Hydrogeological Assessment

Planning Proposal at 196 Old Main Road; 263, 269, 271, 273, 293 & 321 Gan Gan Road, Anna Bay NSW

Final Report

P2208888JR10V02

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Prepared for AB Rise Pty Ltd

environmental science & engineering

Project Details

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1 Introduction

1.1 Overview

This report documents a Hydrogeological Assessment (**HA**) completed by Martens and Associates Pty Ltd (**MA**) on behalf of AB Rise Pty Ltd (the **Client**) to support a planning proposal (**PP**) for the rezoning of land located at 196 Old Main Road, and 263, 269, 271, 273, 293 & 321 Gan Gan Road, Anna Bay (collectively the **Site**) for residential purposes.

We note that there is an area in the southern portion of 293 and 321 Gan Gan Rd which is subject to an existing development application (**DA**). This small portion of the Site is currently zoned residential (R2) and is not included as part of this PP.

1.2 Proposal

Pursuant to the *Port Stephens Local Environmental Plan 2013* (**PS LEP**) the majority of the Site is currently zoned as RU2 Rural Landscape, with portions of 293 and 321 Gan Gan Road zoned as R2 Low Density Residential and C3 Environmental Management.

The PP proposes the rezoning of the entire Site to a mixture of R2 Low Density Residential, C3 Environmental Management, and RE1 Public Recreation.

The proposed masterplan (BKA Architecture, 2024, provided in Appendix A) indicates that the future development will involve:

- Subdivision of the Site into 476 lots for residential use.
- Construction of an internal access road network.
- Installation of associated services.
- Implementation of flood mitigation and drainage infrastructure.
- New public reserves comprising areas of existing bushland and rehabilitated / reforested areas.

MA understands that that the following earthworks are anticipated to be undertaken at the Site:

- Filling of up to approximately 2 - 3 m above existing ground level within proposed lots and roadways.
- Excavation of up to approximately 2.2 m in a small aera in the southeastern portion of the Site.
- Excavation up to approximately 2.5 mbgl for the widening of the existing drainage channel while maintaining the current base level.
- Construction of several stormwater basins across the Site to base levels of approximately –0.1 mAHD.

The locations of proposed basins are shown in the Stormwater Management Strategy prepared by MA (2024, ref. P208888MS16), included as Appendix B.

1.3 Scope of Works

The scope of this HA is outlined as follows:

- Review available Site information including topography, geology and soil landscape mapping.
- Installation of 13 groundwater monitoring wells (**MWs**) being MW01 – MW13 and one surface water monitoring station (SW01) at the Site. We note that MW03, MW06 and MW07 were installed on the DA site concurrently with the PP investigation. The data from these 3 MWs has been included in this assessment to add to the understanding of groundwater conditions.
- Continuous monitoring of groundwater levels and barometric pressure using data loggers recording at 15 minute intervals.
- Completion of rising / falling head slug tests to assess aquifer permeability characteristics.
- Collection and analysis of groundwater samples to assess groundwater quality.
- Review of nearby mapped sensitive environments including groundwater dependent ecosystems (**GDE**) and wetland areas.
- Assessment of likely groundwater impacts arising from the proposed development, and where required, provide recommendations for additional assessment / management measures.

2 Site Background Information

2.1 Site Details

Site details are summarised in Table 1.

Table 1: Site details.

Item	Description
Legal identifiers	Lot 963 in DP 731955 (196 Old Main Road, Anna Bay). Lot 21 in DP 590387 (263 Gan Gan Road, Anna Bay). Lot 23 in DP 590387 (269 Gan Gan Road, Anna Bay). Lot 1 in DP 536752 (271 Gan Gan Road, Anna Bay). Lot 901 in DP436550 (273 Gan Gan Road, Anna Bay). Lot 902 in DP 634550 (293 Gan Gan Road, Anna Bay). Lot 1 in DP 503876 (321 Gan Gan Road, Anna Bay).
Total surveyed lot area	Approximately 118.7 ha.
PP Site area	Approximately 114.1 ha
Local Government Area	Port Stephens Council (**PSC**)

2.2 Site Conditions

Site conditions at the time of reporting are summarised in Table 2

Table 2: Site Conditions.

Item	Description
Site description	The Site predominantly consists of rural pasture and dense vegetation, with existing residences on each lot with associated infrastructure including sheds, driveways / access tracks, services and fences.
Surrounding land description	Bushland and residential pasture to the north and west, low density residential to the east, and high density residential and bushland to the south.
Topography	Site topography is characterised by three primary morphological units: • **Sand dune** – an elongated east to west aligned sand dune is located near the southern Site boundary, reaching elevations of around 20 – 23 mAHD. • **Low lying land** – land to the north of the sand dune is low lying and relatively flat, with elevations ranging between 1 – 2 mAHD. • **Valley area** – a narrow strip of land (a trapped low dune hollow) is located between the sand dune and Gan Gan Road to the south and ranges in elevation between 5 – 7 mAHD.
Geology	The Site contains three geological units broadly aligning with previously described morphological units. These are: • Dune Facies (QP-bd) – Holocene aged coastal dune facies located over the sand dune.

Item	Description
	• Estuarine Plain (QH-es) – Holocene aged estuarine plain sediments including marine and fluvial sands, silts, clays, shell and peat located over the low lying area to the north of the sand dune. • Dune Hollow (QP-brs) – Quaternary or Holocene aged beach ridge swale and dune deflation hollow located over the valley area.
Soil Landscape	Three soil landscapes occupy the Site, broadly aligning with previously described morphological units. These are: • Shoal Bay Variant A (sba) – comprising very deep (>5m) well drained soils consisting of primarily loose dune sand, located over the sand dune. • Bobs Farm (bf) – comprising up to 0.3 m of organic loam overlying 0.2 to over 0.8 of estuarine clays with interspersed shells, located over the low lying area to the north of the sand dune. • Shoal Bay (sb) – comprising deep (>3m) well trained soils consisting of primarily loose sand sheets, often overlying a 1.5 m layer of organic and iron stained sands, located over the valley area.
Acid Sulfate Soils	The PSLEP acid sulfate soils (**ASS**) planning map indicates that the majority of the Site is Class 3 land, with a small portion of the Site along Gan Gan Road mapped as Class 4 land. MA have completed an ASS Assessment (MA, 2023, ref. P2208888JR07V01) which identifies ASS risk associated with the proposed development (particularly due to excavation and drainage modification works) and recommends a number of mitigation measures to manage these risks.

2.3 Nearby Groundwater Users

The Bureau of Meteorology (BoM) Australian Groundwater Explorer (2023) identifies four registered groundwater bores located within 500 m of the site boundary, including one water supply bore. Bore locations are shown in Appendix C Map 02 and summarised in Table 3.

Table 3: Registered bores within 1km of site boundary.

Well ID	Distance from Site Boundary (m)	Direction from Site	Purpose
GW202232	52	Southwest	Water Supply
GW079214	211	Southwest	Unknown
GW080083	314	Southwest	Monitoring
GW080359	349	Southwest	Monitoring

2.4 Environmental Mapping

A review of the NSW Government *HEVAE Vegetation Groundwater Dependent Ecosystems Value* mapping identifies several medium to high value GDEs within the Site. These are shown in Appendix C Map 03.

The *State Environmental Planning Policy (Resilience and Hazards) 2021* (SEPP 2021) does not identify any coastal wetlands or coastal wetland proximity areas within the Site boundary. The nearest coastal wetland identified in SEPP 2021 is located approximately 600 m to the northeast of the Site.

3 Groundwater Monitoring

3.1 Monitoring Methodology

Monitoring was completed using data loggers installed in each MW location, recording at 15 minute intervals. Groundwater monitoring commenced on 7 December 2022 at MW01 – MW07 and 16 February 2023 at MW08 – MW13 and SW01.

Well construction details are summarised in Table 4, and well locations and construction logs are provided in Appendix C Map 04 and Appendix D, respectively.

Table 4: Summary of monitoring well levels.

MW ID	Ground Level (mAHD) ^	Well Base Level	
		mbgl	mAHD
MW01	4.31	5.80	-1.49
MW02	1.74	4.10	-2.36
MW03	4.82	5.60	-0.78
MW04	2.17	4.01	-1.84
MW05	1.85	4.36	-2.51
MW06	4.7	5.47	-0.77
MW07	5.39	5.38	0.01
MW08	0.69	4.11	-3.42
MW09	0.73	4.11	-3.38
MW10	0.98	4.12	-3.14
MW11	1.14	3.23	-2.09
MW12	0.94	3.08	-2.14
MW13	0.84	4.15	-3.31

^ From survey of wells (TSS, 2023)

3.2 Monitoring Results

The following observations were made based on monitoring results:

- Groundwater levels were generally reflective of surface topography, tending to be deeper in MWs near the sand dune and in the southern valley area, and shallower (< 0.5 mbgl) in the low lying land to the north of the dune.
- Rainfall response was observed to vary depending on location within the Site, due to differences in soil type, land use and ground elevation:
    - Groundwater levels in MWs installed to the north of the sand dune (MW02, MW04, MW05, MW08 – MW13) were observed to fluctuate rapidly

in response to rainfall. The rate of fluctuation was generally lower in wells located closer to the sand dune.

- Groundwater in the MW installed to the south of the sand dune (MW01, MW03, MW06 and MW07) displayed a relatively delayed response to heavier rainfall, with minimal fluctuations observed following minor rainfall events.

Summaries of monitoring data collected from 7 December 2022 to 27 November 2024 are provided in the following tables and figures.

Table 5: Statistical summary of monitoring results in mAHD (7/12/2022 – 27/11/2024).

MW ID	Minimum	25th %ile	Median	Mean	75th %ile	Maximum	Range
MW01	0.31	0.74	0.98	1.01	1.18	2.10	1.79
MW02	0.17	0.60	0.85	0.81	1.04	1.32	1.14
MW03	0.57	1.23	2.02	2.12	2.99	3.93	3.36
MW04	0.27	0.72	1.04	1.01	1.31	1.63	1.37
MW05	0.05	0.60	0.88	0.85	1.13	1.67	1.61
MW06	0.35	0.97	1.63	1.71	2.39	3.28	2.93
MW07	0.20	0.69	1.09	1.11	1.51	2.02	1.82
MW08	-0.32	0.00	0.34	0.30	0.53	1.03	1.35
MW09	-0.05	0.22	0.51	0.46	0.65	1.05	1.10
MW10	-0.01	0.39	0.56	0.53	0.68	1.12	1.13
MW11	0.29	0.71	0.93	0.90	1.08	1.48	1.19
MW12	-0.24	0.16	0.42	0.42	0.71	1.04	1.28
MW13	-0.18	0.18	0.41	0.39	0.58	1.05	1.23
SW01	-0.50	-0.31	-0.17	-0.14	-0.03	0.74	1.24

Table 6: Statistical summary of monitoring results in mbgl (7/12/2022 – 27/11/2024).

MW ID	Minimum	25th %ile	Median	Mean	75th %ile	Maximum	Range
MW01	4.00	3.57	3.33	3.30	3.13	2.21	1.79
MW02	1.57	1.14	0.89	0.93	0.70	0.42	1.14
MW03	4.25	3.59	2.80	2.70	1.83	0.89	3.36
MW04	1.90	1.45	1.13	1.16	0.86	0.54	1.37
MW05	1.80	1.25	0.97	1.00	0.72	0.18	1.61
MW06	4.35	3.73	3.07	2.99	2.31	1.42	2.93
MW07	5.19	4.70	4.30	4.28	3.88	3.37	1.82
MW08	1.01	0.69	0.35	0.39	0.16	0.34	1.35
MW09	0.78	0.51	0.22	0.27	0.08	0.32	1.10

MW ID	Minimum	25th %ile	Median	Mean	75th %ile	Maximum	Range
MW10	0.99	0.59	0.42	0.45	0.30	0.14	1.13
MW11	0.85	0.43	0.21	0.24	0.06	0.34	1.19
MW12	1.18	0.78	0.52	0.52	0.23	0.10	1.28
MW13	1.02	0.66	0.43	0.45	0.26	0.21	1.23
SW01	1.57	1.38	1.24	1.21	1.10	0.33	1.24

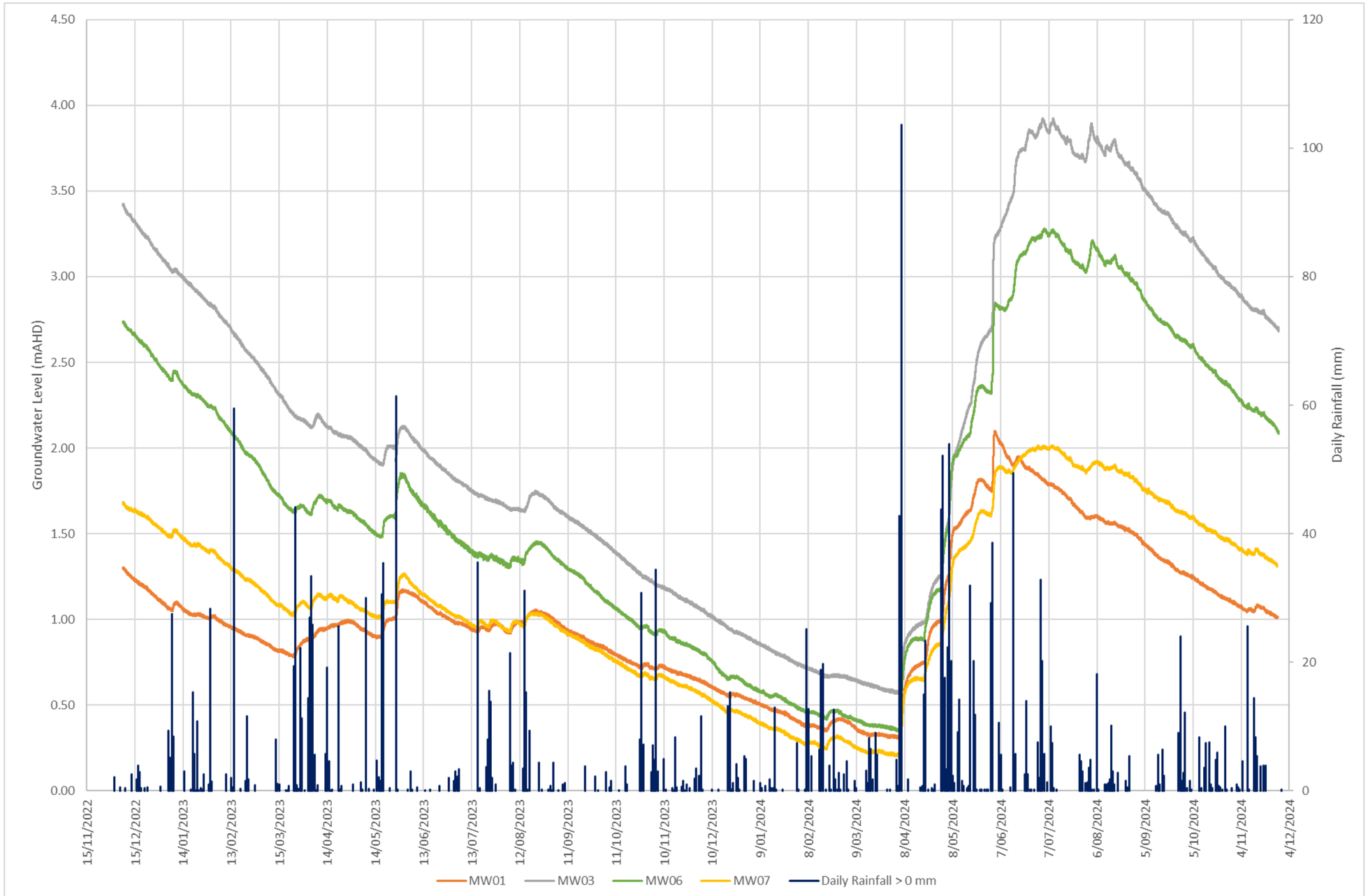


Figure 1: Plot of groundwater level data from MWs installed south of the sand dune (mAHD).

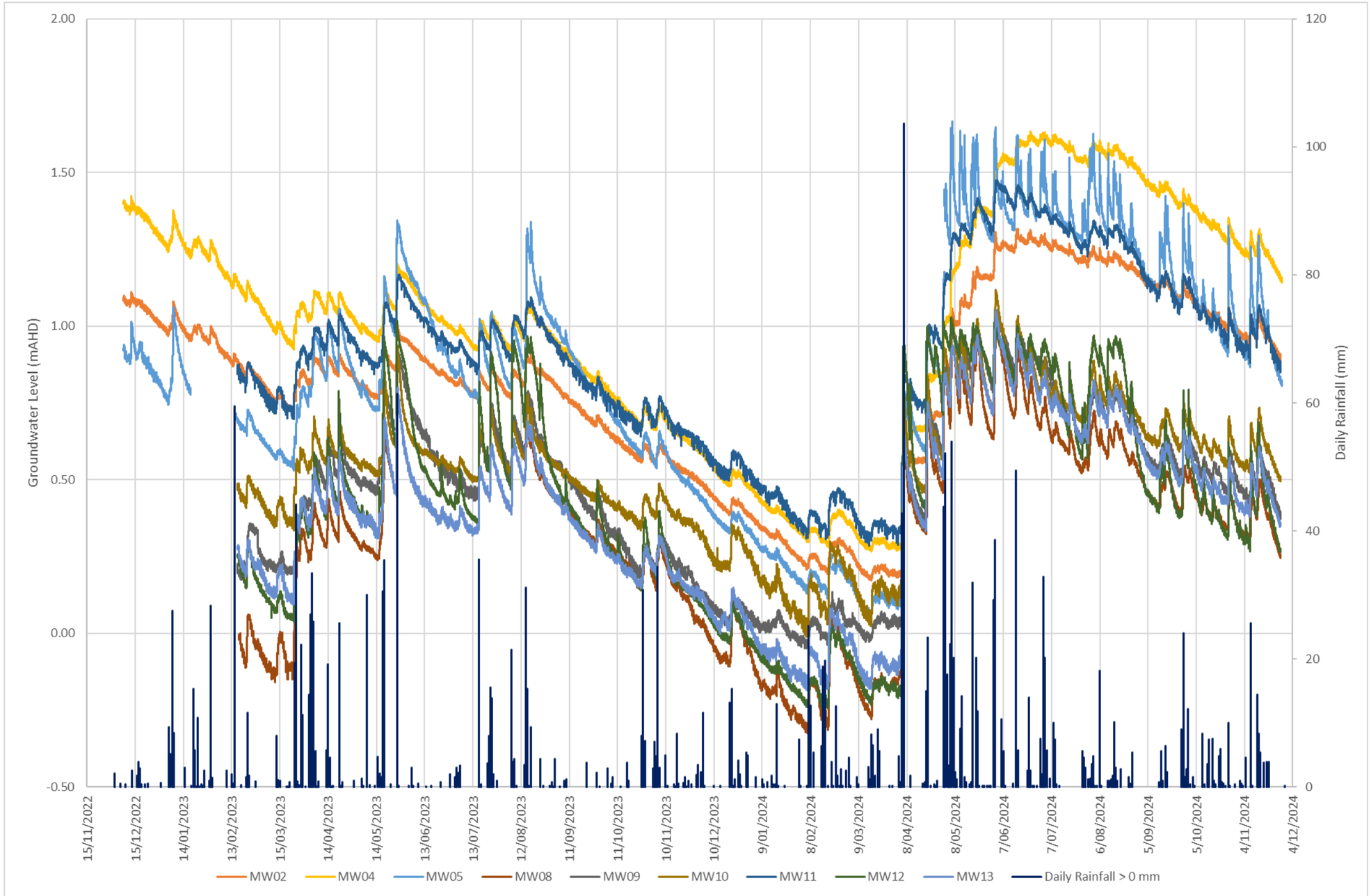


Figure 2: Plot of groundwater level data from MWs installed north of the sand dune (mAHD).

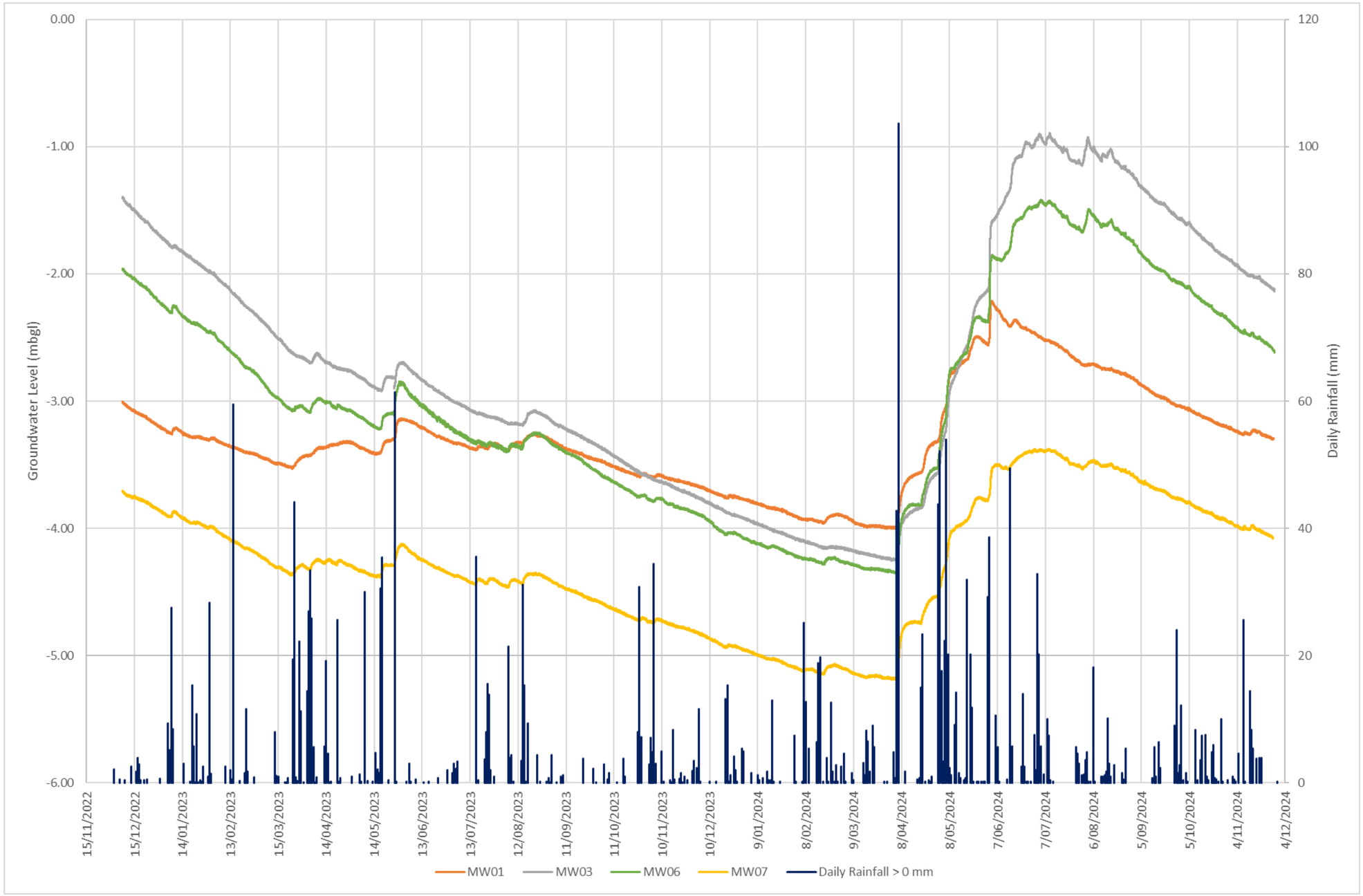


Figure 3: Plot of groundwater depth data from MWs installed to the south of the sand dune (mbgl).

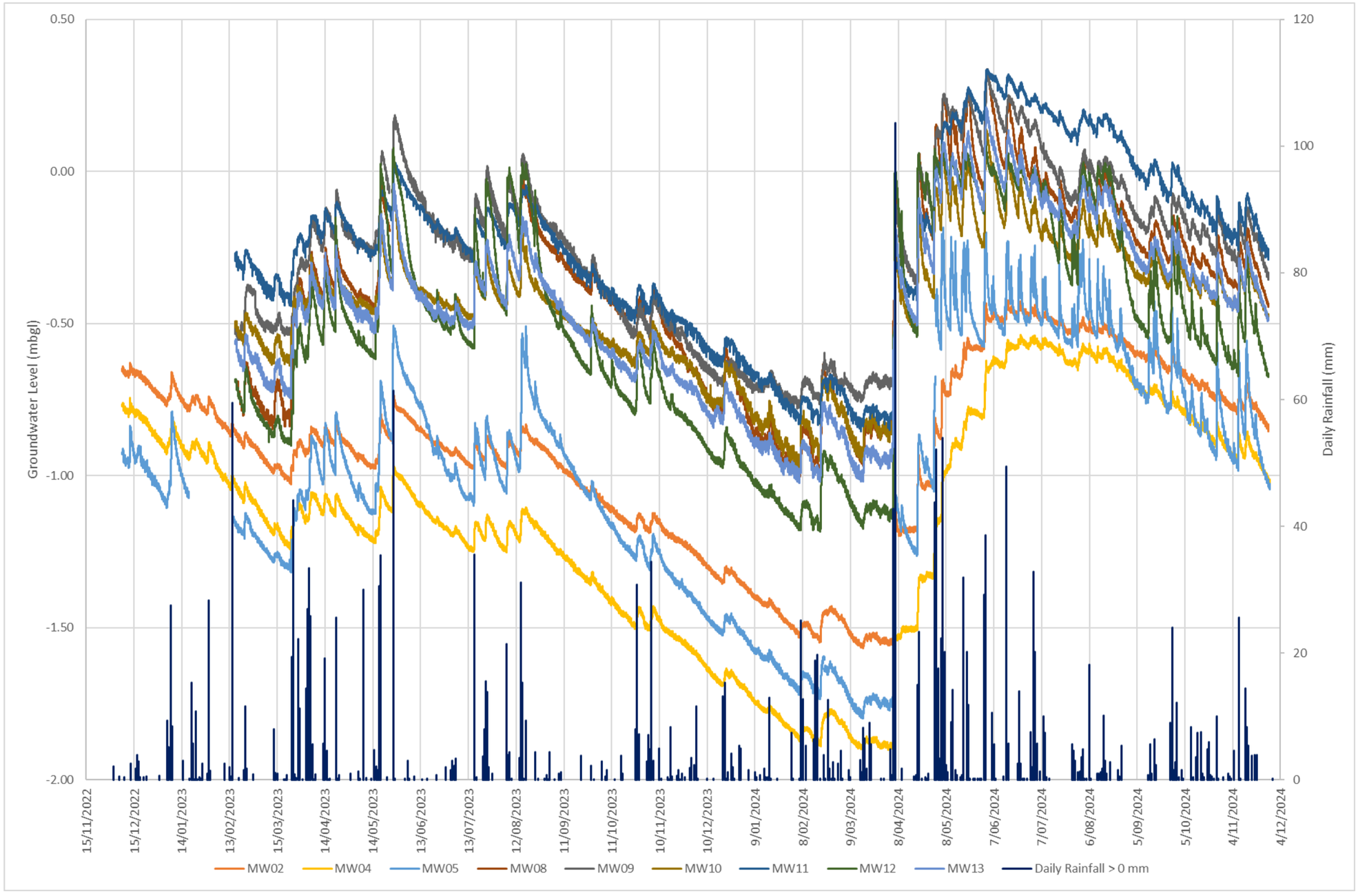


Figure 4: Plot of groundwater depth data from MWs installed to the north of the sand dune (mbgl).

