEPA, March 2025, PFAS NEMP 2025 Interim marine 95%
2013, NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand



	Pesticides												
	Chlorpyrifos *	OPP (others)	Phosalone	Aldrin	BHC (total)	Chlordane (total)	DDT	Endosulfan (total)	Endrin *	Heptachlor	Methoxychlor	OCP (others)	Mirex
	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	0.2	0.2	0.0002	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)	0.009								0.008				
PFAS NEMP 2025 Interim marine 95%													
NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand (>=2m, <4m)													

Field ID	Date	Lab Report Number													
11038 / MW1	06 Nov 2025	394982	<0.2	<0.0002	<0.0002	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.0002	<0.2
11038 / MW5	06 Nov 2025	394982	<0.2	<0.0002	<0.0002	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.0002	<0.2
11038 / MW101	06 Nov 2025	394982	<0.2	<0.0002	<0.0002	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.0002	<0.2

Statistics															
Number of Results	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Number of Detects	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration	<0.2	<0.0002	<0.0002	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.0002	<0.2	<0.2
Maximum Concentration	<0.2	<0.0002	<0.0002	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.0002	<0.2	<0.2

* EQL>SAC thus unable to be determined if exceedance has occurred.

Environmental Standards
2024, ANZG, November 2024, ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)
2025, HEPA, March 2025, PFAS NEMP 2025 Interim marine 95%
2013, NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand



	PAH							PCBs	Solvents
	Anthracene	Benzo(a) pyrene	Fluoranthene	Naphthalene	Phenanthrene	Benzo(a)pyrene TEQ	PAHs (Sum of positives)	PCBs (total)	Cyclohexane
	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	µg/L	mg/L
EQL	0.1	0.1	0.1	0.1	0.1	0.0005	0.0001	2	0.001
ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)	0.4	0.2	1.4	70	2				
PFAS NEMP 2025 Interim marine 95%									
NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand (>=2m, <4m)									

Field ID	Date	Lab Report Number									
11038 / MW1	06 Nov 2025	394982	<0.1	<0.1	<0.1	<0.1	<0.1	<0.0005	<0.0001	<2	<0.001
11038 / MW5	06 Nov 2025	394982	<0.1	<0.1	<0.1	<0.1	<0.1	<0.0005	<0.0001	<2	<0.001
11038 / MW101	06 Nov 2025	394982	<0.1	<0.1	<0.1	<0.1	<0.1	<0.0005	<0.0001	<2	<0.001

Statistics											
Number of Results			3	3	3	3	3	3	3	3	3
Number of Detects			0	0	0	0	0	0	0	0	0
Minimum Concentration			<0.1	<0.1	<0.1	<0.1	<0.1	<0.0005	<0.0001	<2	<0.001
Maximum Concentration			<0.1	<0.1	<0.1	<0.1	<0.1	<0.0005	<0.0001	<2	<0.001

* EQL>SAC thus unable to be determined if exceedance has occurred.

Environmental Standards

2024, ANZG, November 2024, ANZG Marine Water Toxicant DGVs LOSP 95% (November 2024)

2025, HEPA, March 2025, PFAS NEMP 2025 Interim marine 95%

2013, NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand

Appendix G – Laboratory Documentation

SOIL ANALYSIS CHAIN OF CUSTODY FORM

Additional Testing																			
Name		P2511038 – Detailed Site Investigation – 3631 Nelson Bay Road, Bobs Farm, NSW																	
Martens Contact Officer		Bryson Monaghan				Contact Email		bmonaghan@martens.com.au											
Sampling and Shipping		Sample Date		5-6/11/2025		Dispatch Date		7/11/2025		Turnaround Time		standard							
		Our Reference		P2511038COC01V01				Shipping Method (X)		Hand		Post		Courier		X			
		On Ice (X)		X		No Ice (X)				Other (X)									
Laboratory																			
Name		EnviroLab																	
Sample Delivery Address		12 Ashley Street, Chatswood																	
Delivery Contact		Name		Sampler Receipt		Phone		9910 6200		Fax				Email		samplereceipt@envirolabservices.com.au			
Please Send Report By (X)		Post				Fax				Email		X		Reporting Email Address					
														bmonaghan@martens.com.au					
														gtaylor@martens.com.au					
																rmehaffey@martens.com.au			

Sample ID	Composite	Sample ID	Composite	Sample ID	Composite
1 11038 / SS001	Composite 1	28 11038 / SS034	Composite 10	55 11038 / SS063	Composite 19
2 11038 / SS003		29 11038 / SS035		56 11038 / SS064	
3 11038 / SS004		30 11038 / SS036		57 11038 / SS065	
4 11038 / SS005	Composite 2	31 11038 / SS037	Composite 11	58 11038 / SS067	Composite 20
5 11038 / SS006		32 11038 / SS038		59 11038 / SS068	
6 11038 / SS008		33 11038 / SS039		60 11038 / SS069	
7 11038 / SS009	Composite 3	34 11038 / SS041	Composite 12	61 11038 / SS070	Composite 21
8 11038 / SS010		35 11038 / SS042		62 11038 / SS071	
9 11038 / SS011		36 11038 / SS043		63 11038 / SS072	

ENVIROLAB
 12 Ashley Street
 Chatswood NSW 2067
 Ph: (02) 9910 6200
 Job No: 394982
 Date Received: 7/11/25
 Time Received: 1445
 Received By: KC
 Temp: Cool/Ambient 10°C
 Cooling: Ice/Icepack
 Security: Intact/Broken/None

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SOIL ANALYSIS CHAIN OF CUSTODY

	Sample ID	Composite
10	11038 / SS014	Composite 4
11	11038 / SS015	
12	11038 / SS016	
13	11038 / SS017	Composite 5
14	11038 / SS018	
15	11038 / SS019	
16	11038 / SS020	Composite 6
17	11038 / SS021	
18	11038 / SS022	
19	11038 / SS023	Composite 7
20	11038 / SS024	
21	11038 / SS025	
22	11038 / SS026	Composite 8
23	11038 / SS028	
24	11038 / SS029	
25	11038 / SS030	Composite 9
26	11038 / SS031	
27	11038 / SS033	

	Sample ID	Composite
37	11038 / SS044	Composite 13
38	11038 / SS045	
39	11038 / SS046	
40	11038 / SS047	Composite 14
41	11038 / SS048	
42	11038 / SS050	
43	11038 / SS051	Composite 15
44	11038 / SS052	
45	11038 / SS053	
46	11038 / SS054	Composite 16
47	11038 / SS055	
48	11038 / SS056	
49	11038 / SS057	Composite 17
50	11038 / SS058	
51	11038 / SS059	
52	11038 / SS060	Composite 18
53	11038 / SS061	
54	11038 / SS062	

	Sample ID	Composite
64	11038 / SS073	Composite 22
65	11038 / SS074	
66	11038 / SS075	
67	11038 / SS076	Composite 23
68	11038 / SS077	
69	11038 / SS078	
70	11038 / SS079	Composite 24
71	11038 / SS080	
72	11038 / SS081	
73	11038 / SS083	Composite 25
74	11038 / SS084	
75	11038 / SS085	
76	11038 / SS086	Composite 26
77	11038 / SS087	
78	11038 / SS088	
79	11038 / SS089	Composite 27
80	11038 / SS090	
81	11038 / SS091	

Sample ID	OCP/OPP	BHM	Combo 6a	PFAS Short Suite	pH	CEC	BTEXN	TRH	Hold
Composite 1	X	X							
Composite 2	X	X							
Composite 3	X	X							
Composite 4	X	X							
Composite 5	X	X							

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SOIL ANALYSIS CHAIN OF CUSTODY