3.3 Hydraulic Conductivity

Rising / falling head tests were conducted to determine saturated hydraulic conductivity (**K_{sat}**), with duplicate testing completed to provide consistency. K_{sat} results were variable between wells but generally consistent with typical values found in encountered alluvial / marine sands and clays at each monitoring well location.

Results of K_{sat} testing are summarised in Table 7 and calculation sheets are provided in Appendix E.

Table 7: Saturated hydraulic conductivity test results.

MW ID	Screened Material	Test A (m/day)	Test B (m/day)	Test C (m/day)
MW01	Sand (fine – medium)	6.17	6.56	6.52
MW02	Sand (medium – coarse)	22.36	-	-
MW03	Sand (fine – medium)	5.14	6.09	6.95
MW04	Sand (medium – coarse)	20.40	26.86	18.83
MW05	Sand (fine – medium)	7.83	8.15	-
MW06	Sand (fine – medium)	5.96	7.07	6.84
MW07	Sand (fine – medium)	1.83	4.64	4.54
MW08	Clay	0.0062	0.0065	-
MW09	Clay	0.077	0.072	-
MW10	Clay	1.34	1.30	-
MW11	Sand / Clay	10.51	10.04	-
MW12	Sand (fine – medium)	6.81	7.27	-
MW13	Sand (fine – medium)	4.93	4.76	-

3.4 Groundwater Quality Testing

3.4.1 Testing Methodology

Groundwater quality testing was undertaken on 14 December 2022 (for MW01 – MW07) and 14 February 2023 (For MW08 – MW13 & SW01). Wells were purged prior to sampling and all samples were immediately sealed in laboratory provided sampling bottles with appropriate preservatives and no headspace.

Samples were submitted to a NATA accredited laboratory (Envirolab Pty Ltd) and tested for:

- pH
- Electrical conductivity (EC)
- Ionic balance

- Dissolved heavy metals (As, B, Be, Ba, Cd, Cr, Cu, Co, Mn, Mo, Se, Sn, Ag Pb, Hg, Ni and Zn)

3.4.2 Testing Results

Laboratory testing results are summarised in Appendix F, and full laboratory documentation is provided in Appendix G. The following observations were made:

- Site groundwater is fresh to slightly brackish, with EC ranging from 100 µS/cm 1,600 µS/cm (Mayer *et al.*, 2005).
- Site groundwater is slightly acidic to neutral, with pH ranging from 4.9 – 6.9.
- Site groundwater generally contained low levels of dissolved heavy metals, except for aluminium (range of <0.01 mg/L – 0.26 mg/L), copper (range of <0.001 – 0.006) and zinc (range of 0.003 – 0.039 mg/L), which exceeded testing criteria for adopted from the AZNG (2018) 95% default guideline values for fresh water.

4 Impact Assessment

4.1 Hazard Identification and Mitigation

Potential groundwater hazards, pathways to these hazards and recommended impact mitigation measures are outlined in Table 8. Key potential groundwater hazards are summarised as:

1. Contamination of groundwater.
2. Water quality degradation from disturbance of ASS.
3. Loss of groundwater resource.
4. Degradation of GDEs.
5. Loss of yield to other groundwater users.

Table 8: Potential groundwater hazards and impact mitigation measures.

Item	Hazard	Hazard Pathway	Impact Mitigation Measures
1	**Groundwater contamination**	Contaminated stormwater released to groundwater	1. Internal access and hardstand areas to be designed and constructed in accordance with accepted engineering practice and guidelines. 2. Internal access and hardstand to be maintained to prevent erosion and ensure trafficability. 3. Capture and treat all surface water to appropriate standards within a formal stormwater management system.
		Wastewater discharged to groundwater	1. All sewer systems shall be designed to the relevant engineering standards. 2. All sewer systems to be certified by installer and engineer to be compliant with relevant standards following construction. 3. Implement low pressure sewer system in areas of shallow groundwater. 4. Obtain approvals for all sewage treatment systems in accordance with s68 of the *Local Government Act*. 5. Engineering certification following construction that all sewage treatment systems have been built in accordance with the s68 approval. 6. Operate all sewage treatment systems in accordance with the relevant s68 approval(s) and manufacturers requirements.
		Sediment contamination caused by proposed channel widening excavations	1. Implement curtain ring fence around excavation area to limit movement of sediment. 2. Monitor groundwater up / down slope of excavation area.

Item	Hazard	Hazard Pathway	Impact Mitigation Measures
2	**Groundwater Quality Degradation from ASS**	Temporary lowering of groundwater table from excavation	1. Minimise temporary dewatering for construction of basins and channel widening (restrict mechanised pumping where possible). 2. Dewatering to be limited to removal of saturated soils for the channel widening and basins only. 3. Where soils below the water table require excavation, ensure they are drained prior to removing from the area for treatment under an ASS management plan (ASSMP).
		Lowering of groundwater table from development	1. Minimise extent of urban footprint (noting approximately 50% of the Site area north of the sand dune is proposed to be zoned for urban development). 2. Design gravity drainage infrastructure (pits / pipes) to be above the long term average water table. 3. Design integrated water sensitive urban design principals (such as unlined grassed swales and basins) to ensure groundwater recharge occurs in development footprint areas. 4. Implement surface water and groundwater monitoring plan. 5. Stage the development.
		Leaching from excavated ASS treatment	1. Excavation of ASS is to be managed and treated in accordance with an ASSMP prepared in accordance with current guidelines. 2. All leachate from ASS treatment areas is to be collected, treated and validated prior to being discharged.
3	**Loss of groundwater resource**	Proposed excavations for basin construction and channel widening intersect and drain groundwater	1. Complete excavations with conventional earthmoving equipment with no mechanical dewatering.to limit potential impact on groundwater receptors 2. Where excavation occurs below the groundwater table, allow excavated soils to adequately drain back into excavation prior to stockpiling. 3. Any residual leachate from stockpiled material to be appropriately collected, treated and validated prior to discharge back into excavation. 4. Complete groundwater modelling to manage potential mounding of groundwater caused by basins. 5. Obtain relevant *Water Management Act* approvals for any aquifer interference activity.

Item	Hazard	Hazard Pathway	Impact Mitigation Measures
		Stormwater system drains groundwater	1. Design gravity drainage systems to avoid, as far as possible, elements that would intersect the groundwater table. 2. Encourage stormwater recharge to offset any losses. 3. Obtain relevant *Water Management Act* approvals for any aquifer interference activity.
		Services (water, sewer, power) intersect and drain groundwater.	1. Design the services system to avoid as far as possible, elements that would intersect the groundwater table. 2. Sewer system to be pressure sewer to minimise the need for deep excavation and avoid intercepting groundwater. 3. Where services pipelines are located below the water table, these should be contained within sealed systems. 4. Obtain relevant *Water Management Act* approvals for any aquifer interference activity.
		Groundwater impacted by placement of residential fill pads / footings.	1. Minimise footprint of residential development. 2. Encourage stormwater recharge and design appropriate water sensitive urban design elements into the development to offset any losses.
4	**Degradation of GDEs**	Development causes groundwater quality at GDEs to be degraded	1. Minimise footprint of residential development to avoid mapped GDEs. 2. Obtain relevant *Water Management Act* approvals for any aquifer interference activity. 3. All sewer systems to be designed in accordance with relevant state and national standards. 4. All sewer systems to be certified by installer and engineer to be compliant with relevant standards following construction.
		Development causes groundwater flows to GDEs to be modified	1. Minimise footprint of residential development to avoid mapped GDEs. 2. Integrate water sensitive urban design principals into development to ensure groundwater recharge occurs in development footprint areas. 3. Undertake detailed 3D groundwater modelling at DA stage to guide development design. 4. Obtain relevant *Water Management Act* approvals for any aquifer interference or proposed extraction activity.

Item	Hazard	Hazard Pathway	Impact Mitigation Measures
5	**Loss of yield to other GW users**	Development causes lowering of groundwater levels at nearby groundwater extraction bores.	1. Minimise temporary dewatering for construction of basins and channel widening (restrict mechanised pumping where possible). 2. Obtain relevant *Water Management Act* approvals for any aquifer interference activity.

4.2 Risk Assessment Methodology

Risks of the proposed development to groundwater resources, the environment and groundwater users, were assessed in accordance with the following general methodology:

1. Identify hazards through each receptor and hazard pathway (refer to Table 8).
2. Assess consequence of each hazard (refer to Table 9).
3. Determine likelihood of each hazard occurring (Table 10) with risk mitigation measures in place.
4. Classify risk as a combination of consequence and likelihood (Table 11).

Table 9: Adopted hazard consequence definitions.

Descriptor	Definition
Insignificant (A)	No detectable impact on groundwater resources or users
Minor (B)	Minor changes to groundwater conditions but no material harm.
Moderate (C)	Medium term environmental harm or moderate impacts on users
Major (D)	Long term environmental harm or major impacts on users
Severe (E)	Severe, permanent impact on groundwater resources or users.

Table 10: Adopted hazard likelihood definitions.

Descriptor	Definition
Almost certain (1)	Event is expected to occur often (several times per year).
Likely (2)	Event is likely to occur often (once every 1 to 3 years).
Possible (3)	Event might occur (once every 3-10 years).
Unlikely (4)	Event could occur (once every 20 years).
Rare (5)	Event will occur only in rare circumstances (once every 100 years).

Table 11: Adopted risk definitions.

		Consequence				
		Insignificant (A)	**Minor (B)**	**Moderate (C)**	**Major (D)**	**Severe (E)**
Likelihood	**Almost certain (1)**	Low	Medium	High	Very High	Very High
	Likely (2)	Low	Medium	High	Very High	Very High
	Possible (3)	Low	Low	Medium	High	Very High
	Unlikely (4)	Very Low	Low	Low	Medium	High
	Rare (5)	Very Low	Very Low	Low	Medium	High

4.3 Risk Evaluation

A risk assessment for identified hazards is presented in Table 12. This provides an assessment of the hazard consequence [**Cons**] and likelihood [**Prob**] and resultant risks in accordance with the criteria in Table 9, Table 10 and Table 11.

Based on the adopted risk mitigation measures, risks to groundwater arising from the PP are assessed as acceptable, ranging from Very Low to Low. On this basis, hazards to groundwater can be appropriately managed with conventional techniques and significant impacts are not expected to arise from the future development.

Table 12: Risk assessment outcomes.

Receptor	Hazard Pathway	Cons	Prob	Risk
GW contamination	Contaminated stormwater released to groundwater	A	4	**VL**
	Untreated wastewater discharged to groundwater	C	4	**L**
	Sediment contamination caused by proposed channel widening excavations	A	4	**VL**
GW quality degradation from ASS	Temporary lowering of groundwater table from excavation.	B	5	**VL**
	Lowering of groundwater table from development	B	4	**L**
	Leaching from excavated ASS material	B	5	**VL**
Loss of GW resource	Excavations intersect and drain groundwater	B	3	**L**
	Stormwater system drains groundwater	C	4	**L**
	Services (water, sewer, power) intersect and drain groundwater.	B	5	**L**
	Groundwater impacted by placement of residential fill pads / footings.	B	4	**L**
Degradation of GDEs	Development causes groundwater quality at GDEs to be degraded	B	5	**VL**
	Development causes groundwater flows to GDEs to be modified	B	5	**VL**
Loss of yield to other GW users	Development causes lowering of groundwater levels at nearby groundwater extraction bores	B	5	**VL**

5 Conclusions and Recommendations

The following summary remarks and conclusions are made:

- Based on groundwater monitoring data collected to date, Site groundwater is generally shallow, unconfined and responsive to rainfall, particularly to the north of the sand dune.
- Groundwater to the south of the sand dune is typically deeper and less responsive to minor rainfall events.
- Laboratory testing identified minor exceedances of the ANZG (2018) guideline values for dissolved aluminium, copper and zinc. Given that no beneficial groundwater use is proposed at this stage, and that these levels are likely to be naturally occurring, contamination risk to sensitive receptors or the development is expected to be low.
- NSW Government HEVAE mapping identifies several medium to high value GDEs across the Site.
- Groundwater dewatering is expected to be limited to removal of groundwater in soil pore space from the excavation of soils below the water table in limited areas of the Site (basins and drainage channel).
- A comprehensive risk assessment of groundwater hazards has been completed, including documentation of a range of potential impact mitigation measures. The risk assessment found that based on the adopted risk mitigation measures, risks to groundwater arising from the proposed development are assessed as acceptable, ranging from Very Low to Low. On this basis, hazards to groundwater can be appropriately managed through conventional methods, and significant impacts to the groundwater environment are not expected to arise from the development proposal.
- Groundwater modelling should be completed at DA stage to guide implementation of mitigation measures (such as appropriate water sensitive urban design measures and recharge areas) to confirm the findings of the risk assessment.
- A groundwater and surface water monitoring plan should be prepared at the DA stage.

6 References

Australian and New Zealand Governments and Australian State and Territory Governments (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* (ANZG, 2018).

BKA Architecture (2024) *Proposed Masterplan and Yield* & *Proposed Land Zoning Map: Gan Gan Road, Anna Bay.* Ref 22011.

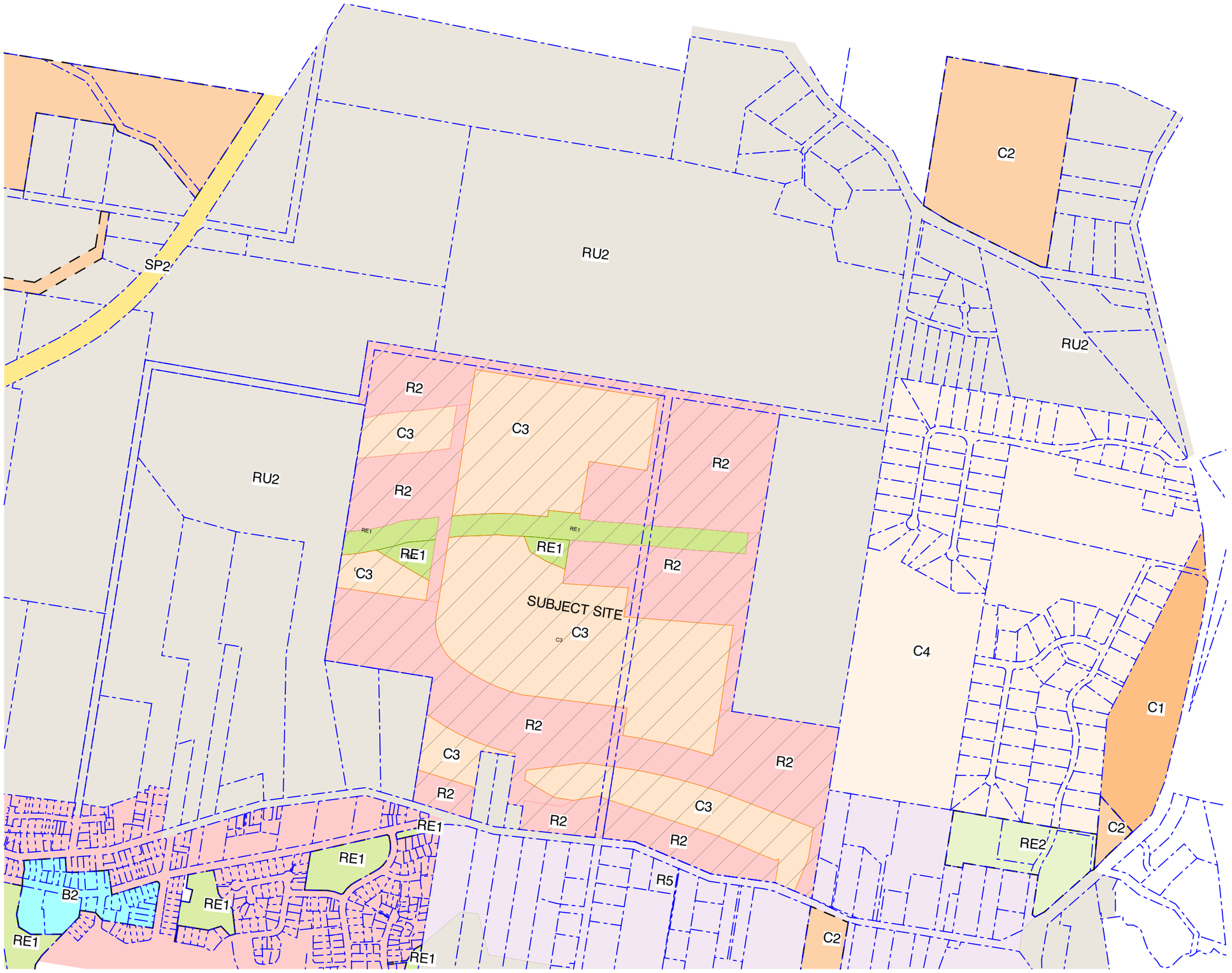
Bureau of Meteorology Groundwater Dependent Ecosystems Atlas. http://www.bom.gov.au/water/groundwater/gde/map.shtml

Martens and Associates (2024) *Geotechnical and Acid Sulfate Soil Assessment: Proposed Rezoning at 196 Old Main Road, 263, 271, 293 and 321 Gan Gan Road, Anna Bay, NSW.*

NSW Department of Planning, Industry & Environment (2022) *Minimum requirements for building site groundwater investigations and reporting.* Referred to as NSW DPIE (2022)

Total Surveying Solutions (2023) *Plan showing Location and Elevation of Monitoring Wells.* (TSS, 2023).

Appendix A – Proposed Masterplan



LEGEND:

Zone

- SP2 INFRASTRUCTURE
- RU2 RURAL LANDSCAPE
- R2 LOW DENSITY RESIDENTIAL
- R5 LARGE LOT RESIDENTIAL
- RE1 PUBLIC RECREATION
- RE2 PRIVATE RECREATION
- B2 LOCAL CENTRE
- C1 NATIONAL PARKS & NATURE RESERVES
- C2 ENVIRONMENTAL CONSERVATION
- C3 ENVIRONMENTAL MANAGEMENT
- C4 ENVIRONMENTAL LIVING
- SUBJECT SITE

General Notes

DO NOT SCALE FROM DRAWING. USE FIGURED DIMENSIONS ONLY. CHECK ALL DIMENSIONS ON SITE BEFORE ANY MANUFACTURE OR CONSTRUCTION

All dimensions are in millimetres unless stated otherwise.
All architectural, drawings are to be read in conjunction with the relevant consultant documents. All dimensions and levels are to be checked and verified on site prior to the commencement of work, shop drawings or fabrication of any components. Refer all discrepancies to the Architect for determination. Drawings are not to be scaled, use only figured dimensions. This drawing is copyright and must not be retained, copied or used without the permission of BKA Architecture. This document has been prepared for and on behalf of the clients noted on the drawing. BKA Architecture's responsibility is to these clients only and not to any third party who may rely on these documents.
Nominated Architects (NSW) - John Baker 3552, John Kavanagh 5999

Rev	Date	Issue
B	22/3/2024	Issue for Scoping Report
C	3/12/2024	Issue for Planning Proposal

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North

Scale at A3
1:10000

Status
Not for Construction

Drawn
VK, JG

Date
3/12/2024

Checked
JG

Project Address
Gan Gan Road, Anna Bay

Drawing
Proposed Land Zoning Map

Project No.	Revision	Drawing No.
22011	C	A013

1 Proposed Masterplan
1:5000

BKA Architecture
22011 Gan Gan Rd, Anna Bay

Calculations

Site Area **Gan Gan Rd** **1,186,830 m2** **approx**

Stage	Section	Residential Area m2	Standard Blocks # 500m2 16.7m x 30m R2	Dual Occupation # 600m2 20m x 30m R2	Dwellings # R2	Public Park m2 RE1	Evironmental Reserve m2 E3
Stage 1	A	8,138	16		16		
	B	8,153	16		16		
	C	2,854	2	0	2		
Stage 2	EA	6,337			25		
	EB	4,328			25		
	FA	6,838	8	3	14		
Stage 3	GA	6,939	11	2	15		
	GB	5,697	10	1	12		
	GC	12,844	24	1	26		
	GD	9,287	10	2	14		
Stage 4	HA	8,083	16		16		
	HB	5,724	10	1	12		
	HC	8,097	8	2	12		
	HD	5,743	10	1	12		
	HE	9,766	18	1	20		
Stage 5	IA	12,127	18	3	24		
	IB	7,957	14	1	16		
	IC	9,783	8	4	16		
	ID	5,728	10	1	12		
	IE	5,728	10	1	12		
	IF	7,728	8	2	12		
	IG	6,068	12		12		
	IH	8,073	16		16		
	IJ	8,071	16		16		
Stage 6	NA	7,212	13	1	15		
Stage 7	MA	11,622	12	7	26		
	MB	15,050	24	3	30		
	MC	15,858	16	11	38		
Stage 8	LA	8,071	16		16		
	LB	7,644	14	1	16		
	LC	7,712	14	1	16		
Stage 9	KA	7,838	11	1	13		
	KB	7,697	15		15		
	KC	8,379	15	1	17		
Stage 10	JA	7,961	13	2	17		
	JB	5,701	8	2	12		
	JC	9,279	10	2	14		
TOTAL		**280,970.24**	**418**	**58**	**584**		

TOTAL Dwellings	**584**	
TOTAL Lots	**476**	plus 2 Multi Dwelling Housing Lots
NOTE: Excludes current R2 zoning (DA)		

General Notes

DO NOT SCALE FROM DRAWING. USE FIGURED DIMENSIONS ONLY. CHECK ALL DIMENSIONS ON SITE BEFORE ANY MANUFACTURE OR CONSTRUCTION

All dimensions are in millimetres unless stated otherwise.
All architectural, drawings are to be read in conjunction with the relevant consultant documents. All dimensions and levels are to be checked and verified on site prior to the commencement of work, shop drawings or fabrication of any components. Refer all discrepancies to the Architect for determination. Drawings are not to be scaled, use only figured dimensions. This drawing is copyright and must not be retained, copied or used without the permission of BKA Architecture. This document has been prepared for and on behalf of the clients noted on the drawing. BKA Architecture's responsibility is to these clients only and not to any third party who may rely on these documents.
Nominated Architects (NSW) - John Baker 3552, John Kavanagh 5999

Rev	Date	Issue
A	4/3/2024	Preliminary Issue to Council
B	22/3/2024	Issue for Scoping Report
C	3/12/2024	Issue for Planning Proposal

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NORTH COAST
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Clunes,
NSW 2480
T: +61 2 6687 2712

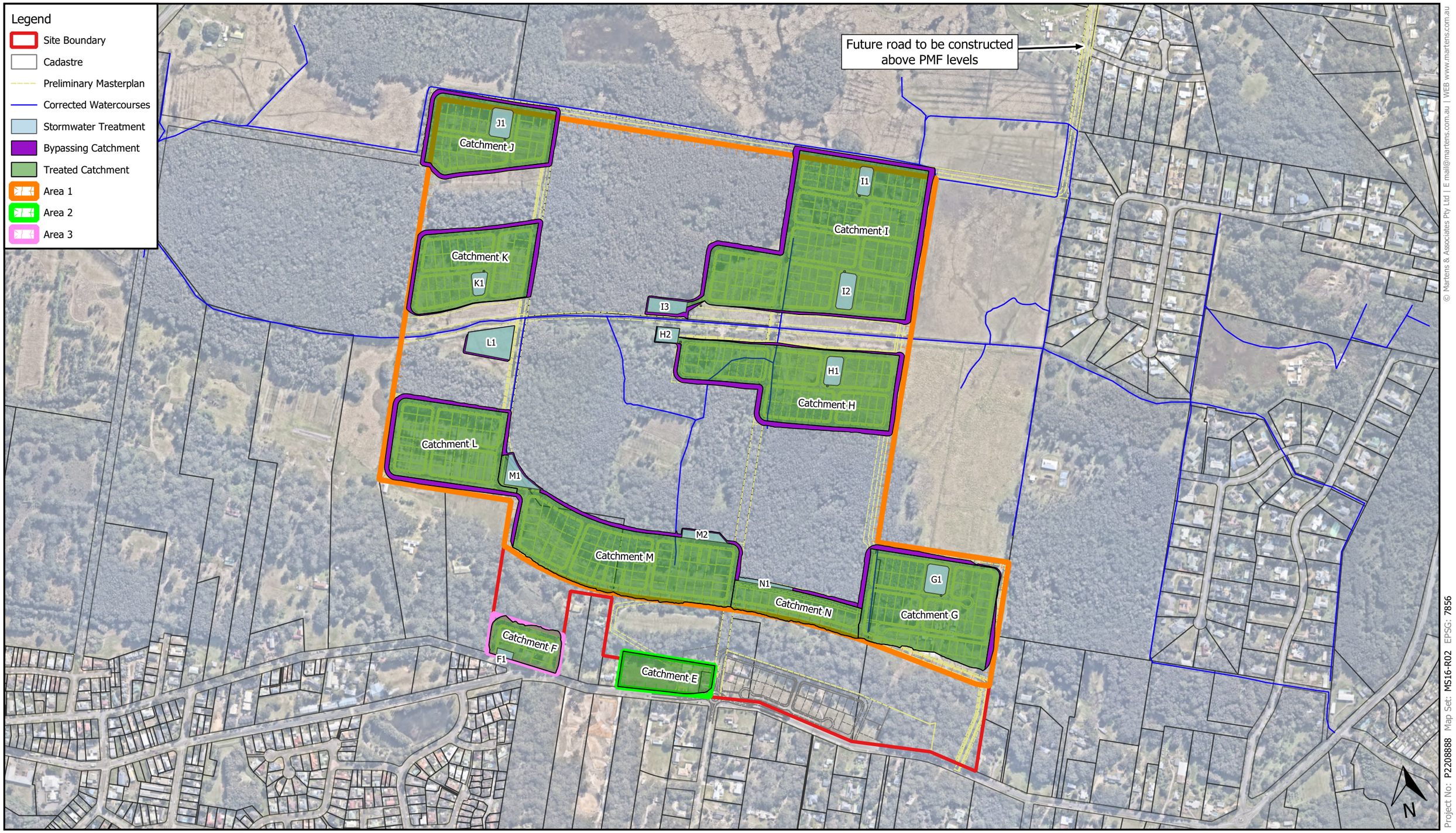
Scale at A1 1:5000
Date 3/12/2024
North
Drawn VK, JG
Checked JG
Status Not for Construction

Project Address
Gan Gan Road, Anna Bay

Drawing
Proposed Masterplan and Yield

Project No. **22011**
Revision **C**
Drawing No. **A100**

Appendix B – Stormwater Management Strategy



Project No: P2208888 Map Set: MS16-R02 EPSG: 7856

0 90 180 270 360 450 m

1:7500 @ A3

Viewport

Note:
- Aerial from Nearmap (2024).
- Cadastre from NSW Spatial Services Clip and Ship (2023).
- Preliminary masterplan from BKA Architecture (2024).
- Corrected watercourses are based on MA Riparian Management Study (2024).
- Catchment areas and basin locations are indicative only.