Sample ID	OCP/OPP	8HM	Combo 6a	PFAS Short Suite	pH	CEC	BTEXN	TRH	Hold
Composite 6	X	X							
Composite 7	X	X							
Composite 8	X	X							
Composite 9	X	X							
Composite 10	X	X							
Composite 11	X	X							
Composite 12	X	X							
Composite 13	X	X							
Composite 14	X	X							
Composite 15	X	X							
Composite 16	X	X							
Composite 17	X	X							
Composite 18	X	X							
Composite 19	X	X							
Composite 20	X	X							
Composite 21	X	X							
Composite 22	X	X							
Composite 23	X	X							
Composite 24	X	X							
Composite 25	X	X							
Composite 26	X	X							
Composite 27	X	X							
82 11038 / SS002	X	X							
83 11038 / SS007	X	X							

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SOIL ANALYSIS CHAIN OF CUSTODY

	Sample ID	OCP/OPP	8HM	Combo 6a	PFAS Short Suite	pH	CEC	BTEXN	TRH	Hold
84	11038 / SS012	X	X							
85	11038 / SS013	X	X							
86	11038 / SS027									X
87	11038 / SS032									X
88	11038 / SS040									X
89	11038 / SS049									X
90	11038 / SS066									X
91	11038 / SS082									X
92	11038 / TP101 / 0 - 0.1									X
93	11038 / TP101 / 0.2 - 0.3			X	X					
94	11038 / TP102 / 0 - 0.1			X	X					
95	11038 / TP102 / 0.4 - 0.5					X	X			
96	11038 / TP103 / 0 - 0.1			X	X					
97	11038 / TP104 / 0 - 0.1			X	X					
98	11038 / TP104 / 0.4 - 0.6					X	X			
99	11038 / TP105 / 0 - 0.1			X	X					X
100	11038 / TP105 / 0.3 - 0.5					X	X			
101	11038 / TP106 / 0 - 0.1			X	X					
102	11038 / TP106 / 0.2 - 0.4									X
103	11038 / TP107 / 0 - 0.1			X	X					
104	11038 / TP107 / 0.2 - 0.4									X
105	11038 / TP108 / 0 - 0.1									X
106	11038 / TP108 / 0.3 - 0.4			X	X					
107	11038 / TP108 / 0.7 - 0.9					X	X			

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SOIL ANALYSIS CHAIN OF CUSTODY

	Sample ID	OCP/OPP	8HM	Combo 6a	PFAS Short Suite	pH	CEC	BTEXN	TRH	Hold
108	11038 / TP109 / 0 - 0.1			X	X					
109	11038 / TP109 / 0.3 - 0.4									X
110	11038 / TP110 / 0 - 0.1									X
111	11038 / TP110 / 0.2 - 0.3			X	X					
112	11038 / TP111 / 0 - 0.1									X
113	11038 / TP111 / 0.2 - 0.3									X
114	11038 / Dup01		X							
115	11038 / Dup02		X							
116	11038 / Dup03		X							
117	11038 / Dup04		X							
118	11038 / Dup05									X
119	11038 / Dup06									X
120	11038 / Dup07									X
121	11038 / Dup08									X
122	11038 / Dup09									X
123	11038 / Dup10									X
124	11038 / Dup11									X
125	11038 / Dup12		X							
126	11038 / Dup13		X							
127	Trip Spike (soil)							X		
128	Trip Spike (soil)							X		
129	Trip Blank (soil)								X	
130	Trip Blank (soil)								X	

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SOIL ANALYSIS CHAIN OF CUSTODY

	Sample ID	Combo 6 (water)	PFAS Short Suite	VOCs	HM	BTEXN	TRH	Hold
131	11038 / MW1	X	X	X				
132	11038 / MW5	X	X	X				
133	11038 / MW101	X	X	X				
134	11038 / MW104							X
135	11038 / GW Dup01				X			
136	Trip Spike (water)					X		
137	Trip Blank (water)						X	

Extra → 138 - TP110 0.4-0.5
-KC

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KC