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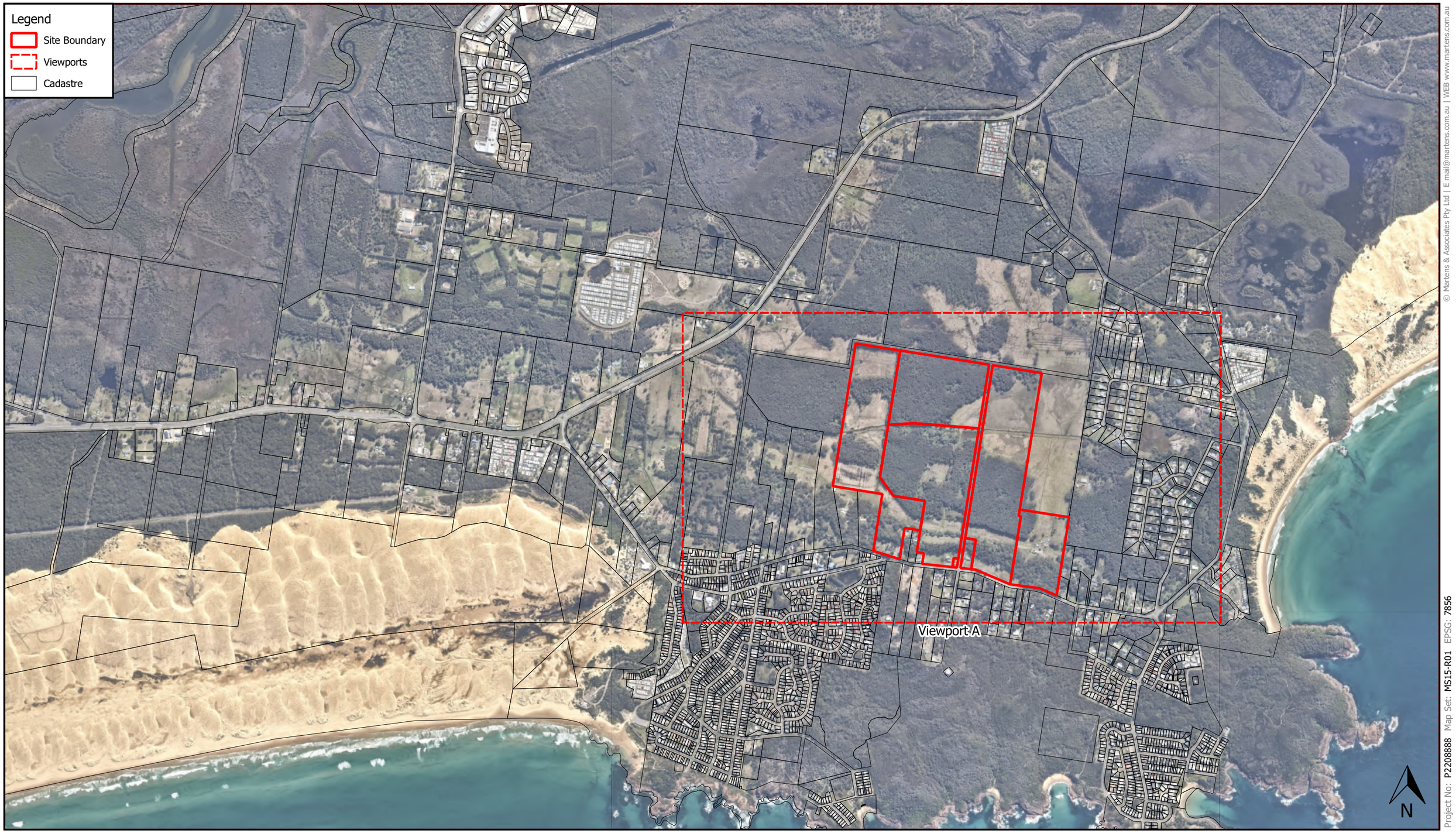
Map Title / Figure:

Stormwater Management Strategy

Map 02	Map
Gan Gan Rd & Old Main Rd, Anna Bay, NSW	Site
Proposed Land Rezoning	Project
Conceptual Stormwater Management Strategy	Sub-Project
AB Rise Pty Ltd	Client
13/12/2024	Date

Appendix C – Site Maps



0 200 400 600 800 1,000 m

1:20000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2024).
- Cadastre from NSW Clip and Ship.

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Map Title / Figure:
Site Setting

Map 01	Map
Lots on Old Main Road and Gan Gan Road, Anna Bay NSW	Site
Proposed Rezoning	Project
Hydrogeological Assessment	Sub-Project
AB Rise Pty Ltd	Client
13/12/2024	Date

Project No: P2208888 Map Set: MS15-R01 EPSG: 7856

Legend

- Site Boundary

NGIS Bores

- Monitoring
- Unknown
- Water Supply

N

0 90 180 270 360 450 m

1:7500 @ A3

Viewport A

Notes:
- Aerial from Nearmap (2024).
- NGIS Bore locations from BoM (2023).

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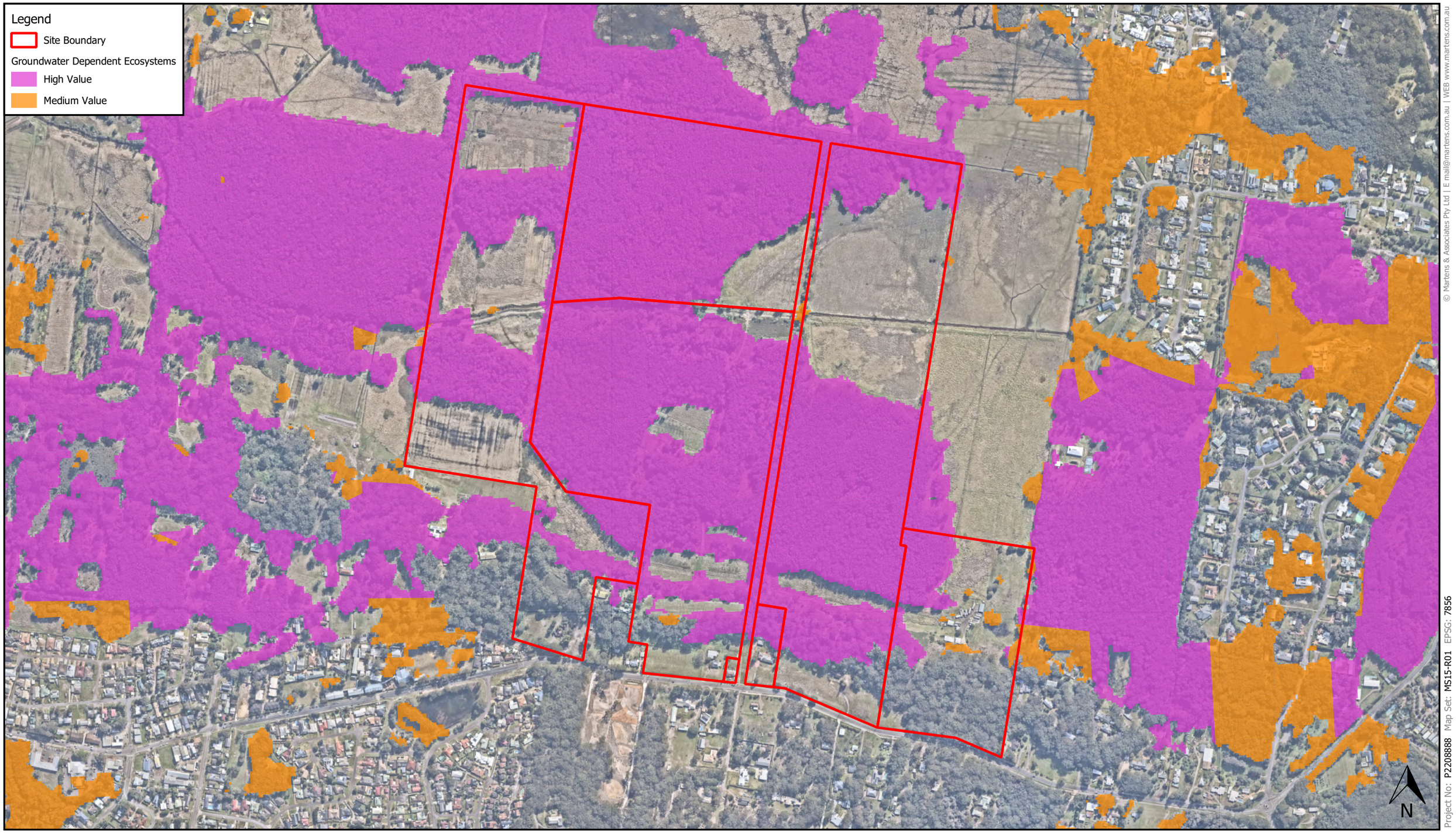
Map Title / Figure:
NGIS Bores

Map 02	Map
Lots on Old Main Road and Gan Gan Road, Anna Bay NSW	Site
Proposed Rezoning	Project
Hydrogeological Assessment	Sub-Project
AB Rise Pty Ltd	Client
13/12/2024	Date

Project No: P2208888 Map Set: MS15-R01 EPSG: 7856



0 90 180 270 360 450 m

1:7500 @ A3

Viewport A

Notes:
- Aerial from Nearmap (2024).
- GDE coverage from NSW Government HEVAE mapping.

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Project No: P2208888 Map Set: MS15-R01 EPSG: 7856

Map Title / Figure:

Groundwater Dependent Ecosystems

Map 03	Map
Lots on Old Main Road and Gan Gan Road, Anna Bay NSW	Site
Proposed Rezoning	Project
Hydrogeological Assessment	Sub-Project
AB Rise Pty Ltd	Client
13/12/2024	Date

Legend

- Site Boundary
- Monitoring Locations
- Contour (1m)

MW12
MW09
MW13
MW08
SW01
MW10
MW11
MW02
MW04
MW05
MW01
MW07
MW03
MW06

0 mAHD
5 mAHD
10 mAHD
15 mAHD
20 mAHD
25 mAHD
30 mAHD
35 mAHD
40 mAHD

0 90 180 270 360 450 m

1:7500 @ A3

Viewport A

Notes:
- Aerial from Nearmap (2024).
- Topography from NSW DFSI (2012).

Project No: P2208888 Map Set: MS15-R01 EPSG: 7856

Map Title / Figure:

Monitoring Locations

Map 04	Map
Lots on Old Main Road and Gan Gan Road, Anna Bay NSW	Site
Proposed Rezoning	Project
Hydrogeological Assessment	Sub-Project
AB Rise Pty Ltd	Client
13/12/2024	Date

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Appendix D – Well Construction Logs

CLIENT	AB Rise Pty Ltd		COMMENCED	13/09/2022	COMPLETED	13/09/2022	**REF BH101/MW01**
PROJECT	ASS Assessment & GW Installation		LOGGED	DS	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quaternary	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.093458	RL SURFACE	4.31 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 6.00 m depth	LATITUDE	-32.775396	ASPECT	South	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/V			0	4.31				SP	TOPSOIL: SAND; fine to medium grained; dark brown - black; with silt.			ID MW01 Static Water Level
				0.15	0.1/S/1 D 0.10 m							Concrete
				4.16				SP	SAND; fine to medium grained; dark grey; trace silt.			
				0.60	0.5/S/Dupe02 D 0.50 m							
				3.71					Becoming grey.			
			1	*1.00*								Casing.
				3.31	1.0/S/Dupe02 D 1.00 m				Becoming brown.			Cuttings
				1.40								
				2.91					Becoming orange - brown.			
					1.5/S/1 D 1.50 m							
			2									Bentonite
					2.5/S/Dupe02 D 2.50 m							
			3									
				3.50								
				0.81					Becoming pale brown.			
			4		4.0/S/Dupe02 D 4.00 m							Sand
												Screen.
			5	*5.00*								
				-0.69					Pale brown - grey.			
					5.5/S/Dupe02 D 5.50 m							
			6	*6.00*								
									Hole Terminated at 6.00 m (Target depth reached)			

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

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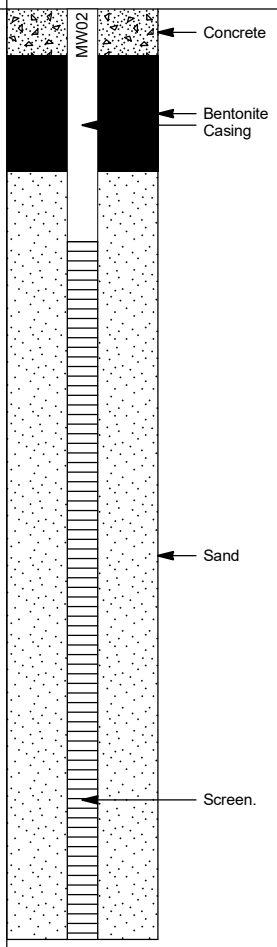
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	13/09/2022	COMPLETED	13/09/2022	**REF BH106/MW02**
PROJECT	ASS Assessment & GW Installation		LOGGED	DS	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quaternary	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.09682	RL SURFACE	1.74 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.20 m depth	LATITUDE	-32.774699	ASPECT	North	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/V			0	1.74				SP	TOPSOIL: SAND; fine to medium grained; dark brown - black; with silt.			ID MW02 Static Water Level
					0.2/S/Dupe02 D 0.20 m							
				0.40 1.34				ML	Sandy SILT; low plasticity; dark brown.			
			1		1.2/S/Dupe02 D 1.20 m							
					1.6/S/1 D 1.60 m							
				2.00 -0.26				SP	SAND; medium to coarse grained; pale brown - grey.			
			2									
					2.6/S/Dupe02 D 2.60 m							
			3									
					4.0/S/1 D 4.00 m							
			4	*4.20*					Hole Terminated at 4.20 m (Target depth reached)			
			5									
			6									



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

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	14/09/2022	COMPLETED	14/09/2022	**REF BH109/MW03**
PROJECT	ASS Assessment & GW Installation		LOGGED	DS	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quaternary	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 5.50 m depth	LATITUDE		ASPECT		SLOPE

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 ID MW03 Static Water Level
AD/V			0	0.20	01/S/Dupe02 D 0.10 m			SP	TOPSOIL: SAND; medium to fine grained; dark grey; trace silt.			Concrete
								SP	SAND; medium to fine grained; grey; trace silt.			MW03
					0.5/S/1 D 0.50 m							
			1	1.00	1.0/S/Dupe02 D 1.00 m				Mild organic odour.			Cuttings
												Casing
				1.40	1.5/S/1 D 1.50 m			SM	Silty SAND; fine to medium grained; dark brown; mild organic odour.			
					1.9/S/1 D 1.90 m							Bentonite
			2	2.00				SP	SAND; fine to medium grained; pale brown - grey; trace silt; shell fragments; mild organic odour.			
					2.5/S/Dupe02 D 2.50 m							
			3									
			4		4.0/S/Dupe02 D 4.00 m							Sand Screen.
				4.50					Grey.			
			5		5.2/S/Dupe02 D 5.20 m							
				5.50					Hole Terminated at 5.50 m (Target depth reached)			
			6									

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

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	15/09/2022	COMPLETED	15/09/2022	**REF BH110/MW04**
PROJECT	ASS Assessment & GW Installation		LOGGED	DS	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quaternary	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.099489	RL SURFACE	2.17 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.50 m depth	LATITUDE	-32.775092	ASPECT	North	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 ID Static Water Level MW04
AD/V				2.17	0.1/S/Dupe02 D 0.10 m			SP	SAND; fine to medium grained; dark brown - black; with silt.			MW04
					0.5/S/1 D 0.50 m							Concrete Casing.
				0.80								Bentonite
				1.37				MH	SILT; medium plasticity; dark grey - black; trace fine grained sand.			
			1		1.0/S/Dupe02 D 1.00 m							
					1.5/S/1 D 1.50 m							
				2.00								
			2	0.17				SP	SAND; fine to medium grained; grey; trace silt.			
					2.5/S/Dupe02 D 2.50 m							Sand
			3									
				3.20								Screen.
				-1.03				SW	SAND; medium to coarse grained; dark grey; trace shell fragments.			
					3.5/S/Dupe02 D 3.50 m							
				4.00								
			4	-1.83					Pale brown - grey.			
					4.3/S/1 D 4.30 m							
				4.50								
									Hole Terminated at 4.50 m (Target depth reached)			
			5									
			6									

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

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	15/09/2022	COMPLETED	15/09/2022	**REF BH112/MW05**
PROJECT	ASS Assessment & GW Installation		LOGGED	DS	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quaternary	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.103303	RL SURFACE	1.85 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.30 m depth	LATITUDE	-32.775175	ASPECT	North	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 ID Static Water Level MW05
AD/V			0	1.85								
				0.15	0.1/S/Dupe02 D			SP	FILL: SAND; black; trace anthropogenic plastics; with silt.			
				1.70	0.10 m			ML	SILT; low plasticity; black; mild organic odour.			
					0.5/S/1 D 0.50 m							
				0.80								
				1.05				SP	SAND; fine to medium grained; brown; with silt.			
			1		1.0/S/Dupe02 D 1.00 m							
					1.5/S/1 D 1.50 m							
			2	*2.00*								
				-0.15	2.0/S/1 D 2.00 m				Becoming dark grey - brown; trace silt.			
					2.5/S/Dupe02 D 2.50 m							
			3									
					3.5/S/1 D 3.50 m							
			4	*4.30*								
									Hole Terminated at 4.30 m (Target depth reached)			
			5									
			6									

PIEZOMETER DETAILS: MW05 — Concrete Casing. — Bentonite — Sand — Screen.

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

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	06/12/2022	COMPLETED	06/12/2022	**REF BH206 / MW06**
PROJECT	Engineering Services		LOGGED	AK	CHECKED		Sheet 1 OF 1
SITE	263, 269, 273, 293, 321, Gan Gan road, Anna Bay, NSW		GEOLOGY	Quaternary	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 5.95 m depth	LATITUDE		ASPECT		SLOPE

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 ID Static Water Level MW06
AD/V		Inflow	1	1.10	0.3-0.5/S/1 D 0.30-0.50 m			SM	Silty SAND; fine to medium grained; pale grey, black.	D		MW06 Concrete
					SPT 1.00-1.45 m 3, 3, 3 N = 6 1.0-1.45/S/1				Brown.			Casing Cuttings
				1.60	1.7-2.0/S/1 D 1.70-2.00 m				Pale brown - orange.			
			2		2.3-2.5/S/1 D 2.30-2.50 m					M		Bentonite
				2.50	SPT 2.50-2.95 m 3, 3, 4 N = 7 2.5-2.95/S/1				Grey.			
			3									
			4		SPT 4.00-4.45 m 2, 3, 4 N = 7 4.0-4.45/S/1					W		Sand
			5									Screen.
					SPT 5.50-10.00 m 5, 6, 10 N = 16 5.5-5.95/S/1							
			6	5.95					Hole Terminated at 5.95 m (Target depth reached)			
			7									
			8									
			9									
			10									

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

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	06/12/2022	COMPLETED	06/12/2022	**REF BH207 / MW07**
PROJECT	Engineering Services		LOGGED	AK	CHECKED		Sheet 1 OF 1
SITE	263, 269, 273, 293, 321, Gan Gan road, Anna Bay, NSW		GEOLOGY	Quaternary	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 5.95 m depth	LATITUDE		ASPECT		SLOPE

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 ID Static Water Level
AD/V			0	0.50	0.1-0.3/S/1 D 0.10-0.30 m			SM	Silty SAND; fine to medium grained; pale grey, brown.			MW07
					0.5-0.7/S/1 D 0.50-0.70 m				Dark brown.			Concrete
			1		0.7-1.0/S/1 D 0.70-1.00 m							Casing
				1.50								Cuttings
					1.7/S/1 D 1.70 m				Light brown.			
			2									Bentonite
					2.7-3.0/S/1 D 2.70-3.00 m					D		
			3		2.8/S/1 D 2.80 m							
				3.50					Pale grey / pale brown.			
			4		3.9-4.0/S/1 D 3.90-4.00 m							Sand
					4.5-4.6/S/1 D 4.50-4.60 m							Screen.
			5									
				5.50	5.4-5.5/S/1 D 5.40-5.50 m							
			6						Hole Terminated at 5.95 m (Target depth reached)			
			7									
			8									
			9									
			10									

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	07/02/2023	COMPLETED	07/02/2023	**REF BH116/MW08**
PROJECT	ASS Assessment & GW Installation		LOGGED	AK	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quarternary deposits	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.097832	RL SURFACE	0.69 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.00 m depth	LATITUDE	-32.769259	ASPECT	South	SLOPE <5%

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 (ID: MW08; Static Water Level)
AD/V	L	Inflow	0	0.69	0.1/S/1 D 0.10 m				Clayey SILT; brown.	M (<<PL)		MW08
				0.50								
				0.19	0.5/S/1 D 0.50 m			SC	Sandy CLAY; high plasticity; grey.			
			1		1.0/S/1 D 1.00 m							Casing.
												Concrete
				1.60	1.5/S/1 D 1.50 m							
				-0.91					Moisture increasing.	M (<PL)		
			2									Bentonite
					2.5/S/1 D 2.50 m							
			3		3.0/S/1 D 3.00 m							Screen.
												Sand
					3.5/S/1 D 3.50 m					M (>PL)		
			4	*4.00*	4.0/S/1 D 4.00 m				Hole Terminated at 4.00 m (Target depth reached)			
			5									
			6									

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	07/02/2023	COMPLETED	07/02/2023	**REF BH118/MW09**
PROJECT	ASS Assessment & GW Installation		LOGGED	AK / TR	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quarternary deposits	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.101463	RL SURFACE	0.73 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.00 m depth	LATITUDE	-32.76705	ASPECT	North	SLOPE <5%

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 (ID: MW09; Static Water Level)
AD/V	L	Inflow	0	0.73				CH	Silty CLAY; high plasticity; brown, grey; trace sand and organics.			
					0.2/S/1 D 0.20 m							
					0.5/S/1 D 0.50 m					M (<<PL)		
			1		1.0/S/1 D 1.00 m							Casing. Concrete
				1.20 -0.47				CH	Silty CLAY; high plasticity; pale grey.	M (<PL)		
					1.5/S/1 D 1.50 m							
			2		2.0/S/1 D 2.00 m					M (>PL)		Bentonite
					2.5/S/1 D 2.50 m							
			3	3.00 -2.27	3.0/S/1 D 3.00 m			SC	Clayey SAND; fine to medium grained; pale grey.			Screen. Sand
					3.5/S/1 D 3.50 m					W		
			4	4.00	4.0/S/1 D 4.00 m				Hole Terminated at 4.00 m (Target depth reached)			
			5									
			6									

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	08/02/2023	COMPLETED	08/02/2023	**REF BH121/MW10**
PROJECT	ASS Assessment & GW Installation		LOGGED	AK / TR	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quarternary deposits	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.100112	RL SURFACE	0.98 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.00 m depth	LATITUDE	-32.771047	ASPECT	South	SLOPE <5%

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 ID MW10 Static Water Level
AD/V	L	Inflow	0	0.98	0.2/S/1 D 0.20 m			CH	Silty CLAY; high plasticity; grey brown; with organics; trace sand.	M (<<PL)		MW10
				0.50 0.48	0.5/S/1 D 0.50 m			SC	Sandy CLAY; high plasticity; grey.			
			1		1.0/S/1 D 1.00 m					M (=PL)		Casing. Concrete
					1.50/S/1 D 1.50 m							
			2		2.0/S/1 D 2.00 m							
					2.5/S/1 D 2.50 m					M (>PL)		
			3		3.0/S/1 D 3.00 m							Sand. Sand
					3.5/S/1 D 3.50 m							
			4	*4.00*	4.0/S/1 D 4.00 m				Hole Terminated at 4.00 m (Target depth reached)			
			5									
			6									

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	08/02/2023	COMPLETED	08/02/2023	**REF BH124/MW11**
PROJECT	ASS Assessment & GW Installation		LOGGED	AK / TR	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quarternary deposits	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.090911	RL SURFACE	1.14 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.00 m depth	LATITUDE	-32.772146	ASPECT	North	SLOPE <5%

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/V	L	Inflow	1	1.14	0.2/S/1 D 0.20 m			CI	Silty CLAY; medium plasticity; grey.	M (<PL)		ID MW11 Static Water Level
				0.50								
				0.64	0.5/S/1 D 0.50 m			SC	Sandy CLAY; medium plasticity; grey.			
			1		1.0/S/1 D 1.00 m							
				1.50								
	L-M			-0.36	1.5/S/1 D 1.50 m				Becoming pale grey with depth.			
					1.6/S/1 D 1.60 m					M (=PL)		
			2		2.0/S/1 D 2.00 m							
					2.4/S/1 D 2.40 m							
					2.5/S/1 D 2.50 m							
				3.00								
			3	-1.86	3.0/S/1 D 3.00 m			SC	Clayey SAND; fine to medium grained; brown.			
					3.5/S/1 D 3.50 m					W		
				4.00								
			4		4.0/S/1 D 4.00 m				Hole Terminated at 4.00 m (Target depth reached)			
			5									
			6									

Concrete
Casing.
Bentonite
Sand
Screen.

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

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	08/02/2023	COMPLETED	08/02/2023	**REF BH126/MW12**
PROJECT	ASS Assessment & GW Installation		LOGGED	AK / TR	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quarternary deposits	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.092219	RL SURFACE	0.94 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.00 m depth	LATITUDE	-32.765779	ASPECT	North	SLOPE <5%

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/V	L	Inflow	1	0.94	0.2/S/1 D 0.20 m			CI	Silty CLAY; medium plasticity; dark grey; with organics and fine to medium grained sand.	M (<<PL)		ID MW12 Static Water Level
				0.50 0.44	0.5/S/1 D 0.50 m			SM	Silty SAND; fine to medium grained; pale grey.	M		Concrete; Casing.; Bentonite; Sand Screen.
					1.0/S/1 D 1.00 m							
					1.4/S/1 D 1.40 m							
					1.5/S/1 D 1.50 m							
			2		2.0/S/1 D 2.00 m							
					2.5/S/1 D 2.50 m					W		
			3	*3.00* -2.06	3.0/S/1 D 3.00 m				With clay.			
					3.5/S/1 D 3.50 m							
			4	*4.00*	4.0/S/1 D 4.00 m				Hole Terminated at 4.00 m (Target depth reached)			
			5									
			6									

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Engineering Log - TEST

CLIENT	AB Rise Pty Ltd		COMMENCED	08/02/2023	COMPLETED	08/02/2023	**REF BH129/MW13**
PROJECT	ASS Assessment & GW Installation		LOGGED	AK / TR	CHECKED		Sheet 1 OF 1
SITE	Gan Gan Road + Nelson Bay Road, Anna Bay, NSW		GEOLOGY	Quarternary deposits	VEGETATION	Grass	PROJECT NO. P2208888
EQUIPMENT		4WD truck-mounted hydraulic drill rig	LONGITUDE	152.09346	RL SURFACE	0.84 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.00 m depth	LATITUDE	-32.768997	ASPECT	South	SLOPE <5%

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 ID MW13 Static Water Level
AD/V	L	Inflow	1	0.84	0.2/S/1 D 0.20 m			CI-CH	Silty CLAY; medium to high plasticity; pale grey, brown; with organics; trace sand.	M (<<PL)		MW13
					0.5/S/1 D 0.50 m							
				1.00 -0.16	1.0/S/1 D 1.00 m			SC	Sandy CLAY; medium to high plasticity; pale grey, brown.	M (<PL)		Casing. Concrete
			2	*1.50* -0.66	1.5/S/1 D 1.50 m			SM	Silty SAND; fine to medium grained; pale grey.			
					2.0/S/1 D 2.00 m							
					2.5/S/1 D 2.50 m					W		Bentonite
			3	*3.00* -2.16	3.0/S/1 D 3.00 m				Becoming dark grey.			Screen.
					3.5/S/1 D 3.50 m							Sand
			4	*4.00*	4.0/S/1 D 4.00 m				Hole Terminated at 4.00 m (Target depth reached)			
			5									
			6									

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Engineering Log - TEST

Appendix E – Slug Test Results

Single Bore Slug Test (Falling Head)

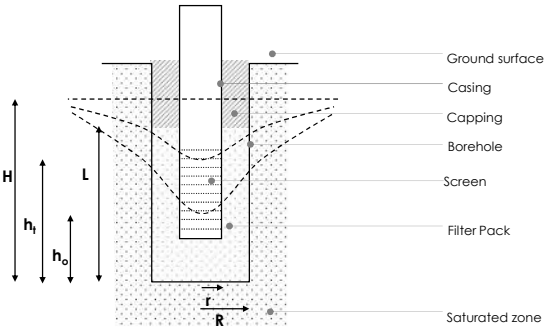
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	7/12/2022
Project Ref	P2208888	Field Testing	DS
Borehole Ref	MW01 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.780	m
h_o - Water level reading at time = 0 (depth)	3.007	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.50	m
T_o - Length of characteristic time	0.09	minutes
K_{sat} - Saturated hydraulic conductivity	6.1678	m/d



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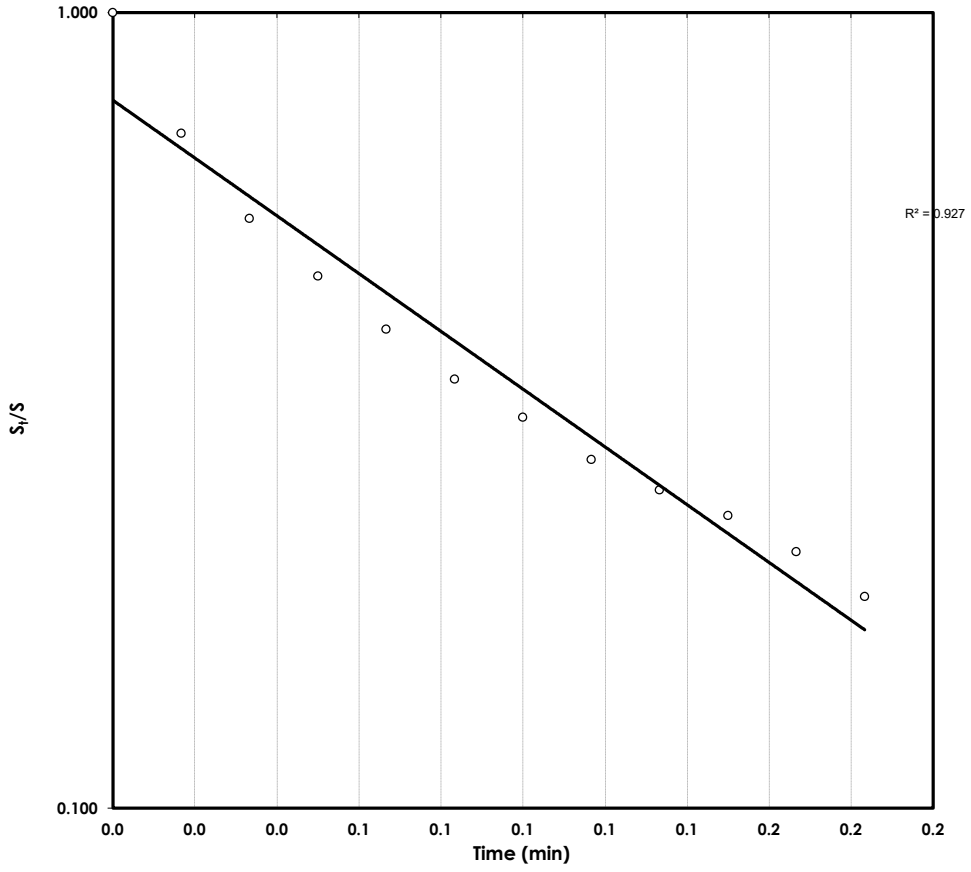

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Single Bore Slug Test (Falling Head)

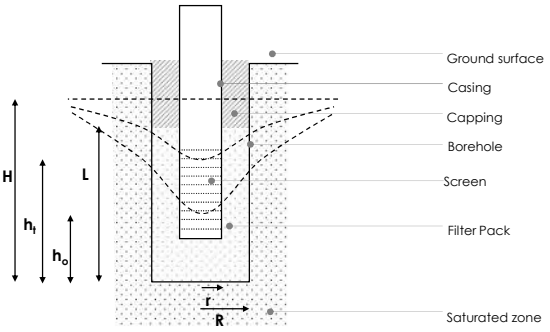
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW01 (2)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.500	m
h_o - Water level reading at time = 0 (depth)	2.722	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.50	m
T_o - Length of characteristic time	0.08	minutes
K_{sat} - Saturated hydraulic conductivity	6.5640	m/d



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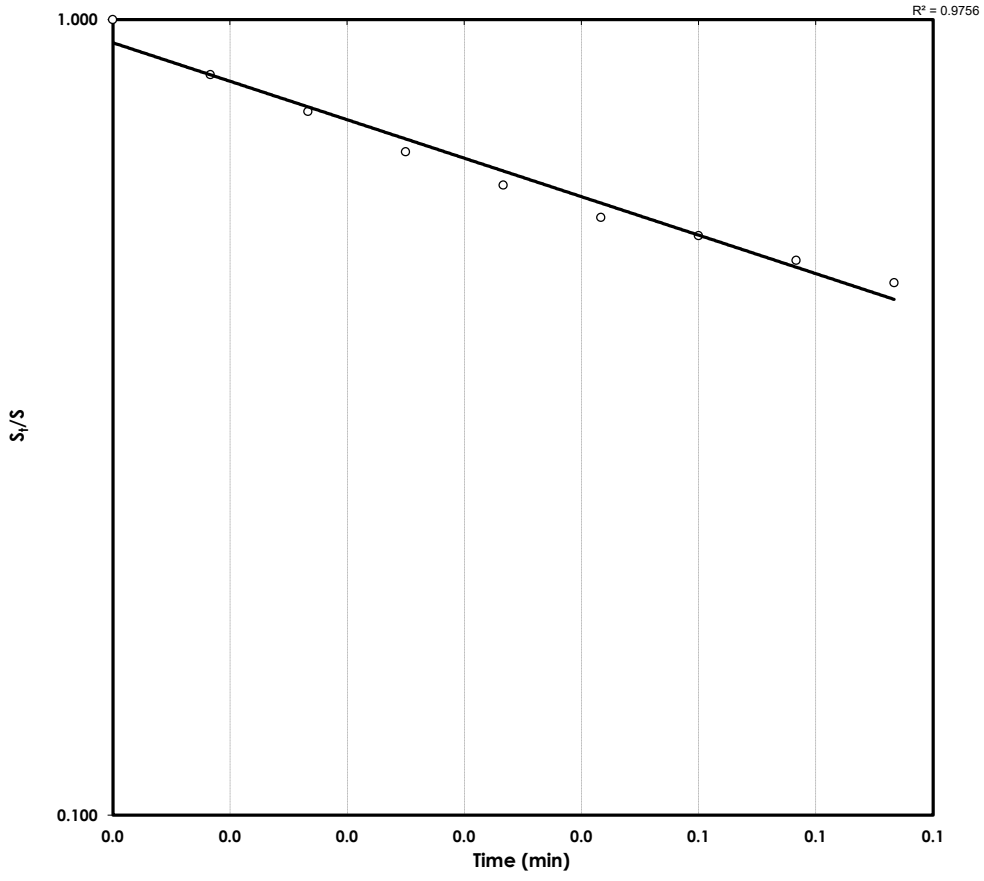

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Single Bore Slug Test (Falling Head)

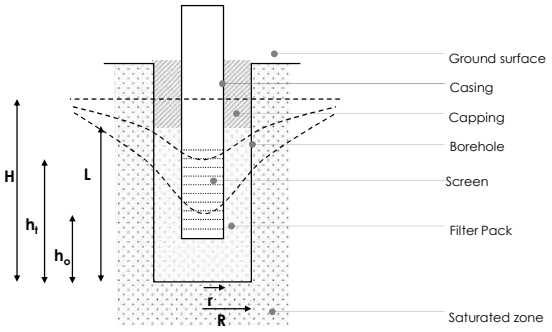
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW01 (3)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.500	m
h_o - Water level reading at time = 0 (depth)	2.814	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.50	m
T_o - Length of characteristic time	0.08	minutes
K_{sat} - Saturated hydraulic conductivity	6.5200	m/d



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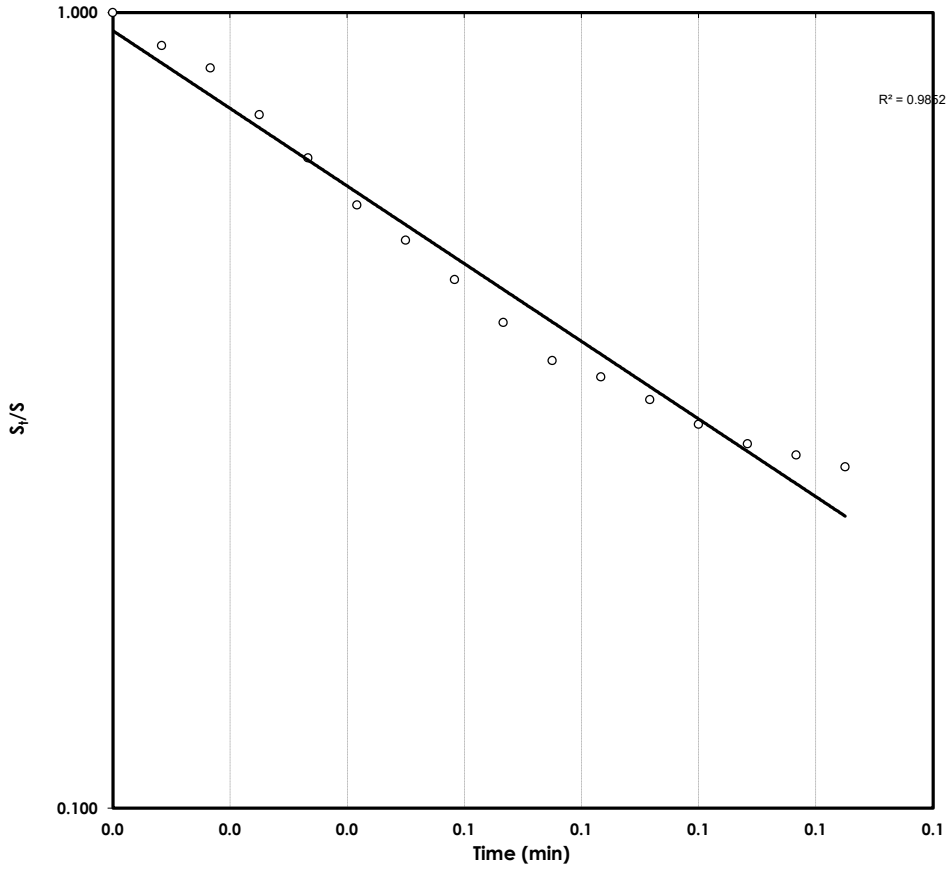

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Single Bore Slug Test (Falling Head)

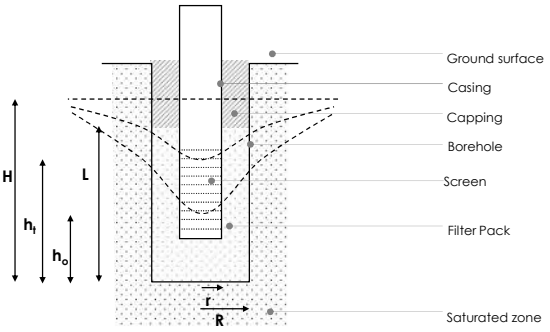
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	7/12/2022
Project Ref	P2208888	Field Testing	DS
Borehole Ref	MW02 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.480	m
h_o - Water level reading at time = 0 (depth)	3.866	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.30	m
T_o - Length of characteristic time	0.03	minutes
K_{sat} - Saturated hydraulic conductivity	22.3636	m/d



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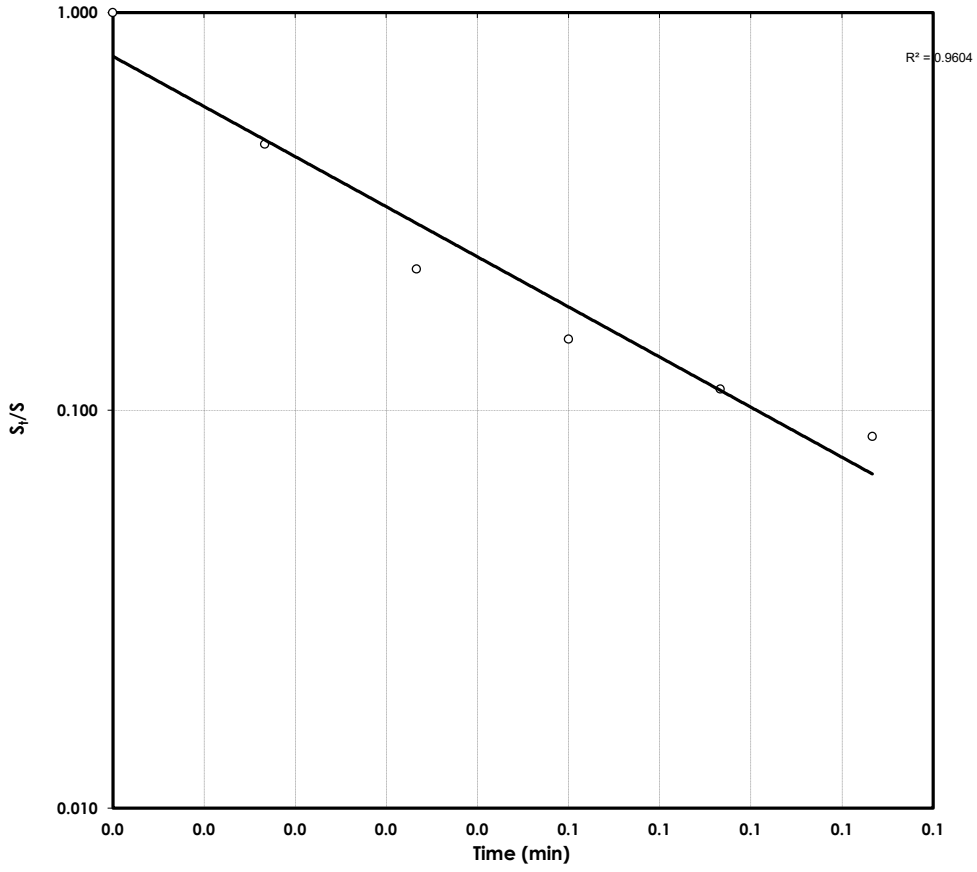

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Single Bore Slug Test (Falling Head)

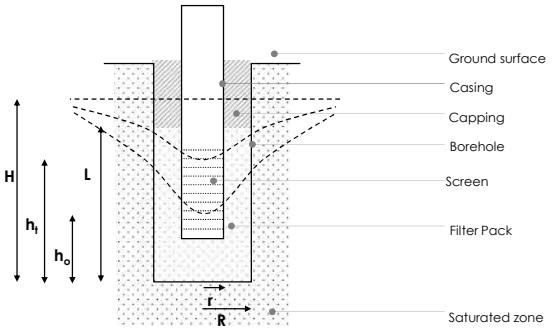
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	7/12/2022
Project Ref	P2208888	Field Testing	DS
Borehole Ref	MW03 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	4.160	m
h_o - Water level reading at time = 0 (depth)	4.846	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.30	m
T_o - Length of characteristic time	0.11	minutes
K_{sat} - Saturated hydraulic conductivity	5.1353	m/d



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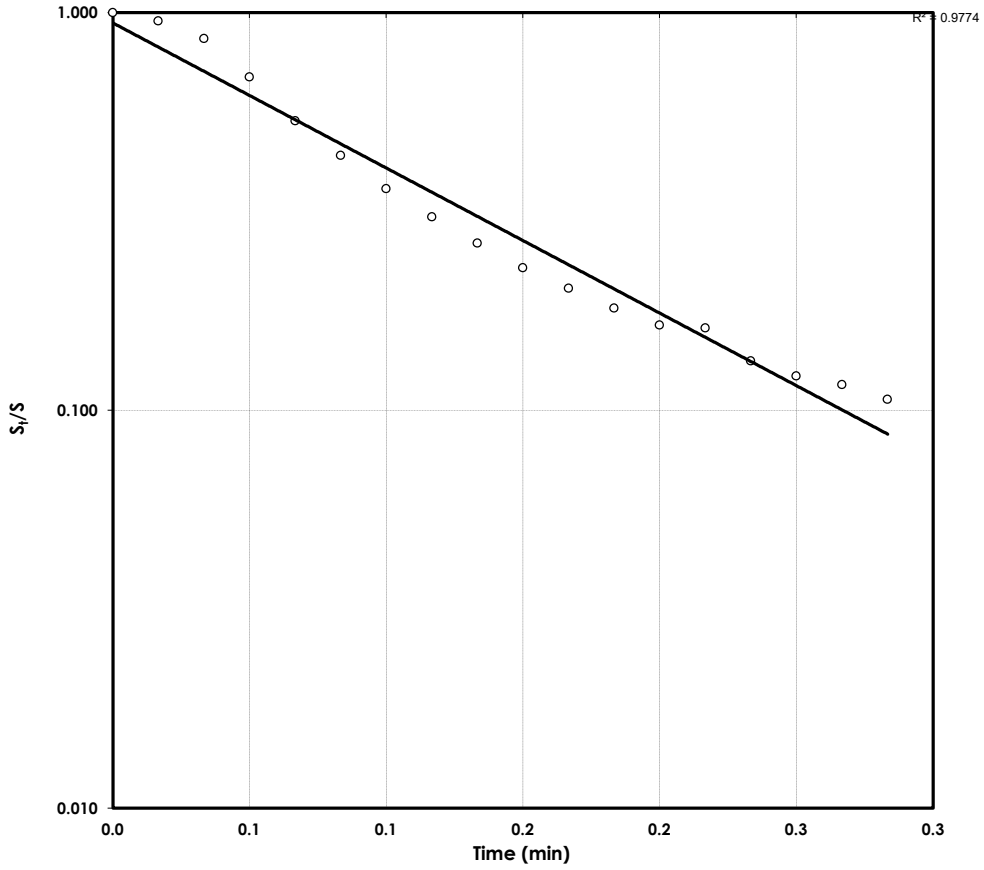

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Single Bore Slug Test (Rising Head)

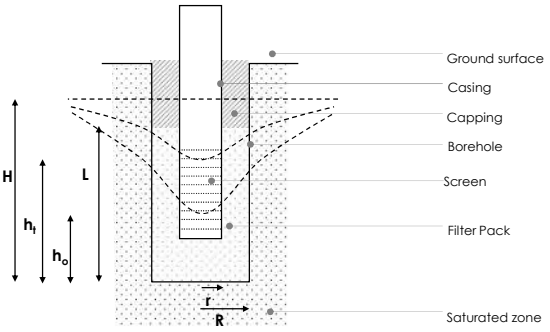
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW03 (2)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.700	m
h_o - Water level reading at time = 0 (depth)	2.043	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.30	m
T_o - Length of characteristic time	0.09	minutes
K_{sat} - Saturated hydraulic conductivity	6.0906	m/d



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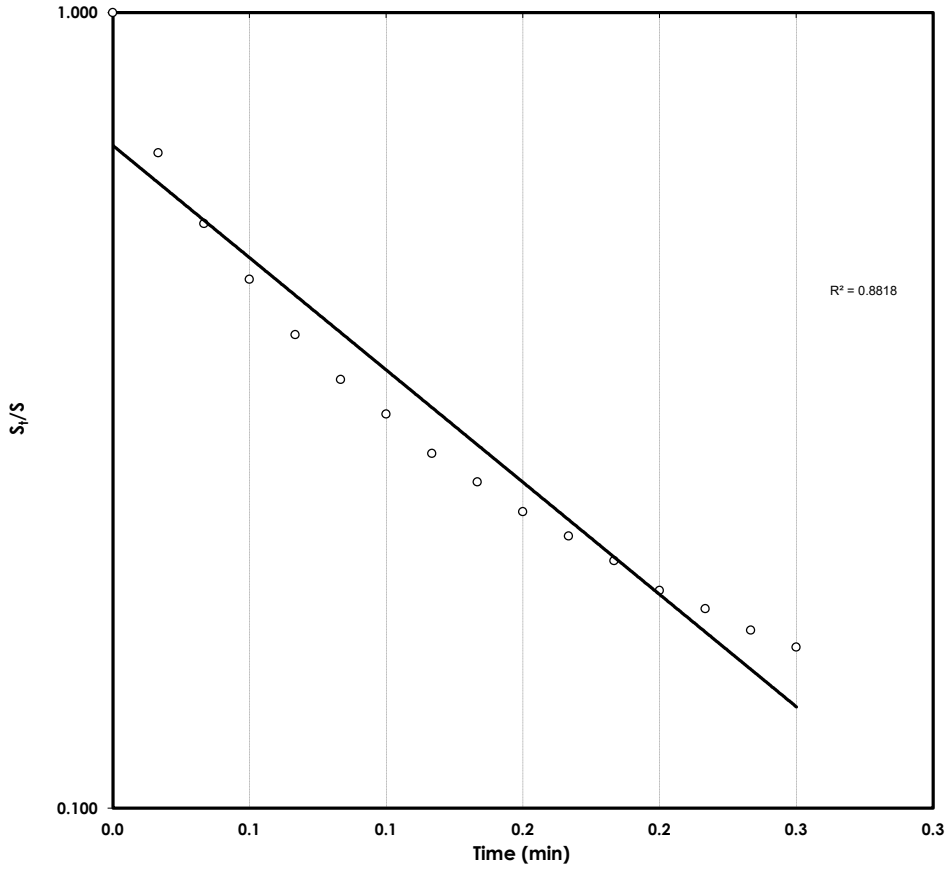

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Single Bore Slug Test (Rising Head)

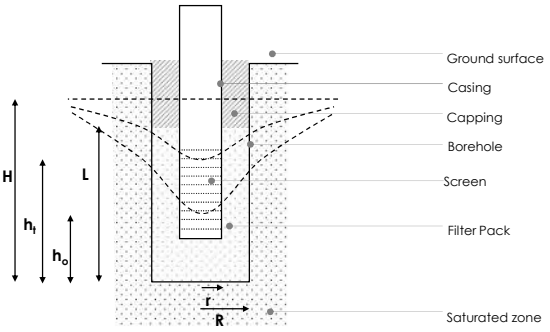
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW03 (3)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.460	m
h_o - Water level reading at time = 0 (depth)	4.056	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.30	m
T_o - Length of characteristic time	0.08	minutes
K_{sat} - Saturated hydraulic conductivity	6.9488	m/d



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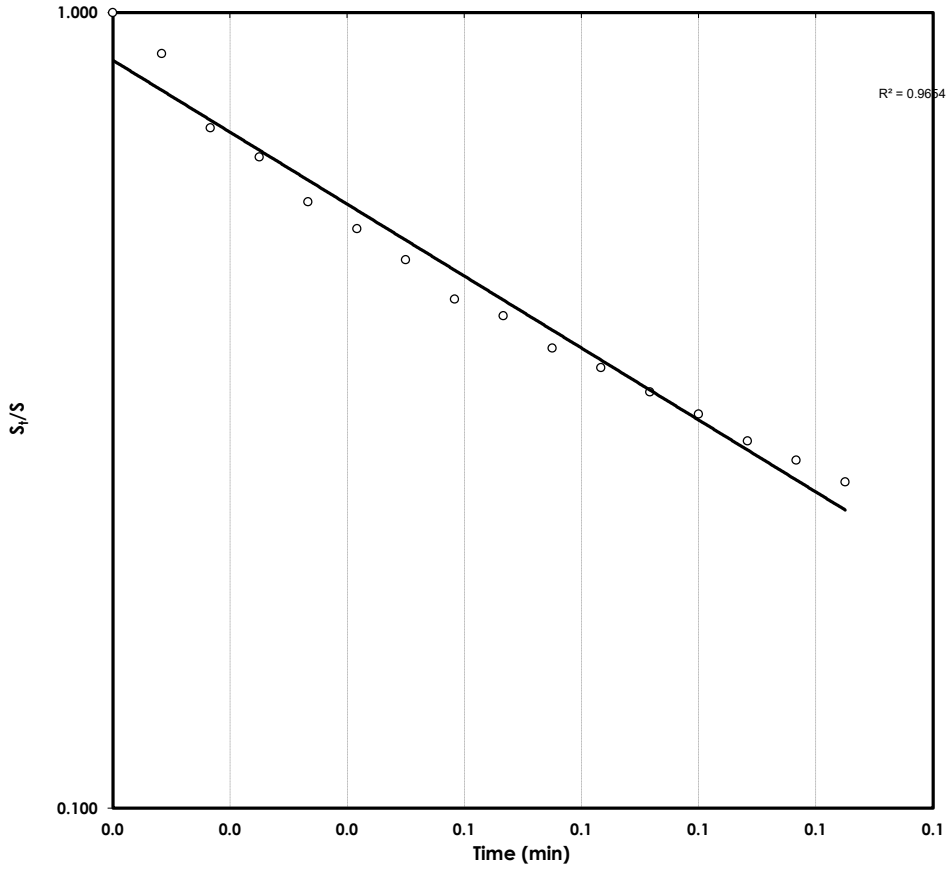

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Single Bore Slug Test (Falling Head)

Method ST-13 Revised 7.3.2007

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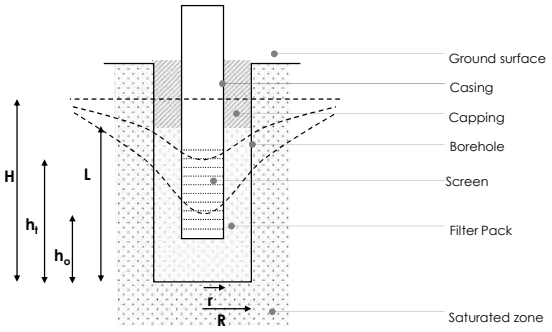
PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	7/12/2022
Project Ref	P2208888	Field Testing	DS
Borehole Ref	MW04 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.270	m
h_o - Water level reading at time = 0 (depth)	3.651	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.20	m
T_o - Length of characteristic time	0.03	minutes
K_{sat} - Saturated hydraulic conductivity	20.3995	m/d



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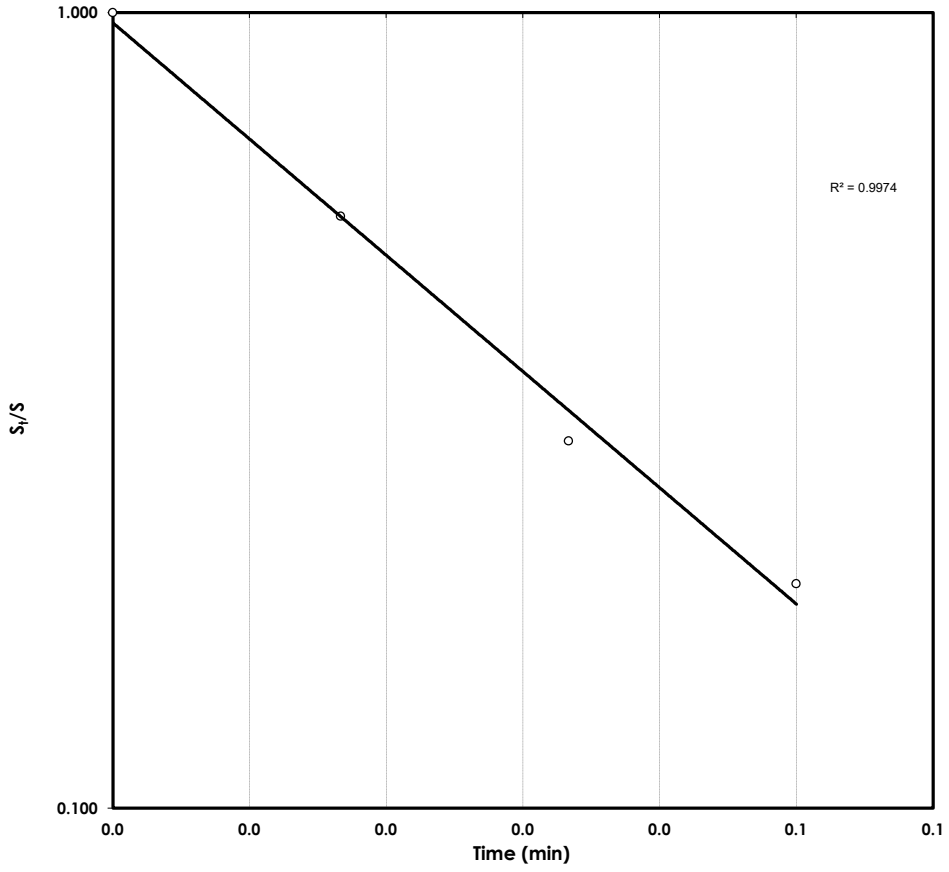

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Single Bore Slug Test (Rising Head)

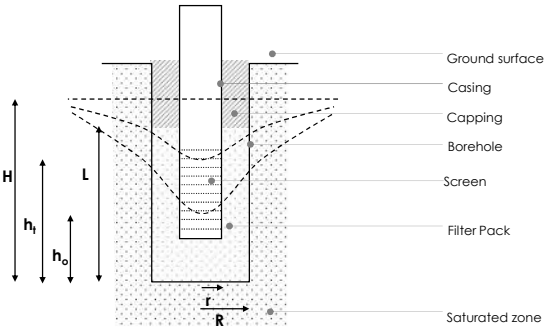
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW04 (2)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.590	m
h_o - Water level reading at time = 0 (depth)	2.466	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.20	m
T_o - Length of characteristic time	0.02	minutes
K_{sat} - Saturated hydraulic conductivity	26.8609	m/d



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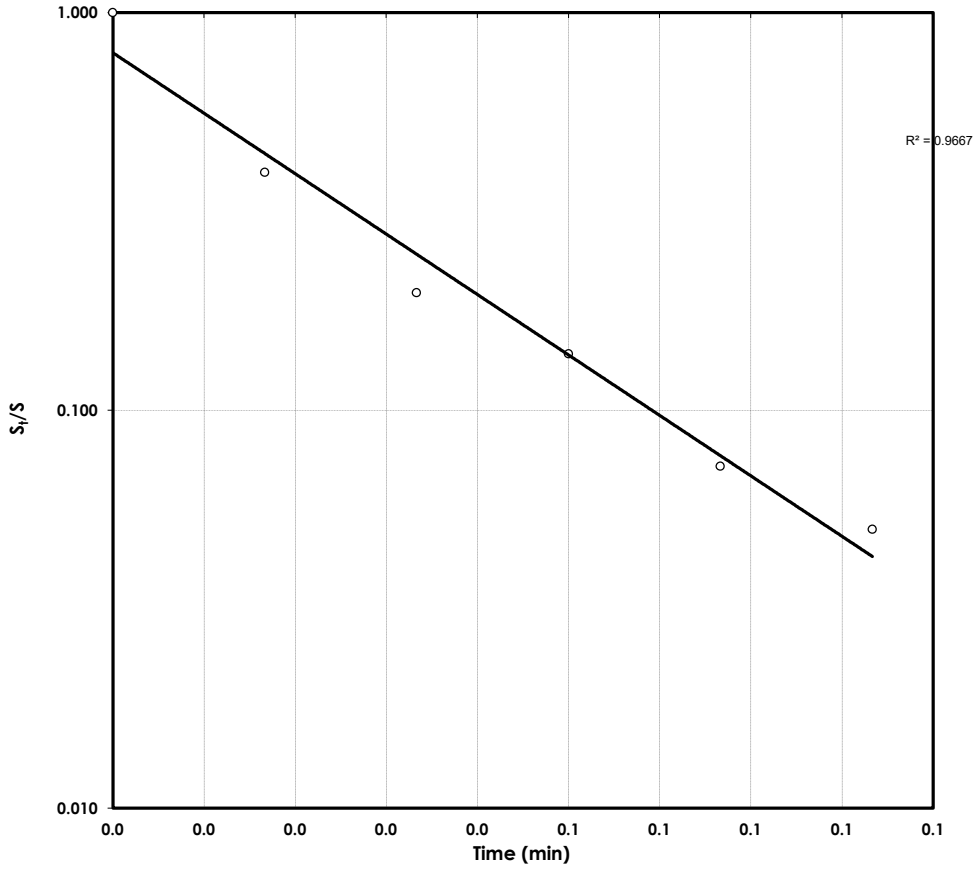

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Single Bore Slug Test (Rising Head)

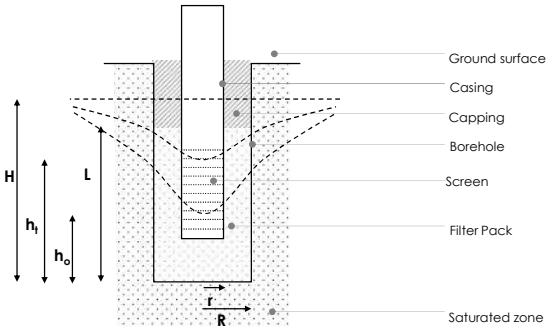
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW04 (3)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.990	m
h_o - Water level reading at time = 0 (depth)	3.087	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.20	m
T_o - Length of characteristic time	0.03	minutes
K_{sat} - Saturated hydraulic conductivity	18.8262	m/d



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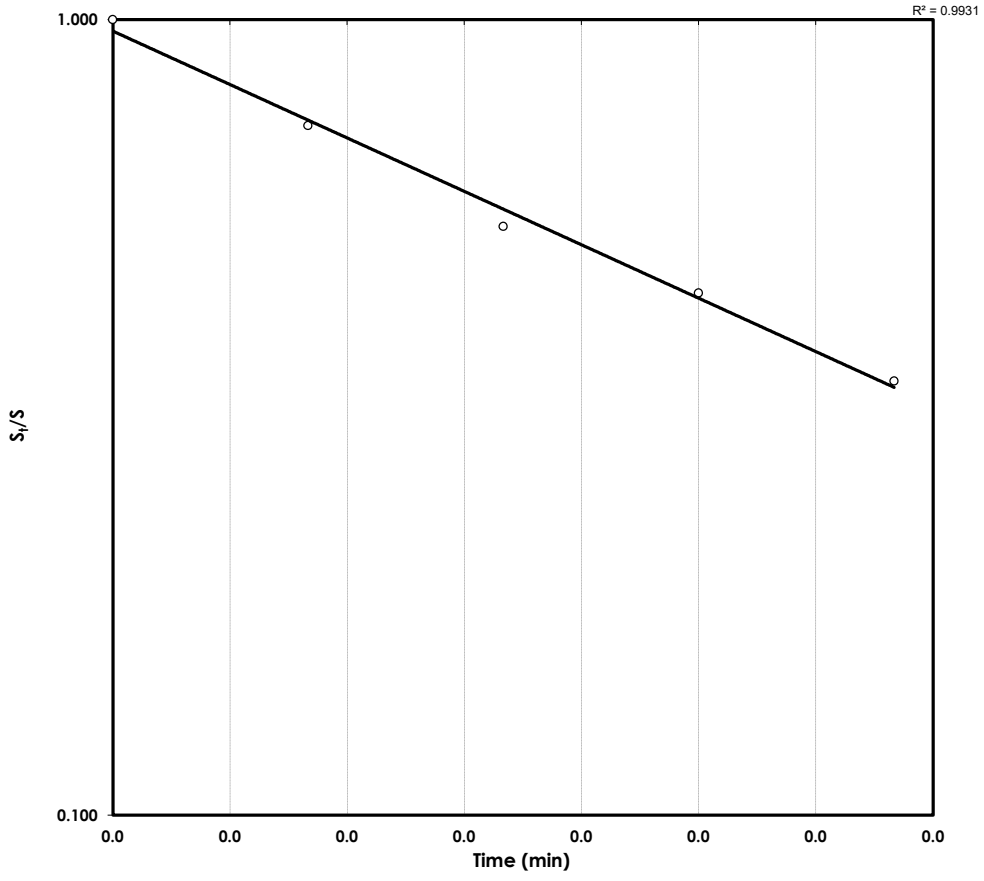

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Single Bore Slug Test (Falling Head)

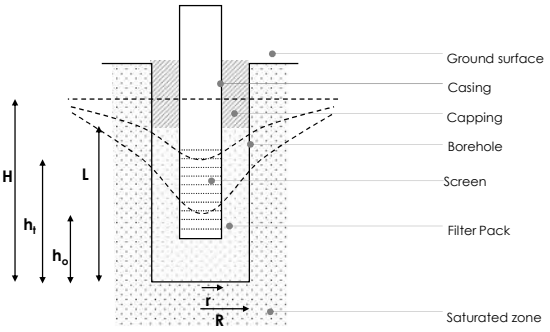
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	7/12/2022
Project Ref	P2208888	Field Testing	DS
Borehole Ref	MW05 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.380	m
h_o - Water level reading at time = 0 (depth)	4.359	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.40	m
T_o - Length of characteristic time	0.07	minutes
K_{sat} - Saturated hydraulic conductivity	7.8315	m/d



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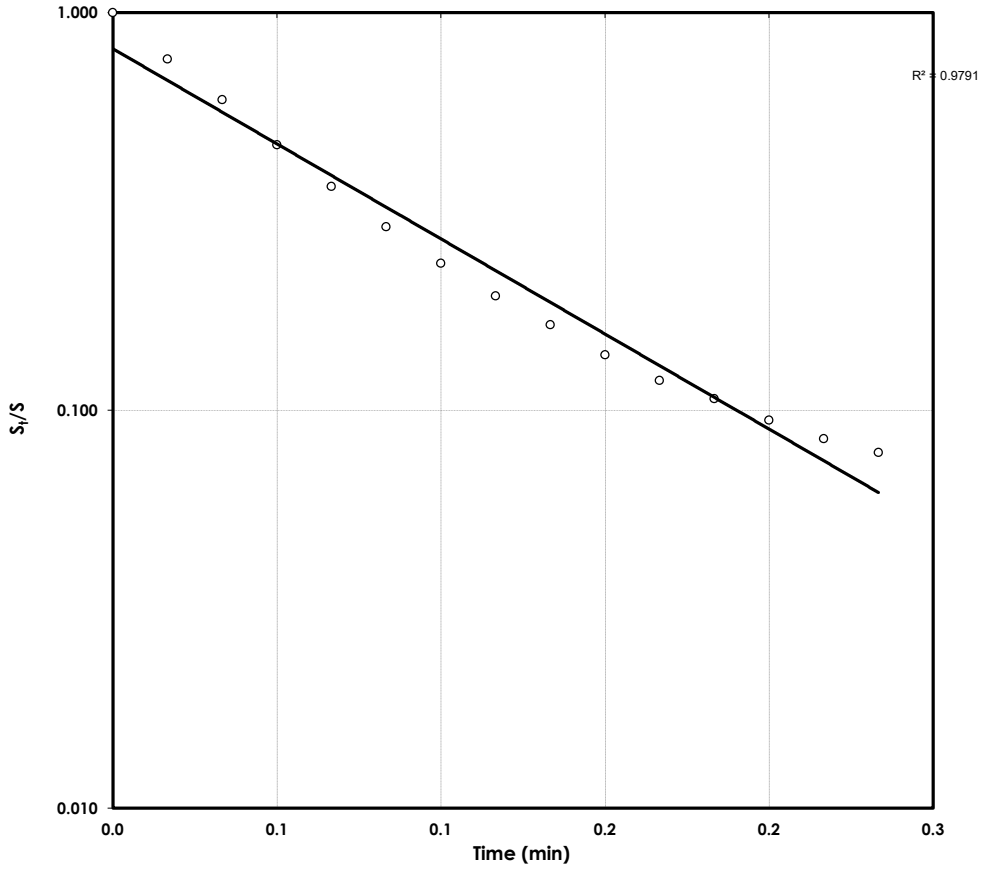

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Single Bore Slug Test (Rising Head)

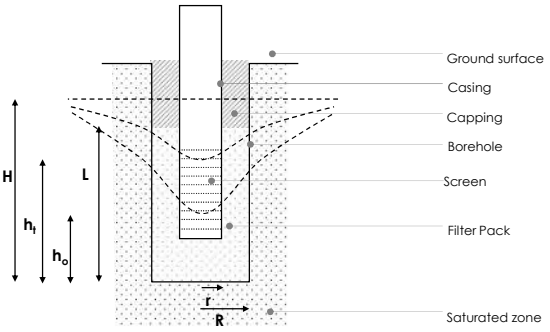
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW05 (2)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.420	m
h_o - Water level reading at time = 0 (depth)	2.805	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.40	m
T_o - Length of characteristic time	0.07	minutes
K_{sat} - Saturated hydraulic conductivity	8.1452	m/d



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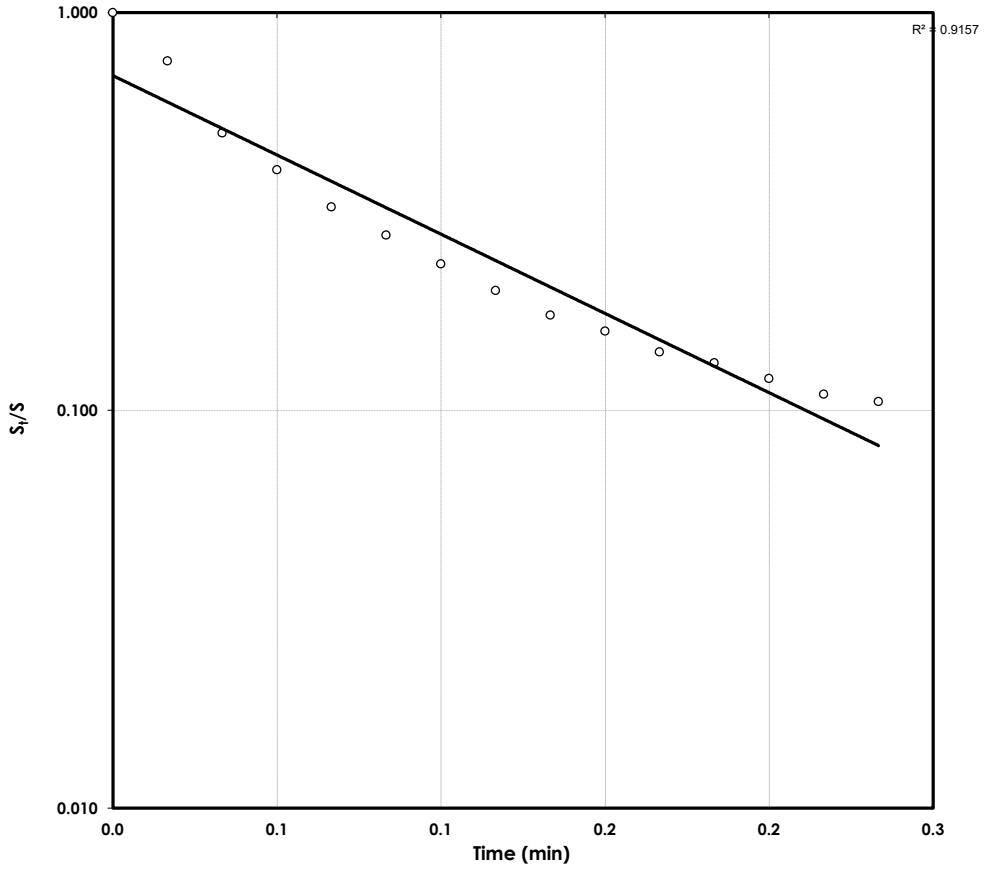

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Single Bore Slug Test (Falling Head)

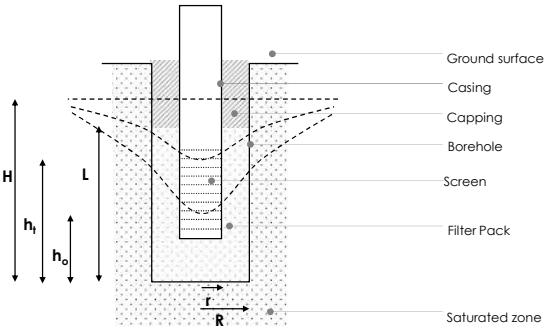
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	7/12/2022
Project Ref	P2208888	Field Testing	DS
Borehole Ref	MW06 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.540	m
h_o - Water level reading at time = 0 (depth)	3.902	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.10	m
T_o - Length of characteristic time	0.10	minutes
K_{sat} - Saturated hydraulic conductivity	5.9575	m/d



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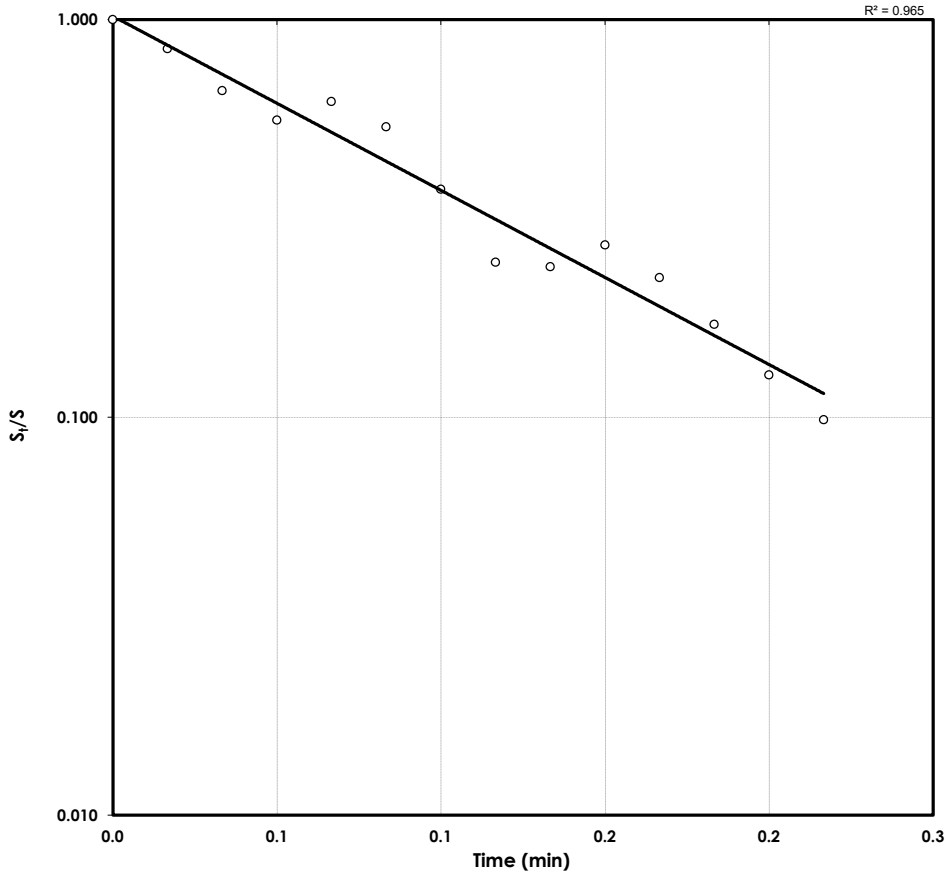

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Single Bore Slug Test (Falling Head)

Method ST-13 Revised 7.3.2007

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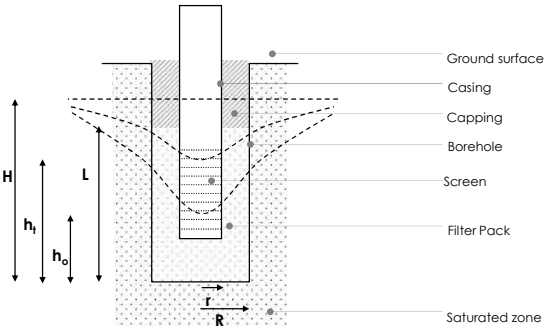
PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW06 (2)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.850	m
h_o - Water level reading at time = 0 (depth)	3.081	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.10	m
T_o - Length of characteristic time	0.08	minutes
K_{sat} - Saturated hydraulic conductivity	7.0722	m/d



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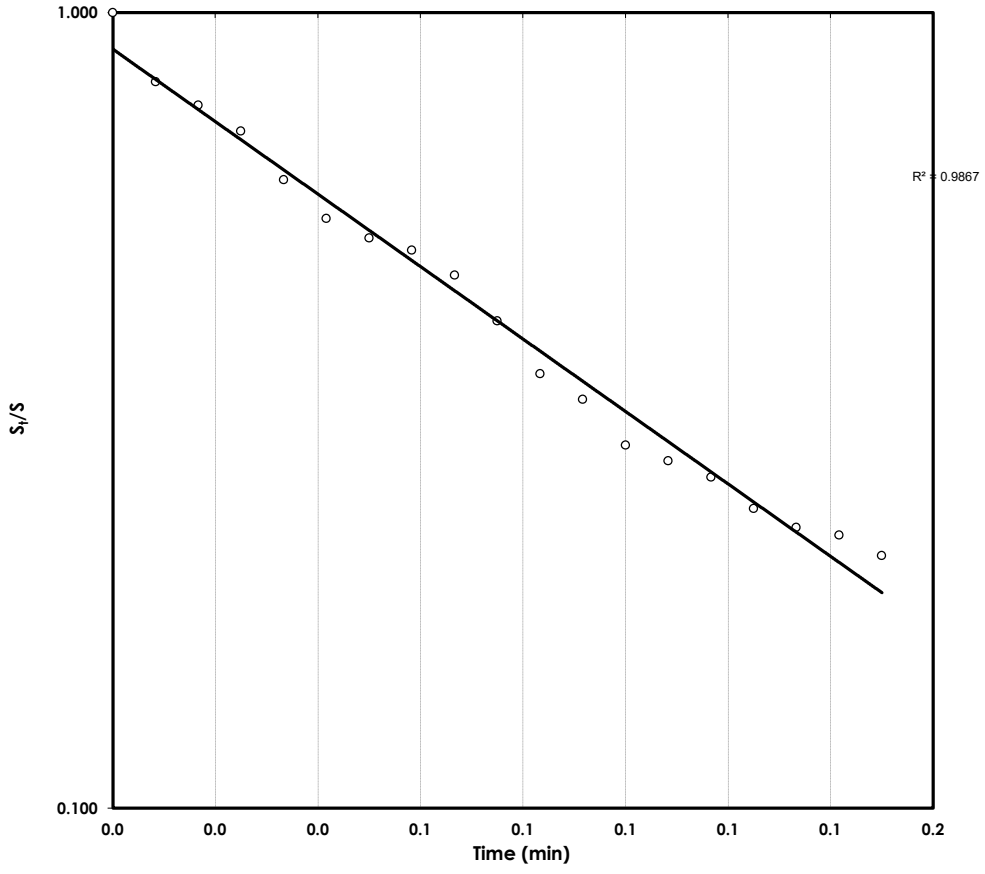

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Single Bore Slug Test (Falling Head)

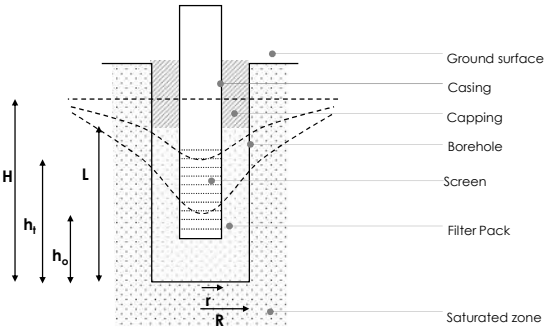
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW06 (3)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.850	m
h_o - Water level reading at time = 0 (depth)	3.123	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.10	m
T_o - Length of characteristic time	0.09	minutes
K_{sat} - Saturated hydraulic conductivity	6.8393	m/d



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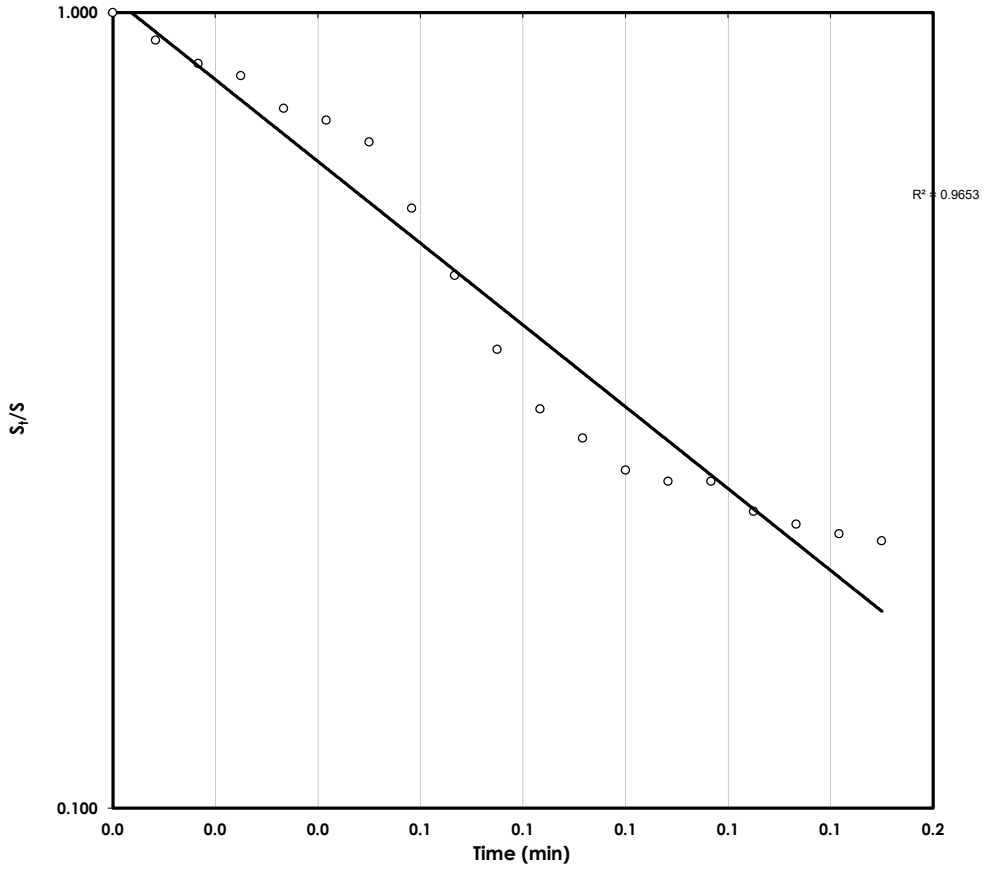

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Single Bore Slug Test (Falling Head)

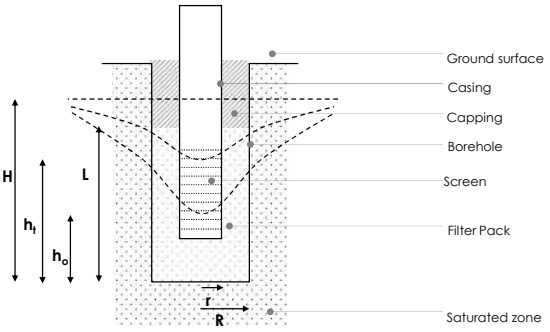
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	7/12/2022
Project Ref	P2208888	Field Testing	DS
Borehole Ref	MW07 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	1.680	m
h_o - Water level reading at time = 0 (depth)	1.838	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.10	m
T_o - Length of characteristic time	0.33	minutes
K_{sat} - Saturated hydraulic conductivity	1.8290	m/d



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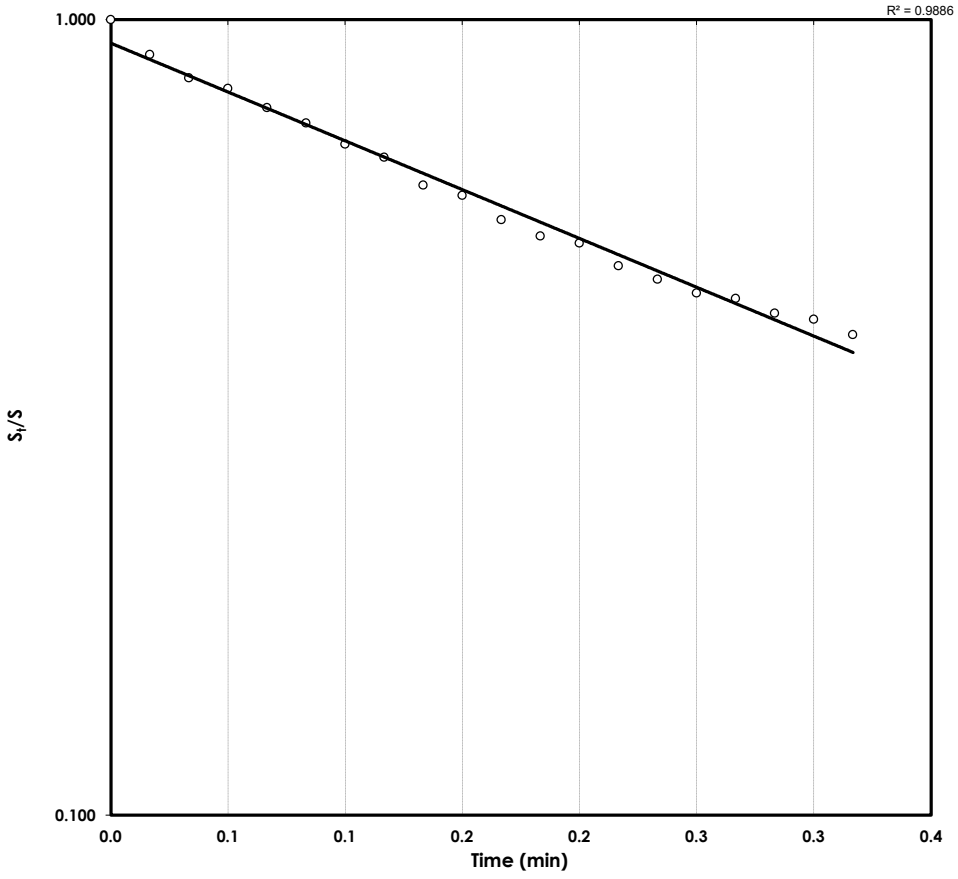

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Single Bore Slug Test (Falling Head)

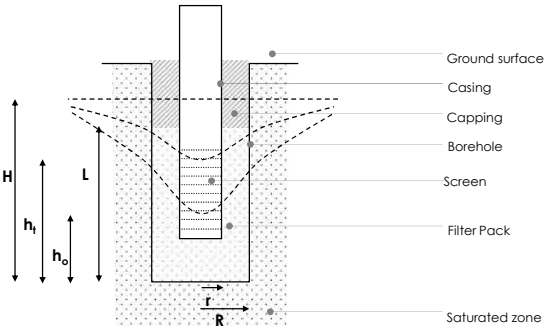
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW07 (2)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	0.830	m
h_o - Water level reading at time = 0 (depth)	1.241	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.10	m
T_o - Length of characteristic time	0.13	minutes
K_{sat} - Saturated hydraulic conductivity	4.6352	m/d



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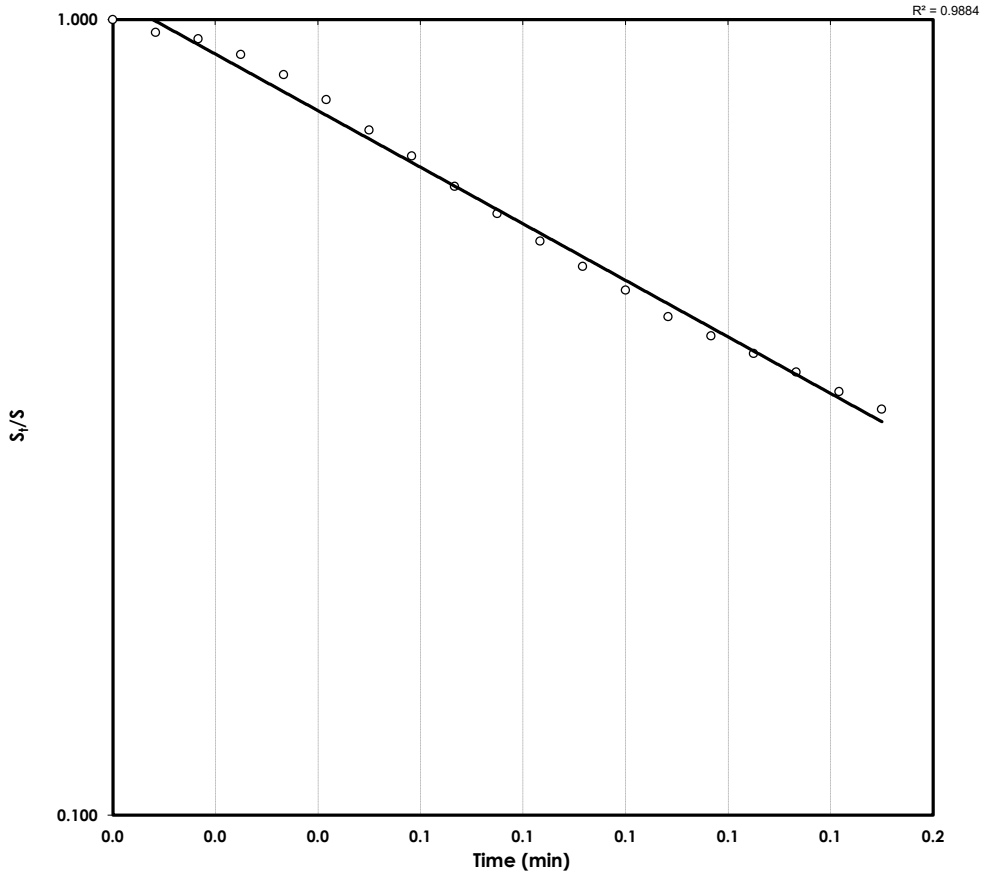

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Single Bore Slug Test (Falling Head)

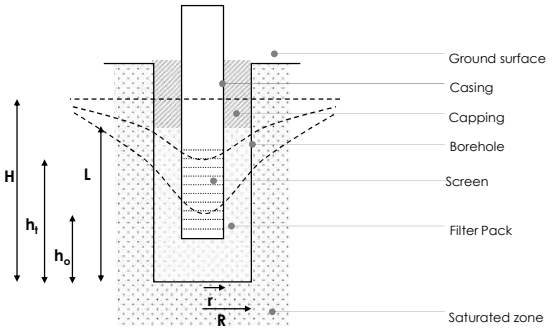
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW07 (3)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	0.830	m
h_o - Water level reading at time = 0 (depth)	1.099	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	3.10	m
T_o - Length of characteristic time	0.13	minutes
K_{sat} - Saturated hydraulic conductivity	4.5402	m/d



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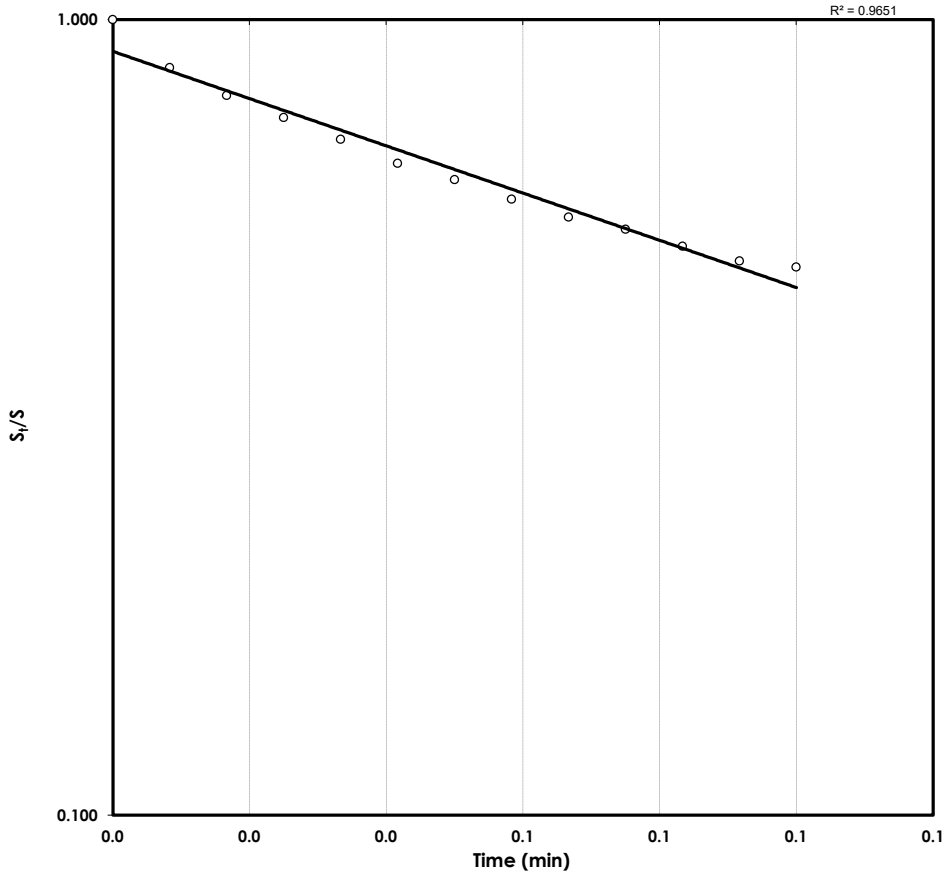

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Single Bore Slug Test (Falling Head)

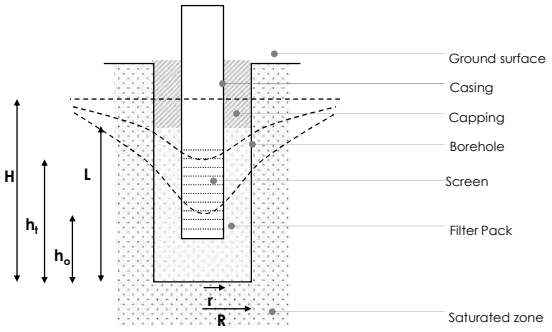
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW08 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.730	m
h_o - Water level reading at time = 0 (depth)	0.411	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	165.14	minutes
K_{sat} - Saturated hydraulic conductivity	0.0062	m/d



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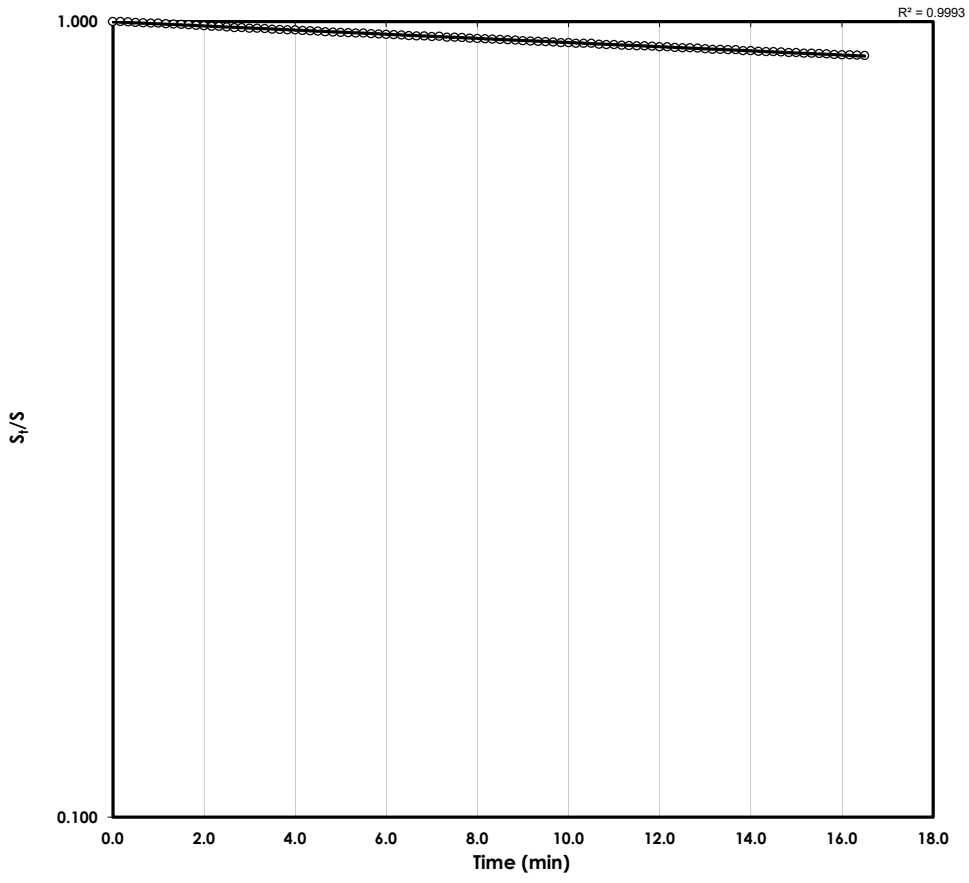

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Single Bore Slug Test (Falling Head)

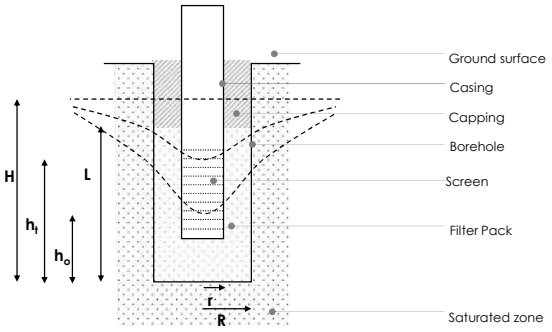
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW08 (2)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.570	m
h_o - Water level reading at time = 0 (depth)	0.170	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	157.35	minutes
K_{sat} - Saturated hydraulic conductivity	0.0065	m/d



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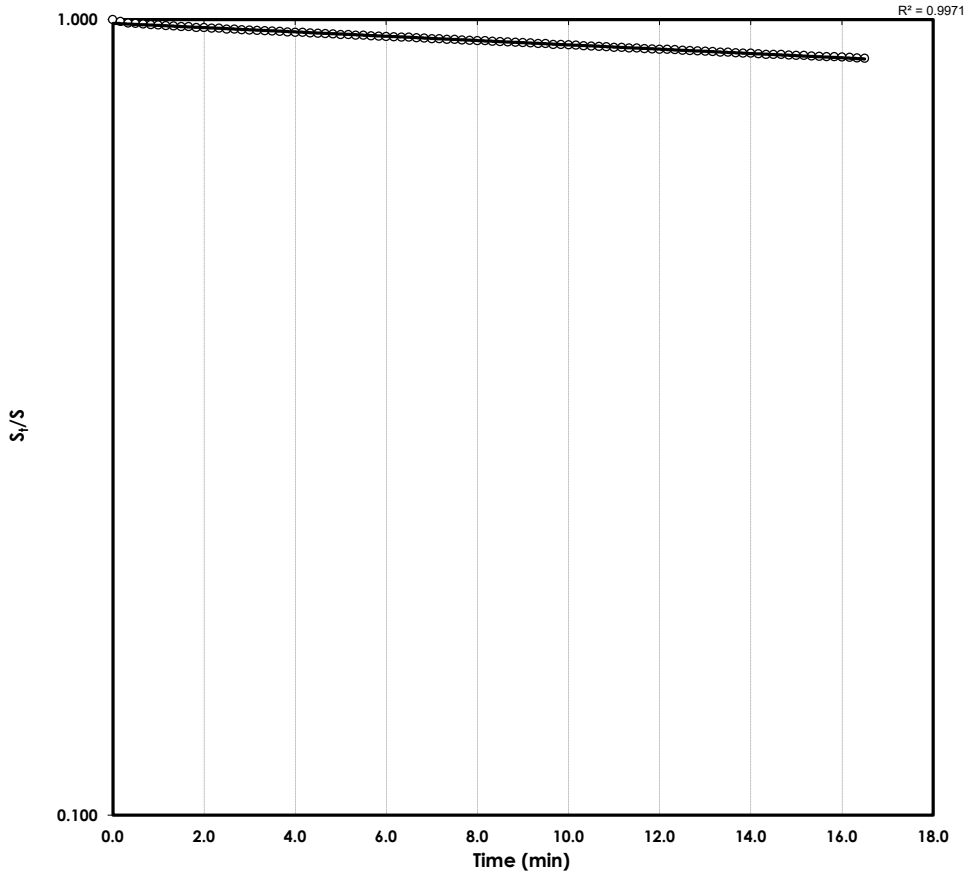

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Single Bore Slug Test (Falling Head)

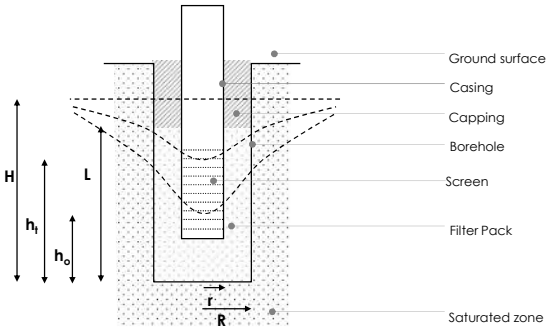
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW09 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.870	m
h_o - Water level reading at time = 0 (depth)	1.224	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	13.25	minutes
K_{sat} - Saturated hydraulic conductivity	0.0770	m/d



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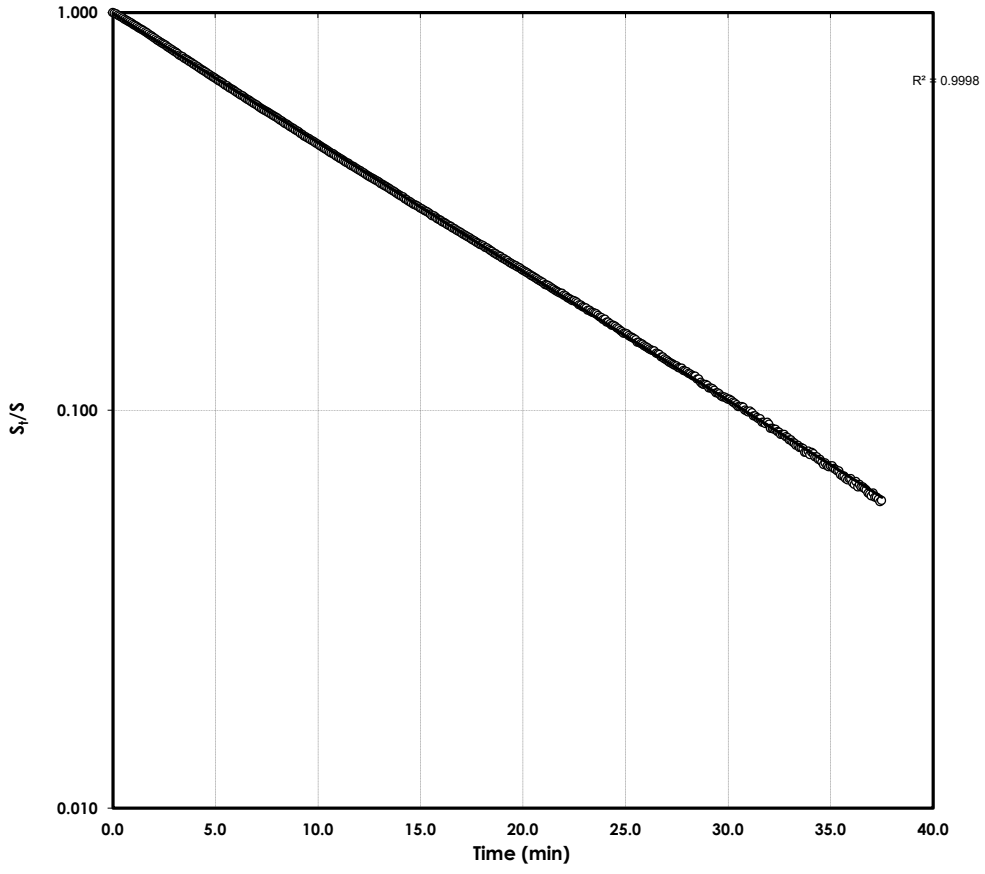

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Single Bore Slug Test (Falling Head)

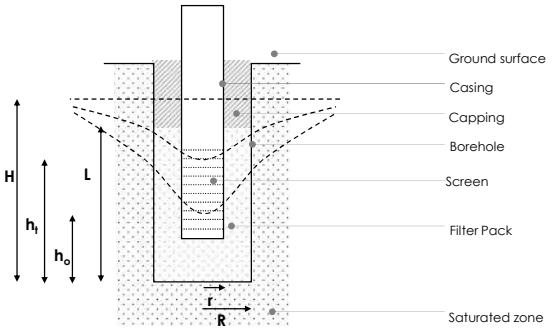
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW09 (2)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.830	m
h_o - Water level reading at time = 0 (depth)	0.651	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	14.15	minutes
K_{sat} - Saturated hydraulic conductivity	0.0721	m/d



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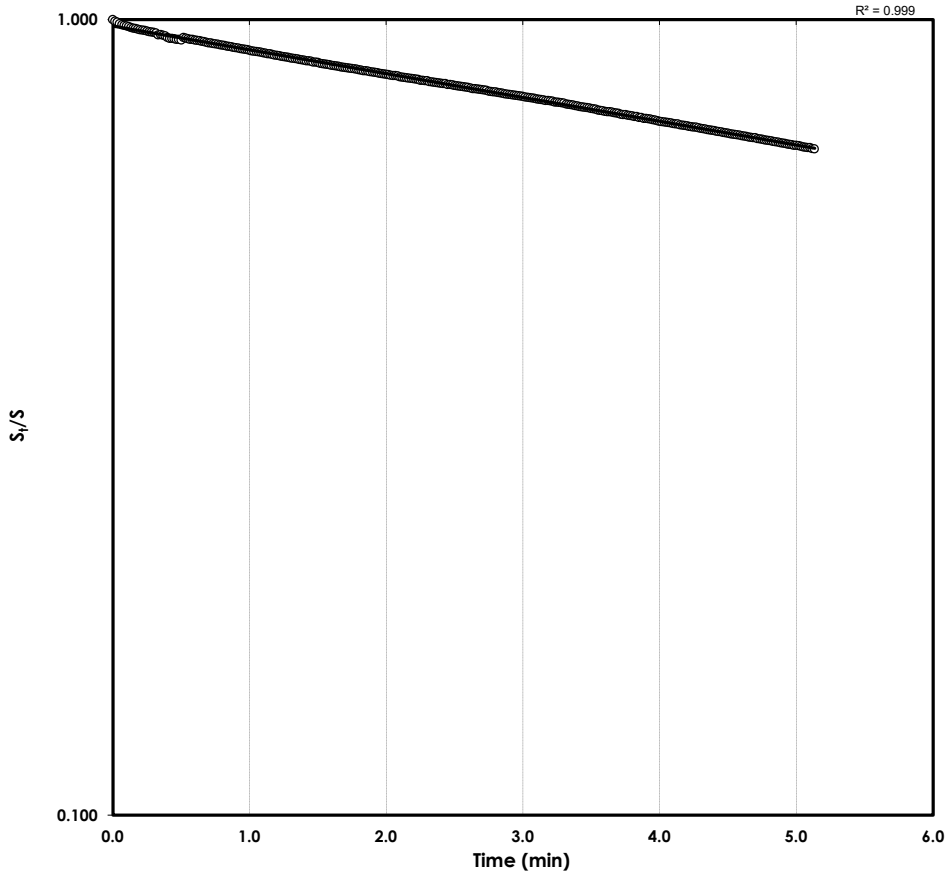

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Single Bore Slug Test (Falling Head)

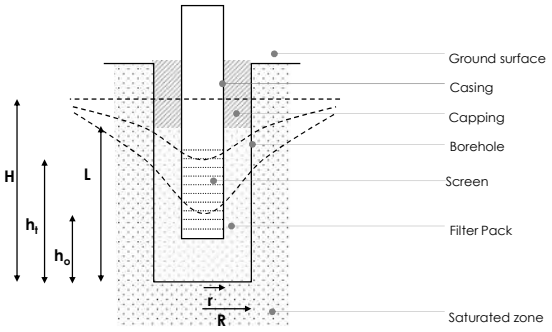
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW10 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.060	m
h_o - Water level reading at time = 0 (depth)	0.445	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	0.76	minutes
K_{sat} - Saturated hydraulic conductivity	1.3371	m/d



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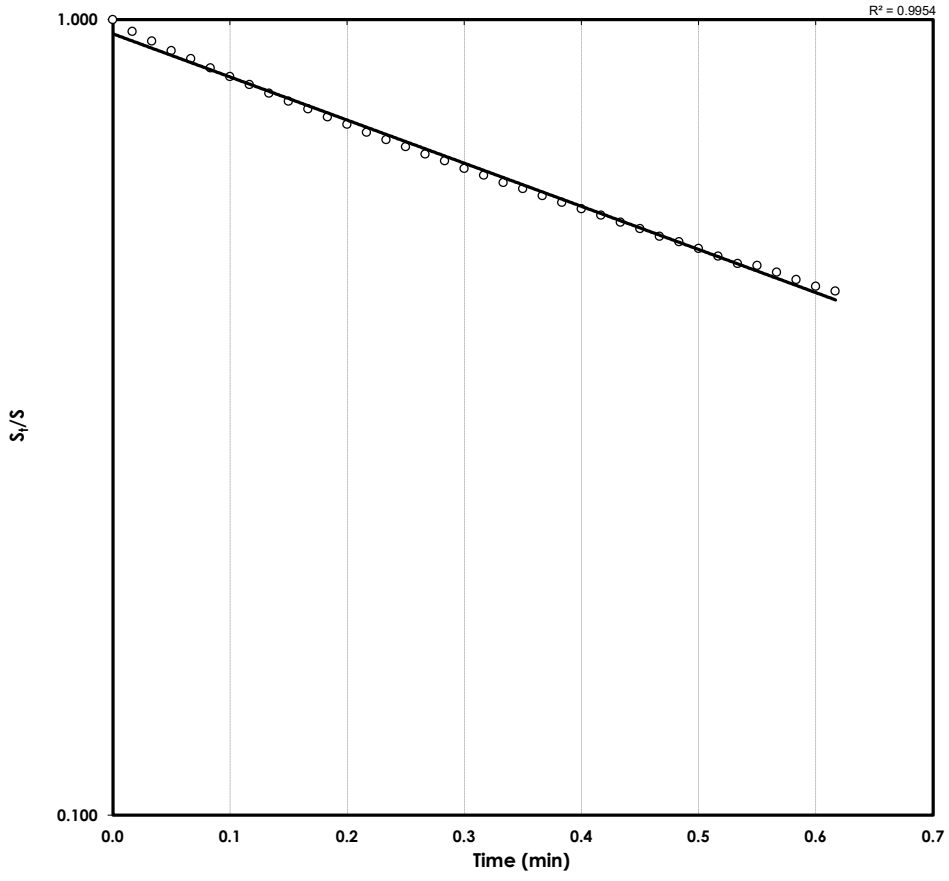

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Single Bore Slug Test (Falling Head)

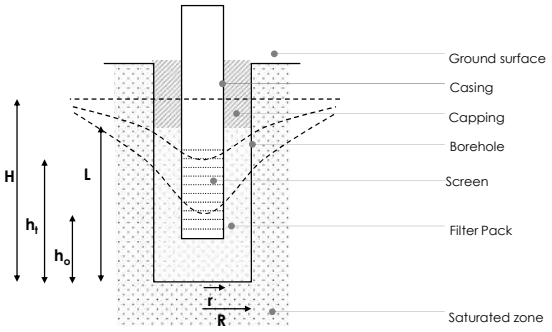
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW10 (2)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.060	m
h_o - Water level reading at time = 0 (depth)	0.166	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	0.79	minutes
K_{sat} - Saturated hydraulic conductivity	1.2956	m/d



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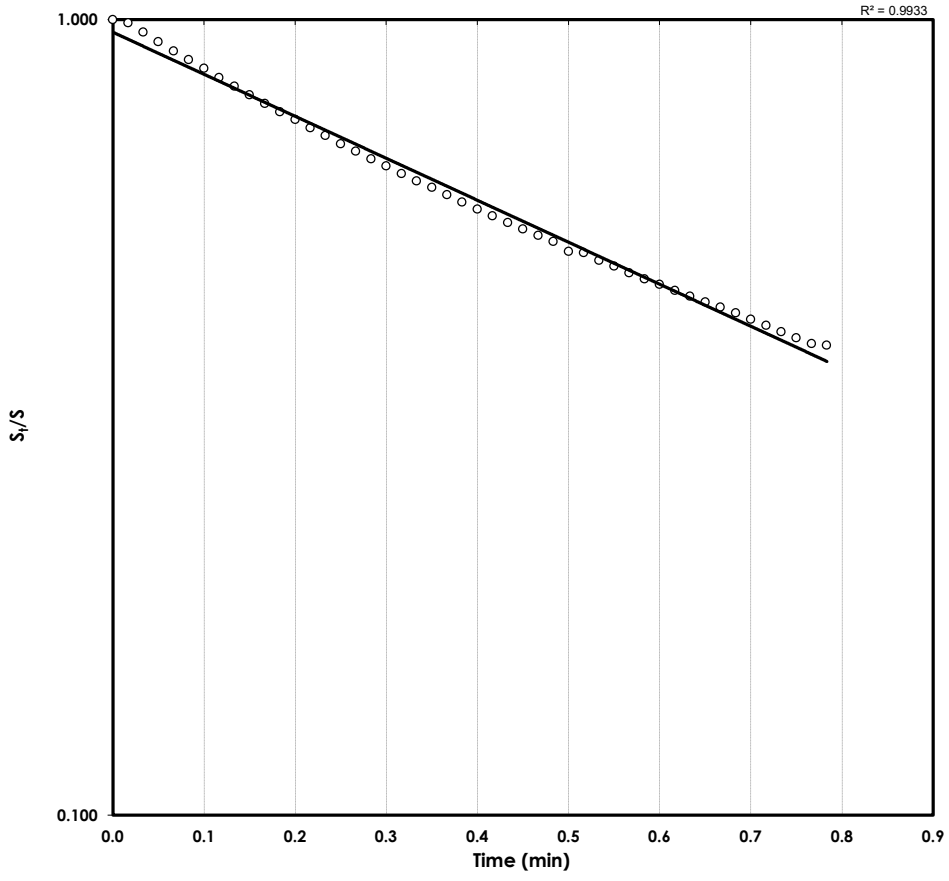

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Single Bore Slug Test (Falling Head)

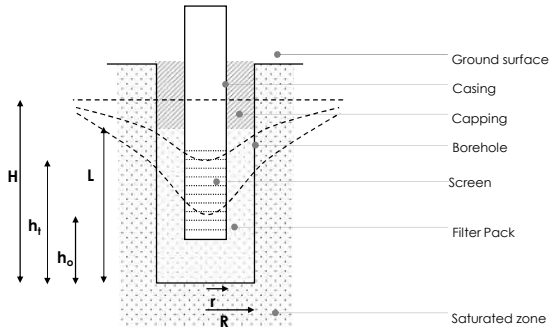
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW11 (1)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.920	m
h_o - Water level reading at time = 0 (depth)	3.321	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	0.10	minutes
K_{sat} - Saturated hydraulic conductivity	10.5052	m/d



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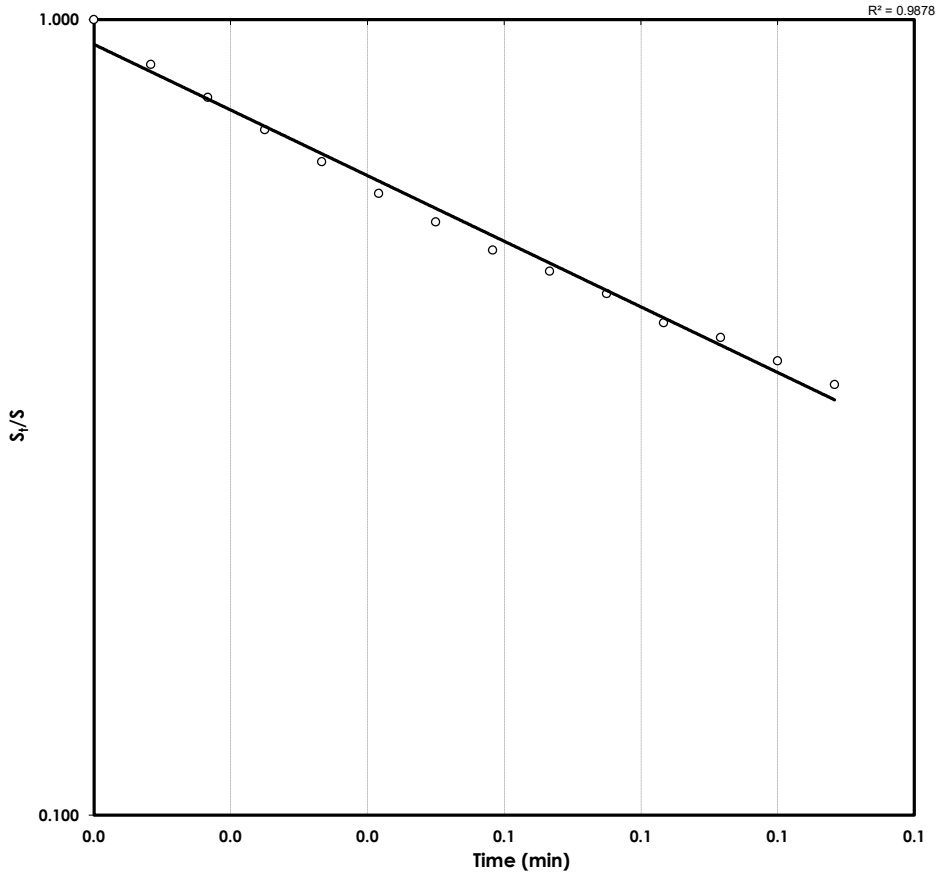

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Single Bore Slug Test (Falling Head)

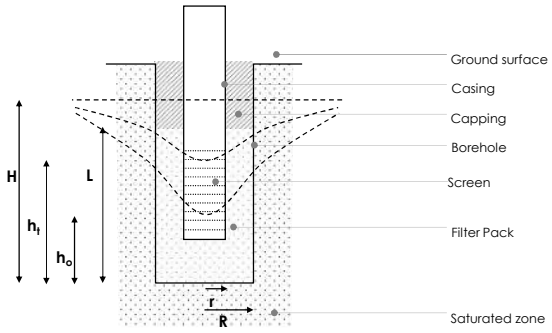
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	26/11/2024
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW11 (2)	Data Analysis	BTM
Method	Hvorslev (1981)	Reviewed	DS

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.920	m
h_o - Water level reading at time = 0 (depth)	3.339	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	0.10	minutes
K_{sat} - Saturated hydraulic conductivity	10.0354	m/d



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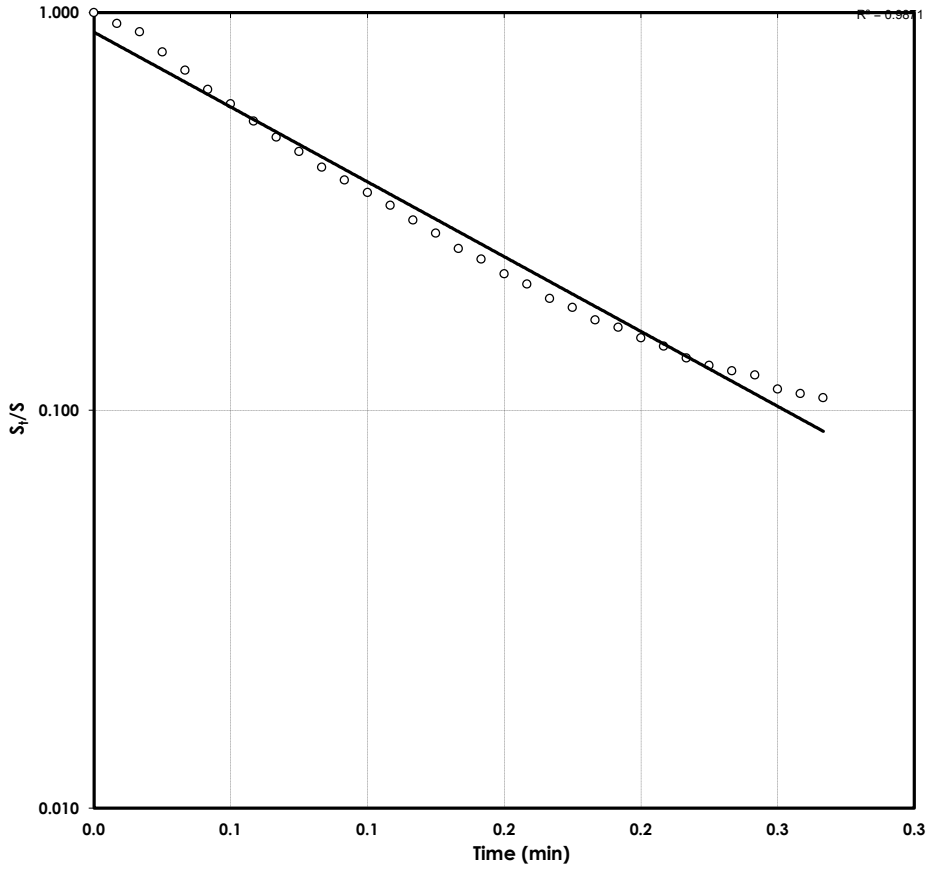

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Single Bore Slug Test (Falling Head)

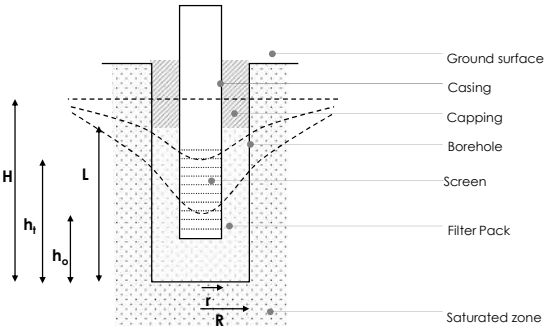
Method ST-13 Revised 7.3.2007

PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW12 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.300	m
h_o - Water level reading at time = 0 (depth)	1.348	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	0.15	minutes
K_{sat} - Saturated hydraulic conductivity	6.8116	m/d



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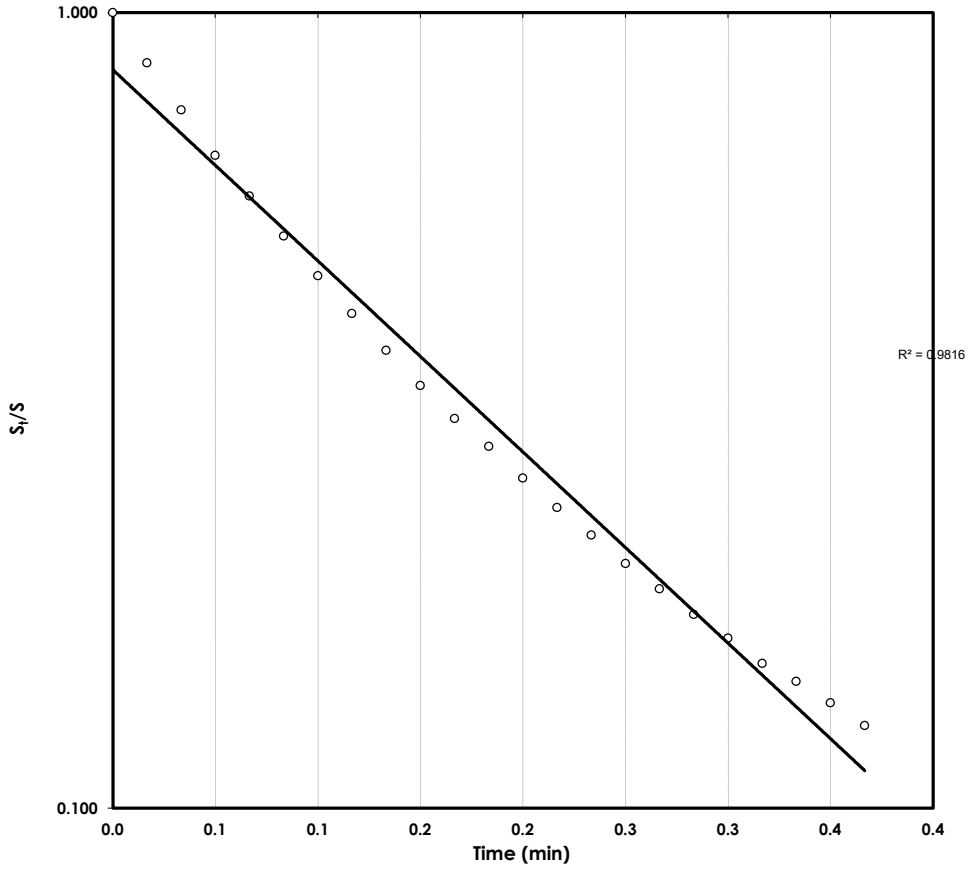

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Method ST-13 Revised 7.3.2007

PROJECT DETAILS

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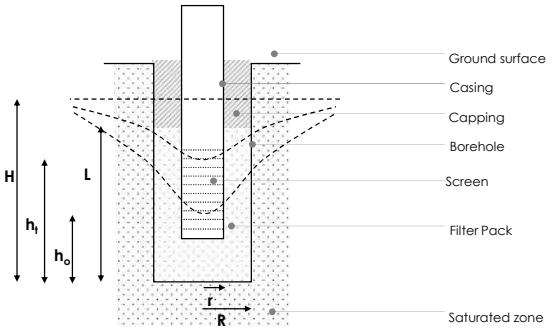
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW12 (2)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	2.300	m
h_o - Water level reading at time = 0 (depth)	1.564	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.50	m
T_o - Length of characteristic time	0.14	minutes
K_{sat} - Saturated hydraulic conductivity	7.2693	m/d



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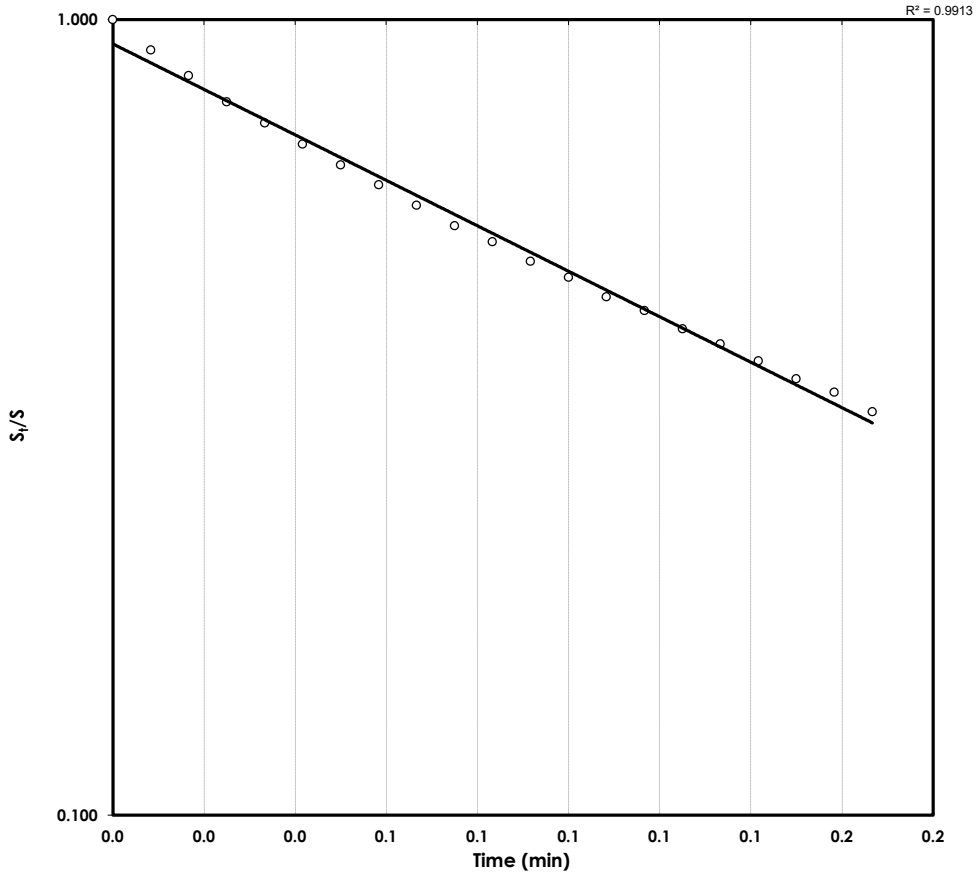

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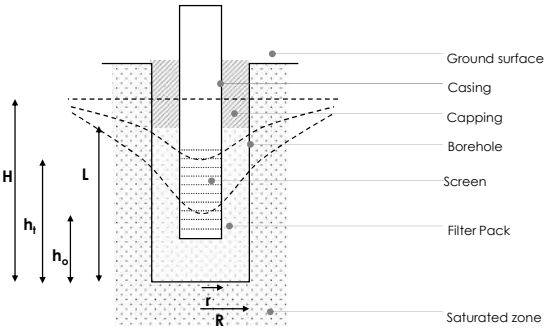
PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW13 (1)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.130	m
h_o - Water level reading at time = 0 (depth)	1.155	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.40	m
T_o - Length of characteristic time	0.22	minutes
K_{sat} - Saturated hydraulic conductivity	4.9345	m/d



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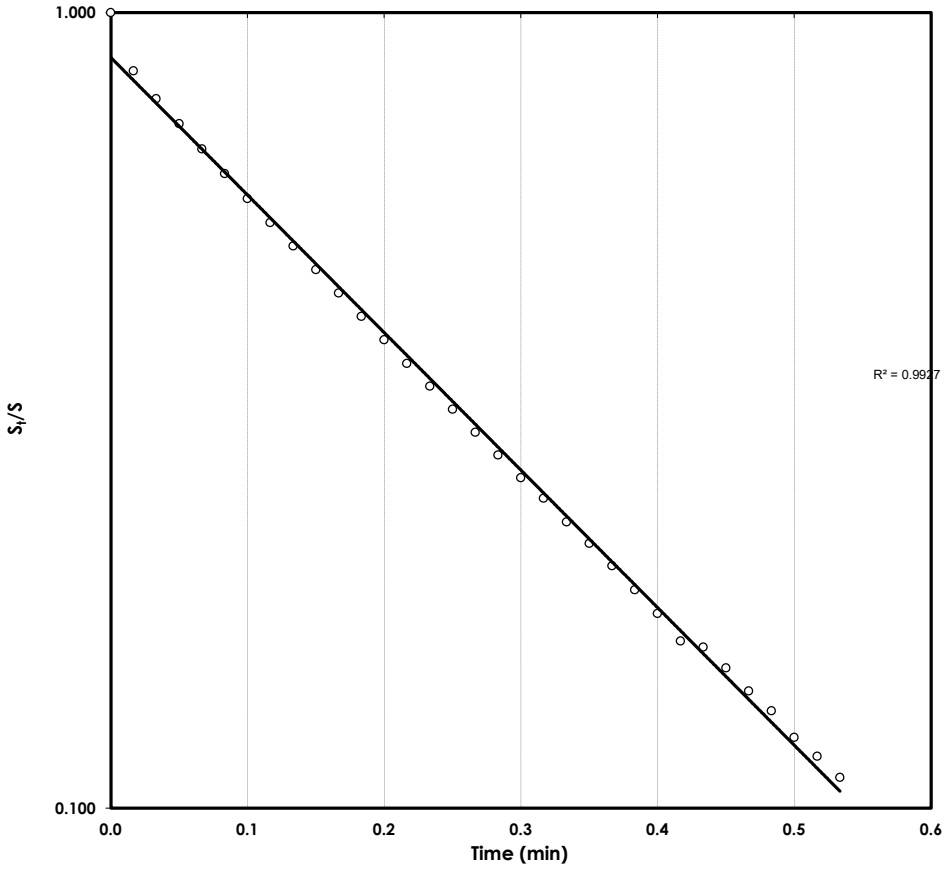

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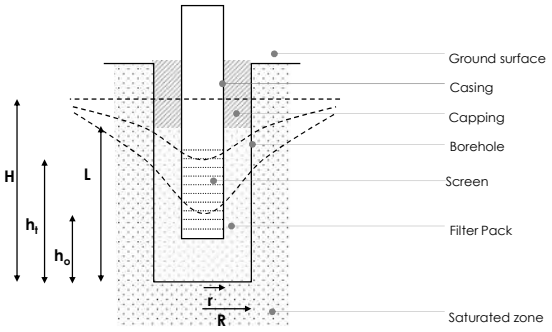
PROJECT DETAILS

Project	Gan Gan Road, Anna Bay, NSW	Test Date	25/05/2023
Project Ref	P2208888	Field Testing	BTM
Borehole Ref	MW13 (2)	Data Analysis	DS
Method	Hvorslev (1981)	Reviewed	JF

FIELD TEST DATA

FACTOR	Enter Data	Unit
H - Initial water level reading (depth)	3.130	m
h_o - Water level reading at time = 0 (depth)	1.502	m
r - Casing radius	0.025	m
R - Bore radius	0.050	m
L - Length of open screen	1.40	m
T_o - Length of characteristic time	0.22	minutes
K_{sat} - Saturated hydraulic conductivity	4.7641	m/d



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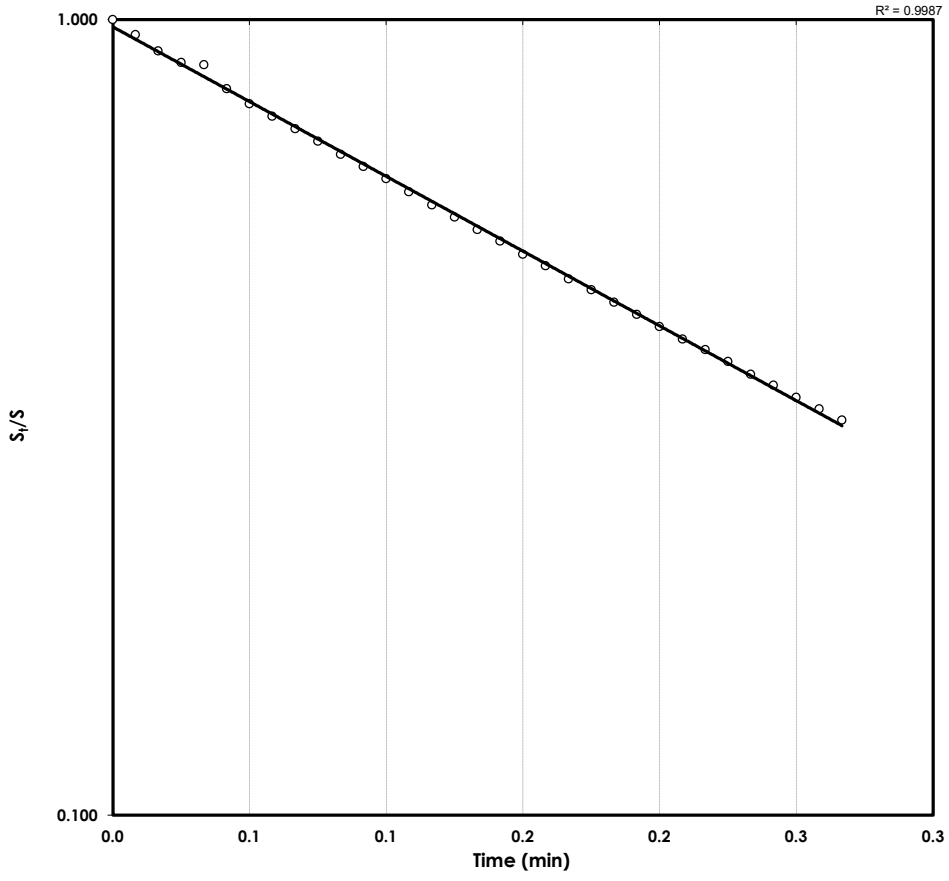

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Appendix F – Laboratory Summary Table

		Inorganics									Metals																				
		Hardness (filtered)	Electrical Conductivity (Non Compensated)	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (total) as CaCO3	Chloride	Ionic Balance	pH (Lab)	Sodium (filtered)	Sulphate	Aluminium (filtered)	Antimony (filtered)	Arsenic (filtered)	Barium (filtered)	Boron (filtered)	Cadmium (filtered)	Calcium (filtered)	Chromium (III+VI) (filtered)	Cobalt (filtered)	Copper (filtered)	Iron (filtered)	Lead (filtered)	Magnesium (filtered)	Manganese (filtered)	Molybdenum (filtered)	Nickel (filtered)	Potassium (filtered)	Tin (filtered)	Uranium (filtered)	Vanadium (filtered)	Zinc (filtered)
		mgCaCO3/	µS/cm	mg/L	mg/L	mg/L	%	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L
EQL			1	5	5	1			0.5	1	0.01	0.001	0.001	0.001	0.02	0.0001	0.5	0.001	0.001	0.001	0.01	0.001	0.5	0.005	0.001	0.001	0.5	0.001	0.5	0.001	0.001
ANZG Freshwater Toxicant DGVs LOSP 95% (July 2023)											0.055				0.94	0.0002				0.0014		0.0034		1.9		0.011					0.008
Field ID	**Date**																														
MW01	**14 Dec 2022**	8.70	130	10	10	19	0	5.4	18	12	*<0.01*	*<0.001*	*<0.001*	0.002	*<0.02*	*<0.0001*	2	*<0.001*	*<0.001*	0.002	*<0.01*	*<0.001*	0.9	*<0.005*	*<0.001*	*<0.001*	*<0.5*	*<0.001*	*<0.5*	*<0.001*	0.004
MW02	**14 Dec 2022**	44	230	22	22	32	2	5.9	19	21	*<0.01*	*<0.001*	0.009	0.005	0.03	*<0.0001*	13	*<0.001*	*<0.001*	0.006	*<0.01*	*<0.001*	3	0.017	0.009	0.002	7.4	*<0.001*	*<0.5*	*<0.001*	0.016
MW03	**14 Dec 2022**	66	370	23	23	77	-1	5.7	29	7	*<0.01*	*<0.001*	*<0.001*	0.013	0.02	*<0.0001*	13	*<0.001*	*<0.001*	0.002	*<0.01*	*<0.001*	8.3	0.006	*<0.001*	*<0.001*	5	*<0.001*	*<0.5*	*<0.001*	0.015
MW04	**14 Dec 2022**	27	390	7	7	84	-3	5.3	46	13	*<0.01*	*<0.001*	*<0.001*	0.009	0.02	*<0.0001*	2	*<0.001*	*<0.001*	0.005	*<0.01*	*<0.001*	5.1	*<0.005*	*<0.001*	*<0.001*	3	*<0.001*	*<0.5*	*<0.001*	0.007
MW05	**14 Dec 2022**	34	130	19	19	13	6	5.6	8.3	12	*<0.01*	0.002	0.004	0.007	*<0.02*	0.0001	9.7	0.001	0.001	0.002	*<0.01*	*<0.001*	2	0.005	0.036	0.003	3	*<0.001*	*<0.5*	*<0.001*	0.022
MW06	**14 Dec 2022**	31	180	18	18	33	0	5.9	18	5	*<0.01*	*<0.001*	*<0.001*	0.002	0.09	*<0.0001*	6.5	*<0.001*	*<0.001*	0.003	*<0.01*	*<0.001*	4	0.005	0.001	*<0.001*	1	*<0.001*	*<0.5*	*<0.001*	0.005
MW07	**14 Dec 2022**	23	110	12	12	13	9	5.4	8.9	8	*<0.01*	*<0.001*	0.002	0.001	0.03	*<0.0001*	7.9	*<0.001*	*<0.001*	0.004	*<0.01*	*<0.001*	0.9	0.028	*<0.001*	0.004	3	*<0.001*	*<0.5*	*<0.001*	0.027
MW08	**15 Feb 2023**	88	360	99	99	53	-4	6.8	31	2	0.01	*<0.001*	*<0.001*	0.003	0.06	*<0.0001*	27	*<0.001*	*<0.001*	0.002	0.05	*<0.001*	5.2	0.031	0.001	*<0.001*	4	*<0.001*	0.8	*<0.001*	0.006
MW09	**15 Feb 2023**	19	200	11	11	53	-2	5.9	28	*<1*	*<0.01*	*<0.001*	*<0.001*	*<0.001*	*<0.02*	*<0.0001*	3	*<0.001*	*<0.001*	0.001	*<0.01*	*<0.001*	3	0.006	0.002	*<0.001*	2	*<0.001*	*<0.5*	*<0.001*	0.006
MW10	**15 Feb 2023**	29	240	18	18	57	-2	6.1	30	4	0.04	*<0.001*	*<0.001*	*<0.001*	0.04	*<0.0001*	5	*<0.001*	*<0.001*	0.003	0.04	*<0.001*	4	0.01	*<0.001*	0.002	3	0.002	*<0.5*	*<0.001*	0.011
MW11	**15 Feb 2023**	51	420	25	25	100	-6	6.2	48	10	0.03	*<0.001*	0.006	0.024	*<0.02*	*<0.0001*	8.9	*<0.001*	*<0.001*	0.001	1.1	*<0.001*	6.9	0.022	0.001	0.002	4	0.005	*<0.5*	*<0.001*	0.025
MW12	**15 Feb 2023**	13	100	*<5*	*<5*	21	9	4.9	12	3	0.26	*<0.001*	*<0.001*	0.003	*<0.02*	*<0.0001*	2	*<0.001*	0.001	*<0.001*	0.41	*<0.001*	2	0.019	0.005	0.006	1	*<0.001*	2.9	0.006	0.005
MW13	**15 Feb 2023**	100	1,600	15	15	470	0	6	280	46	0.02	*<0.001*	*<0.001*	0.037	0.1	*<0.0001*	11	*<0.001*	*<0.001*	0.001	0.16	*<0.001*	18	0.024	0.001	0.002	12	0.007		*<0.001*	0.039
SW01	**15 Feb 2023**	26	250	9	9	63	1	5.6	37	9	0.04	*<0.001*	*<0.001*	0.002	*<0.02*	*<0.0001*	3	*<0.001*	*<0.001*		0.05	*<0.001*	4	0.007	*<0.001*	*<0.001*	2	*<0.001*	*<0.5*	*<0.001*	0.003
Statistics																															
Minimum Detect		**8.7**	**100**	**7**	**7**	**13**	**-14**	**4.9**	**8.3**	**2**	**0.01**	**0.002**	**0.002**	**0.001**	**0.02**	**0.0001**	**2**	**0.001**	**0.001**	**0.001**	**0.04**	**0.002**	**0.9**	**0.005**	**0.001**	**0.002**	**1**	**0.002**	**0.8**	**0.006**	**0.002**
Maximum Detect		**100**	**1600**	**99**	**99**	**470**	**9**	**6.8**	**280**	**46**	**0.26**	**0.002**	**0.009**	**0.037**	**0.1**	**0.0001**	**27**	**0.001**	**0.001**	**0.006**	**1.1**	**0**	**18**	**0.031**	**0.036**	**0.006**	**12**	**0.007**	**2.9**	**0.006**	**0.039**

Appendix G – Laboratory Documentation

martens
consulting engineers since 1989

WATER SAMPLING CHAIN OF CUSTODY FORM

Water Testing													
Name	P2208888: Gan Gan Road, Anna Bay NSW												
Martens Contact Officer	Dean Shi					Contact Email	dshi@martens.com.au						
Sampling and Shipping	Sample Date	14/12/2022		Dispatch Date	20/12/2022		Turnaround Time		standard				
	Our Reference	P2208888COC04V1				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	Sample Receipt	Phone	9910 6200	Fax		Email	samplereceipt@envirolabservices.com.au
Please Send Report By (X)	Post		Fax		Email	X	Reporting Email Address	dshi@martens.com.au jfulton@martens.com.au

Sample ID	pH	EC	Ionic Balance Suite	17 Dissolved HM*	HOLD
MW01 1	X	X	X	X	
MW02 2	X	X	X	X	
MW03 3	X	X	X	X	
MW04 4	X	X	X	X	
MW05 5	X	X	X	X	
MW06 6	X	X	X	X	
MW07 7	X	X	X	X	
DUP01 8					X

*Please filter for heavy metals from non-preservative bottles

ENVIROLAB GROUP
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 313617
Date Received: 20/12/22
Time Received: 17:30
Received By: DHAW
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Head Office
Suite 201, Level 2, 20 George Street
Hornsby NSW 2077, Australia
Ph 02 9476 9999 Fax 02 9476 8767

> mail@martens.com.au
> www.martens.com.au
MARTENS & ASSOCIATES P/L
ABN 85 070 240 890 ACN 070 240 890

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

SAMPLE RECEIPT ADVICE

Client Details

Client	Martens & Associates Pty Ltd
Attention	Dean Shi

Sample Login Details

Your reference	P2208888, Gan Gan Rd Anna Bay NSW
Envirolab Reference	313617
Date Sample Received	20/12/2022
Date Instructions Received	20/12/2022
Date Results Expected to be Reported	06/01/2023

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	8 Water
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	8
Cooling Method	Ice
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

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

Sample ID	pH	Electrical Conductivity	Calcium - Dissolved	Potassium - Dissolved	Sodium - Dissolved	Magnesium - Dissolved	Hardness	Hydroxide Alkalinity (OH-) as CaCO3	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulphate, SO4	Chloride, Cl	Ionic Balance	All metals in water-dissolved
MW01	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW02	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW03	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW04	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW05	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW06	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW07	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dup01	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.
Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.
TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

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

CERTIFICATE OF ANALYSIS 313617

Client Details

Client	Martens & Associates Pty Ltd
Attention	Dean Shi
Address	Suite 201, 20 George St, Hornsby, NSW, 2077

Sample Details

Your Reference	**P2208888, Gan Gan Rd Anna Bay NSW**
Number of Samples	8 Water
Date samples received	20/12/2022
Date completed instructions received	20/12/2022

Analysis Details

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

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

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

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

Report Details

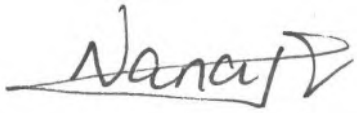
Date results requested by	06/01/2023
Date of Issue	06/01/2023

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Diego Bigolin, Inorganics Supervisor
Loren Bardwell, Development Chemist
Nick Sarlamis, Assistant Operation Manager

Authorised By



Nancy Zhang, Laboratory Manager

Miscellaneous Inorganics						
Our Reference		313617-1	313617-2	313617-3	313617-4	313617-5
Your Reference	UNITS	MW01	MW02	MW03	MW04	MW05
Date Sampled		14/12/2022	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022	20/12/2022
pH	pH Units	5.4	5.9	5.7	5.3	5.6
Electrical Conductivity	µS/cm	130	230	370	390	130

Miscellaneous Inorganics				
Our Reference		313617-6	313617-7	313617-8
Your Reference	UNITS	MW06	MW07	Dup01
Date Sampled		14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water
Date prepared	-	20/12/2022	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022	20/12/2022
pH	pH Units	5.9	5.4	5.3
Electrical Conductivity	µS/cm	180	110	390

Ion Balance						
Our Reference		313617-1	313617-2	313617-3	313617-4	313617-5
Your Reference	UNITS	MW01	MW02	MW03	MW04	MW05
Date Sampled		14/12/2022	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022	20/12/2022
Calcium - Dissolved	mg/L	2	13	13	2	9.7
Potassium - Dissolved	mg/L	1	7.4	5	3	3
Sodium - Dissolved	mg/L	18	19	29	46	8.3
Magnesium - Dissolved	mg/L	0.9	3	8.3	5.1	2
Hardness	mgCaCO 3 /L	8.7	44	66	27	34
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	10	22	23	7	19
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	10	22	23	7	19
Sulphate, SO4	mg/L	12	21	7	13	12
Chloride, Cl	mg/L	19	32	77	84	13
Ionic Balance	%	0	2.0	-1.0	-3.0	6.0

Ion Balance				
Our Reference		313617-6	313617-7	313617-8
Your Reference	UNITS	MW06	MW07	Dup01
Date Sampled		14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water
Date prepared	-	20/12/2022	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022	20/12/2022
Calcium - Dissolved	mg/L	6.5	7.9	2
Potassium - Dissolved	mg/L	1	3	3
Sodium - Dissolved	mg/L	18	8.9	45
Magnesium - Dissolved	mg/L	4	0.9	5
Hardness	mgCaCO 3 /L	31	23	26
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	18	12	8
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	18	12	8
Sulphate, SO4	mg/L	5	8	13
Chloride, Cl	mg/L	33	13	85
Ionic Balance	%	0	9.0	-5.0

All metals in water-dissolved						
Our Reference		313617-1	313617-2	313617-3	313617-4	313617-5
Your Reference	UNITS	MW01	MW02	MW03	MW04	MW05
Date Sampled		14/12/2022	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	22/12/2022	22/12/2022	22/12/2022	22/12/2022	22/12/2022
Date analysed	-	22/12/2022	22/12/2022	22/12/2022	22/12/2022	22/12/2022
Arsenic-Dissolved	µg/L	<1	9	<1	<1	4
Boron-Dissolved	µg/L	<20	30	20	20	<20
Barium-Dissolved	µg/L	2	5	13	9	7
Beryllium-Dissolved	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1	<0.1	0.1
Cobalt-Dissolved	µg/L	<1	<1	<1	<1	1
Chromium-Dissolved	µg/L	<1	<1	<1	<1	1
Copper-Dissolved	µg/L	2	6	2	5	2
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Manganese-Dissolved	µg/L	<5	17	6	<5	5
Molybdenum-Dissolved	µg/L	<1	9	<1	<1	36
Nickel-Dissolved	µg/L	<1	2	<1	<1	3
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1
Antimony-Dissolved	µg/L	<1	<1	<1	<1	2
Selenium-Dissolved	µg/L	<1	<1	<1	<1	<1
Tin-Dissolved	µg/L	<1	<1	<1	<1	<1
Zinc-Dissolved	µg/L	4	16	15	7	22

All metals in water-dissolved				
Our Reference		313617-6	313617-7	313617-8
Your Reference	UNITS	MW06	MW07	Dup01
Date Sampled		14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water
Date prepared	-	22/12/2022	22/12/2022	22/12/2022
Date analysed	-	22/12/2022	22/12/2022	22/12/2022
Arsenic-Dissolved	µg/L	<1	2	<1
Boron-Dissolved	µg/L	90	30	30
Barium-Dissolved	µg/L	2	1	9
Beryllium-Dissolved	µg/L	<0.5	<0.5	<0.5
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1
Cobalt-Dissolved	µg/L	<1	<1	<1
Chromium-Dissolved	µg/L	<1	<1	<1
Copper-Dissolved	µg/L	3	4	5
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05
Manganese-Dissolved	µg/L	5	28	<5
Molybdenum-Dissolved	µg/L	1	<1	<1
Nickel-Dissolved	µg/L	<1	4	<1
Lead-Dissolved	µg/L	<1	<1	<1
Antimony-Dissolved	µg/L	<1	<1	<1
Selenium-Dissolved	µg/L	<1	<1	<1
Tin-Dissolved	µg/L	<1	<1	<1
Zinc-Dissolved	µg/L	5	27	12

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-040	The concentrations of the major ions (mg/L) are converted to milliequivalents and summed. The ionic balance should be within +/- 15% ie total anions = total cations +/-15%.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			20/12/2022	1	20/12/2022	20/12/2022		20/12/2022	[NT]
Date analysed	-			20/12/2022	1	20/12/2022	20/12/2022		20/12/2022	[NT]
pH	pH Units		Inorg-001	[NT]	1	5.4	5.4	0	100	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	1	130	130	0	100	[NT]

QUALITY CONTROL: Ion Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	313617-2
Date prepared	-			20/12/2022	1	20/12/2022	20/12/2022		20/12/2022	20/12/2022
Date analysed	-			20/12/2022	1	20/12/2022	20/12/2022		20/12/2022	20/12/2022
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	2	2	0	96	93
Potassium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	1	1	0	96	91
Sodium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	18	18	0	93	81
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	0.9	0.9	0	97	98
Hardness	mgCaCO 3 /L	3	Metals-020	[NT]	1	8.7	8.2	6	[NT]	[NT]
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	<5	0	[NT]	[NT]
Bicarbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	10	10	0	[NT]	[NT]
Carbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	10	10	0	95	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	1	12	12	0	90	111
Chloride, Cl	mg/L	1	Inorg-081	<1	1	19	19	0	88	80
Ionic Balance	%		Inorg-040	[NT]	1	0	0		[NT]	[NT]

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	313617-2
Date prepared	-			22/12/2022	1	22/12/2022	22/12/2022		22/12/2022	22/12/2022
Date analysed	-			22/12/2022	1	22/12/2022	22/12/2022		22/12/2022	22/12/2022
Arsenic-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	93	93
Boron-Dissolved	µg/L	20	Metals-022	<20	1	<20	<20	0	104	93
Barium-Dissolved	µg/L	1	Metals-022	<1	1	2	2	0	99	94
Beryllium-Dissolved	µg/L	0.5	Metals-022	<0.5	1	<0.5	<0.5	0	120	114
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	1	<0.1	<0.1	0	95	94
Cobalt-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	99	97
Chromium-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	94	91
Copper-Dissolved	µg/L	1	Metals-022	<1	1	2	2	0	96	94
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	1	<0.05	[NT]		89	[NT]
Manganese-Dissolved	µg/L	5	Metals-022	<5	1	<5	<5	0	96	98
Molybdenum-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	89	86
Nickel-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	91	90
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	100	89
Antimony-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	82	90
Selenium-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	93	92
Tin-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	93	91
Zinc-Dissolved	µg/L	1	Metals-022	<1	1	4	5	22	96	103

Result Definitions

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

Quality Control Definitions

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

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

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

Report Comments

Dissolved Metals:
- no filtered, preserved sample was received, therefore the unpreserved sample was filtered through 0.45µm filter at the lab. Note: there is a possibility some elements may be underestimated.

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consulting engineers since 1989

WATER SAMPLING CHAIN OF CUSTODY FORM

Additional Water Testing												
Name	P2208888: Gan Gan Road, Anna Bay NSW											
Martens Contact Officer	Ali Kandil					**Contact Email**	akandil@martens.com.au					
Sampling and Shipping	**Sample Date**	15-16/02/2023		**Dispatch Date**	17/02/2023		**Turnaround Time**		Standard			
	Our Reference	P2208888COC04V1				**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**	Sample Receipt		**Phone**	9910 6200	**Fax**		**Email**	samplereceipt@envirolabservices.com.au			
Please Send Report By (X)	**Post**		**Fax**		**Email**	X	**Reporting Email Address**	akandil@martens.com.au jfulton@martens.com.au				

	Sample ID	pH	EC	Ionic Balance Suite	17 Dissolved HM*	HOLD
1	MW08	X	X	X	X	
2	MW09	X	X	X	X	
3	MW10	X	X	X	X	
4	MW11	X	X	X	X	
5	MW12	X	X	X	X	
6	MW13	X	X	X	X	
7	SW01	X	X	X	X	

***Please filter for heavy metals from non-preservative bottles**

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 316793
Date Received: 17/2/23
Time Received: 1400
Received By: EW
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Head Office
Suite 201, Level 2, 20 George Street
Hornsby NSW 2077, Australia
Ph 02 9476 9999 **Fax** 02 9476 8767

> mail@martens.com.au
> www.martens.com.au
MARTENS & ASSOCIATES P/L
ABN 85 070 240 890 ACN 070 240 890

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

SAMPLE RECEIPT ADVICE

Client Details

Client	Martens & Associates Pty Ltd
Attention	Ali Kandil

Sample Login Details

Your reference	P2208888: Gan Gan Road Anna Bay NSW
Envirolab Reference	316793
Date Sample Received	17/02/2023
Date Instructions Received	17/02/2023
Date Results Expected to be Reported	24/02/2023

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	7 Water
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	2
Cooling Method	Ice
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

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

Sample ID	All metals in water-dissolved	pH	Electrical Conductivity	Calcium - Dissolved	Potassium - Dissolved	Sodium - Dissolved	Magnesium - Dissolved	Hardness	Hydroxide Alkalinity (OH-) as CaCO3	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulphate, SO4	Chloride, Cl	Ionic Balance
MW08	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW09	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW11	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW12	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW13	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SW01	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.
Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.
TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

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

CERTIFICATE OF ANALYSIS 313617

Client Details

Client	Martens & Associates Pty Ltd
Attention	Dean Shi
Address	Suite 201, 20 George St, Hornsby, NSW, 2077

Sample Details

Your Reference	**P2208888, Gan Gan Rd Anna Bay NSW**
Number of Samples	8 Water
Date samples received	20/12/2022
Date completed instructions received	20/12/2022

Analysis Details

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

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

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

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

Report Details

Date results requested by	06/01/2023
Date of Issue	06/01/2023

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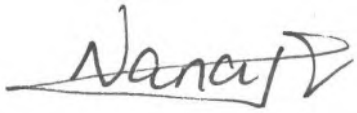
Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Diego Bigolin, Inorganics Supervisor
Loren Bardwell, Development Chemist
Nick Sarlamis, Assistant Operation Manager

Authorised By



Nancy Zhang, Laboratory Manager

Miscellaneous Inorganics						
Our Reference		313617-1	313617-2	313617-3	313617-4	313617-5
Your Reference	UNITS	MW01	MW02	MW03	MW04	MW05
Date Sampled		14/12/2022	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022	20/12/2022
pH	pH Units	5.4	5.9	5.7	5.3	5.6
Electrical Conductivity	µS/cm	130	230	370	390	130

Miscellaneous Inorganics				
Our Reference		313617-6	313617-7	313617-8
Your Reference	UNITS	MW06	MW07	Dup01
Date Sampled		14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water
Date prepared	-	20/12/2022	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022	20/12/2022
pH	pH Units	5.9	5.4	5.3
Electrical Conductivity	µS/cm	180	110	390

Ion Balance						
Our Reference		313617-1	313617-2	313617-3	313617-4	313617-5
Your Reference	UNITS	MW01	MW02	MW03	MW04	MW05
Date Sampled		14/12/2022	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022	20/12/2022
Calcium - Dissolved	mg/L	2	13	13	2	9.7
Potassium - Dissolved	mg/L	1	7.4	5	3	3
Sodium - Dissolved	mg/L	18	19	29	46	8.3
Magnesium - Dissolved	mg/L	0.9	3	8.3	5.1	2
Hardness	mgCaCO 3 /L	8.7	44	66	27	34
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	10	22	23	7	19
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	10	22	23	7	19
Sulphate, SO4	mg/L	12	21	7	13	12
Chloride, Cl	mg/L	19	32	77	84	13
Ionic Balance	%	0	2.0	-1.0	-3.0	6.0

Ion Balance				
Our Reference		313617-6	313617-7	313617-8
Your Reference	UNITS	MW06	MW07	Dup01
Date Sampled		14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water
Date prepared	-	20/12/2022	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022	20/12/2022
Calcium - Dissolved	mg/L	6.5	7.9	2
Potassium - Dissolved	mg/L	1	3	3
Sodium - Dissolved	mg/L	18	8.9	45
Magnesium - Dissolved	mg/L	4	0.9	5
Hardness	mgCaCO 3 /L	31	23	26
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	18	12	8
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	18	12	8
Sulphate, SO4	mg/L	5	8	13
Chloride, Cl	mg/L	33	13	85
Ionic Balance	%	0	9.0	-5.0

All metals in water-dissolved						
Our Reference		313617-1	313617-2	313617-3	313617-4	313617-5
Your Reference	UNITS	MW01	MW02	MW03	MW04	MW05
Date Sampled		14/12/2022	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	22/12/2022	22/12/2022	22/12/2022	22/12/2022	22/12/2022
Date analysed	-	22/12/2022	22/12/2022	22/12/2022	22/12/2022	22/12/2022
Arsenic-Dissolved	µg/L	<1	9	<1	<1	4
Boron-Dissolved	µg/L	<20	30	20	20	<20
Barium-Dissolved	µg/L	2	5	13	9	7
Beryllium-Dissolved	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1	<0.1	0.1
Cobalt-Dissolved	µg/L	<1	<1	<1	<1	1
Chromium-Dissolved	µg/L	<1	<1	<1	<1	1
Copper-Dissolved	µg/L	2	6	2	5	2
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Manganese-Dissolved	µg/L	<5	17	6	<5	5
Molybdenum-Dissolved	µg/L	<1	9	<1	<1	36
Nickel-Dissolved	µg/L	<1	2	<1	<1	3
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1
Antimony-Dissolved	µg/L	<1	<1	<1	<1	2
Selenium-Dissolved	µg/L	<1	<1	<1	<1	<1
Tin-Dissolved	µg/L	<1	<1	<1	<1	<1
Zinc-Dissolved	µg/L	4	16	15	7	22

All metals in water-dissolved				
Our Reference		313617-6	313617-7	313617-8
Your Reference	UNITS	MW06	MW07	Dup01
Date Sampled		14/12/2022	14/12/2022	14/12/2022
Type of sample		Water	Water	Water
Date prepared	-	22/12/2022	22/12/2022	22/12/2022
Date analysed	-	22/12/2022	22/12/2022	22/12/2022
Arsenic-Dissolved	µg/L	<1	2	<1
Boron-Dissolved	µg/L	90	30	30
Barium-Dissolved	µg/L	2	1	9
Beryllium-Dissolved	µg/L	<0.5	<0.5	<0.5
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1
Cobalt-Dissolved	µg/L	<1	<1	<1
Chromium-Dissolved	µg/L	<1	<1	<1
Copper-Dissolved	µg/L	3	4	5
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05
Manganese-Dissolved	µg/L	5	28	<5
Molybdenum-Dissolved	µg/L	1	<1	<1
Nickel-Dissolved	µg/L	<1	4	<1
Lead-Dissolved	µg/L	<1	<1	<1
Antimony-Dissolved	µg/L	<1	<1	<1
Selenium-Dissolved	µg/L	<1	<1	<1
Tin-Dissolved	µg/L	<1	<1	<1
Zinc-Dissolved	µg/L	5	27	12

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-040	The concentrations of the major ions (mg/L) are converted to milliequivalents and summed. The ionic balance should be within +/- 15% ie total anions = total cations +/-15%.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			20/12/2022	1	20/12/2022	20/12/2022		20/12/2022	[NT]
Date analysed	-			20/12/2022	1	20/12/2022	20/12/2022		20/12/2022	[NT]
pH	pH Units		Inorg-001	[NT]	1	5.4	5.4	0	100	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	1	130	130	0	100	[NT]

QUALITY CONTROL: Ion Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	313617-2
Date prepared	-			20/12/2022	1	20/12/2022	20/12/2022		20/12/2022	20/12/2022
Date analysed	-			20/12/2022	1	20/12/2022	20/12/2022		20/12/2022	20/12/2022
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	2	2	0	96	93
Potassium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	1	1	0	96	91
Sodium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	18	18	0	93	81
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	0.9	0.9	0	97	98
Hardness	mgCaCO 3 /L	3	Metals-020	[NT]	1	8.7	8.2	6	[NT]	[NT]
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	<5	0	[NT]	[NT]
Bicarbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	10	10	0	[NT]	[NT]
Carbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	10	10	0	95	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	1	12	12	0	90	111
Chloride, Cl	mg/L	1	Inorg-081	<1	1	19	19	0	88	80
Ionic Balance	%		Inorg-040	[NT]	1	0	0		[NT]	[NT]

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	313617-2
Date prepared	-			22/12/2022	1	22/12/2022	22/12/2022		22/12/2022	22/12/2022
Date analysed	-			22/12/2022	1	22/12/2022	22/12/2022		22/12/2022	22/12/2022
Arsenic-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	93	93
Boron-Dissolved	µg/L	20	Metals-022	<20	1	<20	<20	0	104	93
Barium-Dissolved	µg/L	1	Metals-022	<1	1	2	2	0	99	94
Beryllium-Dissolved	µg/L	0.5	Metals-022	<0.5	1	<0.5	<0.5	0	120	114
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	1	<0.1	<0.1	0	95	94
Cobalt-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	99	97
Chromium-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	94	91
Copper-Dissolved	µg/L	1	Metals-022	<1	1	2	2	0	96	94
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	1	<0.05	[NT]		89	[NT]
Manganese-Dissolved	µg/L	5	Metals-022	<5	1	<5	<5	0	96	98
Molybdenum-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	89	86
Nickel-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	91	90
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	100	89
Antimony-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	82	90
Selenium-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	93	92
Tin-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	93	91
Zinc-Dissolved	µg/L	1	Metals-022	<1	1	4	5	22	96	103

Result Definitions

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

Quality Control Definitions

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

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

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

Report Comments

Dissolved Metals:
- no filtered, preserved sample was received, therefore the unpreserved sample was filtered through 0.45µm filter at the lab. Note: there is a possibility some elements may be underestimated.